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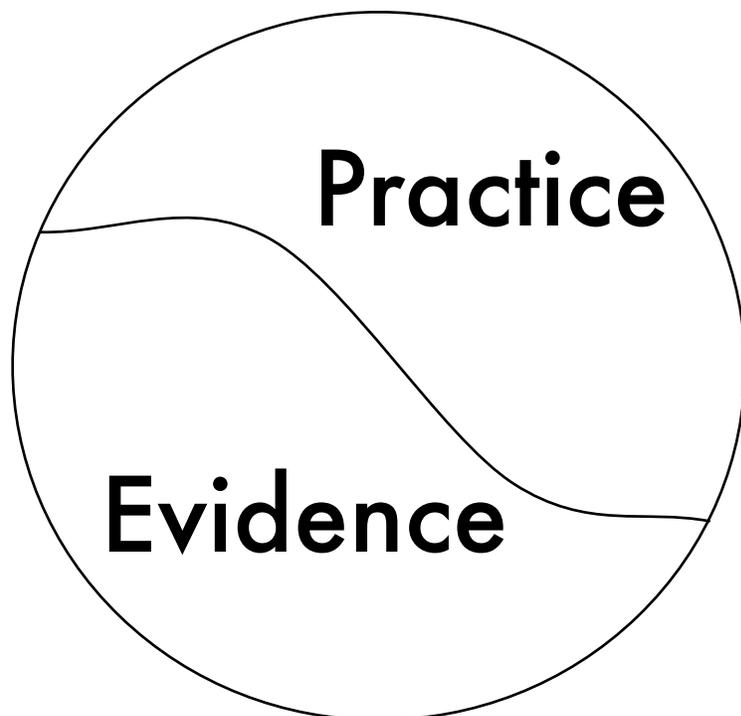
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Poster Session #1: 1:00pm to 2:00pm

Poster Session #2: 2:00pm to 3:00pm

Effects of thalamic deep brain stimulation and topiramate medication on vocal, oral and upper limb essential tremor

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This poster presents the results of two studies. In the first study, the effects of topiramate were evaluated in an open-label study in 18 patients with essential tremor of the voice, tongue, jaw, and upper limb. All patients had been unresponsive to at least one other anti-tremor medication. Topiramate was started at 25 mg/day, titrated over 6 to 12 weeks to a maximum effective dose, and maintained at this dose for a minimum of 2 weeks prior to the final evaluation. The final topiramate doses ranged from 100 to 350 mg/day (mean dose 155 mg/day). Treatment effect was measured using instrumental measures, a standard clinical rating scale for tremor, a perceptual rating of vocal tremor, and a quality of life visual analogue scale. Results demonstrated a significant improvement in hand, jaw and voice tremor on both instrumental measures and clinical rating of tremor. Patient self-ratings of tremor-related disabilities showed an improvement for activities of daily living including eating, hygiene, and working. Patients also reported significant improvement in quality of life measures. Side effects were a considerable factor in some patients and may limit the use of topiramate in this population. This study demonstrated improvement in vocal, jaw, and upper limb essential tremor with topiramate in a treatment resistant population.

In the second study, vocal, oral and limb tremors were examined in six individuals receiving thalamic deep brain stimulator (DBS) treatment for essential tremor. Subjects were evaluated during stimulator 'on' and 'off' conditions. The stimulator 'on' condition was associated with a significant improvement in vocal tremor for the instrumental measures of tremor amplitude, and the clinical ratings of tremor severity. Thalamic DBS had a greater and more consistent effect on vocal and jaw tremor than on tongue tremor. Perceptual speech ratings showed a slight reduction in speech intelligibility for the stimulator 'on' condition. The stimulator 'on' condition was associated with a significant improvement in upper limb tremor for the instrumental measures, clinical ratings, functional tasks and self-ratings. These results provide support for a focus on vocal and jaw tremor as primary treatment targets in future thalamic DBS procedures.

Impact of otitis media on
later developing language skills in children

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This critical review examines the relationship between Otitis media (OM) in early childhood and later developing language skills. All of the reviewed studies were identified as prospective, longitudinal, correlational designs. Each of the studies indicated little to no relationship between OM and language development, however, many of studies examined contained serious methodological, measurement, and statistical flaws. Therefore, there is an inadequate basis for determining whether or not prioritization of children with OM histories should be considered for speech-language pathology (S-LP) services.

Introduction

Otitis media (OM) covers a variety of conditions that involve the presence of fluid within the middle-ear space. Each episode of acute otitis media is accompanied by a period of effusion which may last weeks or even months (Rvachew, Slawinski, Williams, and Green, 1999). Mild to moderate hearing loss may occur during any of the possible acute or non-acute phases of the disease (Fria, Cantekin, and Eichler, 1985).

The linkage between otits media and later developing language delays is a controversial issue. While it is generally assumed that OM is associated with later developing lanugage delays, many studies have been unable to relate an early childhood history of OM to language development during the preschool and school-age years. There have been many inconsistencies in study findings and methological problems have surfaced. Research in this area is ongoing, for several reasons. First, OM is one of the most frequently occuring illnesses in childhood, and it primarily occurs during the critical period in which a child's speech and language skills are developing (Burchinal,Roberts, and Zeisel, 2002). Children hear speech sounds from their environment and begin to associate meaning with these sounds, which then forms the foundation of their developing language. Children with OM typically experience mild to moderate fluctuating hearing loss and as a result, they misperceive or miss sounds or words altogether. These "holes" in their knowledge base may impact their language learning (Burchinal *et al.*, 2002). It has also been hypothesized that any areas of difficulty resulting from OM (such as language) will be especially apparent during the school-aged years, when the child is faced with stresses of the school environment (i.e., reading, language based-subjects) (Burchinal *et al*., 2002).

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of OM on later developing language skills in young children. The secondary objective is to propose an evidence-based practice recommendation about prioritization of children with a history of OM for S-LP services.

Methods

Search Strategy

Studies were found using computerized databases, including CINAHL, Cochrane Library, Medline, PsycINFO, and PubMed. The search strategy utilized the following key words:

[(otitis media) OR (otitis media with effusion) OR (OM) OR (OME)] AND [(language) OR (communication)] AND [(child*) OR (preschool) OR (school-aged)]

The search was limited to articles written in English between 1990 and 2004.

Selection Criteria

All studies selected for inclusion in this critical review paper examined the impact of OM history on later language development. The research studies were selected without restrictions on demographics or outcome measures.

Data Collection

The literature search results yielded four articles that employed prospective, longitudinal, correlational designs.

Results

Impact of Otitis Media on Later Language Development

Roberts *et al*. (2000) looked at the relationship between children's otitis media with effusion (OME) history during the first four years of life and the level of growth in their language development from four years through second grade. A significant relationship (p = 0.003) was reported between the history of early OME from six months to two years of age and lower expressive language (EL) scores at the end of kindergarten. Using Pearson correlation statistics, it was also determined that children with more total OME six months to two years and six months to four years scored lower on the <u>CELF-P</u> EL subset at the end of kindergarten (r = -0.025 and r = -0.26, respectively). These r-values indicate little or no relationship of the variables. This weak association was not mentioned in the study's interpretation, which leaves the reader uncertain of the true correlation.

Paradise *et al.* (2000) were concerned with the relationship between children's cumulative duration of middle ear effusion (MEE) in their first three years of life and their scores on measures of language. They found that mean developmental test scores at three years of age were consistently highest in the low-MEE group and consistently lowest in the high-MEE group, however none of the correlations were statistically significant (p = 0.07 to 0.24). Pearson correlations between individual children's cumulative proportions of total days with MEE and their scores at three years of age on various developmental measures were reported to be mainly negative, but generally weak (r = 0.21). Finally, all correlations for conversational sample analyses fell in the range of -0.08 to 0.2, which indicates little or no relationship existed between the variables, and all p-values fell above 0.05, indicating that the findings may be due to chance.

The study conducted by Feldman *et al*. (1999) addressed whether parent-reported levels of language and communication skills at one and two years of age correlated negatively with the cumulative percentage of days with MEE. This study reported a significant correlation between the percentage of days with bilateral or total MEE in the second year of life and the first two years of life combined and parent reports on the Vocabulary Production subset of the <u>MacArthur Communicative Development Inventory (CDI)</u> at two years of age (p = 0.03). After adjusting for pertinent variables (e.g., age) no other significant correlations remained between results on the <u>CDI</u> subsets and OM history. No statistically significant negative correlations were found between parent reports of language levels and communication skills at one year of age and the cumulative percentage of days with MEE in the first year of life.

Green *et al*. (1999) hypothesized that infants with early-onset (EO) OM would demonstrate smaller canonical syllable ratios (CSRs) in comparison with infants who experienced no OM during the first six months of life (LO). The EO group obtained lower mean CSRs at each age level in comparison with the LO group, and an ANOVA revealed significant main effects for both age (p = 0.0001) and group (p = 0.0046).

The methodological problems that were seen across all of the studies reviewed impacted the rigour of the results significantly. For example, children who belonged to foster homes, possessed other illnesses, had a low birth weight, had developmental deficits, etc. were excluded from all of the studies. This is concerning because many children who do suffer from OM also, in fact, have these co-occurring deficits or delays in other areas. Another flaw noted in all of the studies was the lack of inclusion of a control group. For research such as this, where an intervention is not being provided, there is little ethical concern for using a control group, thus, it should have been a consideration in the research.

It was also found that most studies did not adjust for known confounding variables (e.g., maternal education, social economic status, and childcare environment) that have been shown to explain a considerably larger portion of children's language development than OM. This is critical because one cannot be confident that the results of these studies are in fact, due to OM.

The measurement tools used to assess language development in these studies were questionable in terms of appropriateness. Half of the studies failed to include a formal standardized test when assessing the children's language abilities. These studies used solely parent-reported screening tools in the form of questionnaires and checklists to determine the child's language functioning, which poses a major threat to the validity. The results of these reports may have been overestimated due to parents' lack of training and inability to notice subtle features of their child's language use. Thus, the children's language skills may have actually been poorer than reported, and the relationship between OM history and language could have been underestimated, which would greatly affect the results of these studies.

Thus, although none of the reviewed studies have found OM history to be significantly related to later language skills, all four of these studies had serious methodological, measurement, and statistical flaws. Since there is no evidence to prove that a significant relationship between OM and later language development does exist, we would generally have to accept the null hypothesis, that is,

there is no existing relationship. However, given the research weaknesses, it is critical to continue research in this area to determine whether or not OM does or does not impact later language development.

Prioritization of SL-P Services for children with OM history

From the literature reviewed, **it is obvious** that there are serious methodological flaws in current research that are compromising the rigor of the study results. When combined with the statistical and measurement issues that were also found in these studies, the results become highly questionable. Thus, there is reason to further investigate the relationship between OM and language. Based on this belief, it is recommended that the notion of prioritization of S-LP services for these children not be discarded until more rigorous research supports or denies this.

From the literature, it was discovered that OM history does impact early language (i.e. reduced canonical syllable ratios (CSRs)); thus, we can now determine at a very early age, who may potentially be at risk for later language development. Early intervention is supported by this research, and therefore this study is valuable in terms of clinical relevance. However, more research must be completed to determine if these reduced CSRs are, in fact, related to later language development before we can be certain of the long-term effect of treatment for these babies.

Conclusions

It should be recognized that although earlier retrospective studies of the OME-language learning relationship had many methodological problems, more recent studies avoided many of these problems by following children prospectively. However, in using the prospective design to study these subjects, many other methodological, measurement, and statistical flaws have surfaced which have compromised the rigor of the studies and put them into question. Further research should focus on improving methodology (e.g., using exclusionary criteria for subject selection that does not discount the great deal of the population at risk, use of control groups, etc.), use of appropriate measurement tools (e.g., increasing the use of standardized tests to compliment screening tools), and statistically related issues as mentioned previously such that the results of the studies can guide us to answers regarding the usefulness of prioritization for children with OM histories for S-LP services.

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The efficacy of oral myofunctional therapy on swallowing and speech difficulties

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This critical review examines the effects of oral myofunctional therapy among persons with swallowing and speech disorders. Study designs include: critical review, a randomized controlled trial, and pre- post test designs. Overall, research supports the use of oral myofunctional therapy as a treatment for tongue thrust; however, not as a sole treatment for speech difficulties.

Introduction

Since the 1970's, when the debate began about the existence of tongue-thrust and its therapy, speech pathology programs and clinicians have avoided dealing with oral myofunctional therapy. However, with ASHA's 1991 positive statement on "The Role of the Speech-Language Pathologist in Assessment and Management of Oral Myofunctional Disorders, this has been shifting (Landis, 1994). Since than, an increase in the awareness and interest of myofunctional disorders has been seen.

An orofacial myofunctional disorders is any pattern involving oral and/or orofacial musculature that interferes with normal growth, development or function of structures or calls attention to it (ASHA, 1993). Dentists and orthodontists have for many years been the experts from whom we seek advice on oral structure, oral care, and and related problems. Because dentition can be affected by the pressures exerted on it by the tongue at rest and during swallowing, dentists have turned to the speech pathologist for assistance in developing treatment programs (Pierce, 1980). Orofacial myofunctional disorder variables are classified as lingual, labial, dental and skeletal factors, soft tissue differences, oral habits, mouth-breathing, lips-apart rest postures, and speech differences (Kellum, 1994). Myofunctional therapy provides increasing awareness of and exercises for these muscles (of the tongue, cheek, lips, and jaw); it also focuses on orofacial muscle tone and rest posture (Landis, 1994).

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of oral myofunctional therapy on individuals with tongue thrust and speech difficulties.

Methods

Search Strategy
Computerized databases, including CINAHL, PubMed, and The University of Toronto Library, were searched using the following search strategy:
> ((Swallowing Disorders) OR (Dysphagia)) AND ((Oral myofunctional Therapy) OR (OMT) OR (oromyofunctional therapy)).

The search was limited to articles written in English between 1980 and 2004.

Selection Criteria
Studies selected for inclusion in this critical review paper were required to investigate the impact of any type of oral myofunctional therapy program on the tongue thrust swallowing pattern, articulation errors (eg. sibilant /s/ distortion), and intelligibility issues. No limits were set on the demographics of research participants or outcome measures.

Data Collection
Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: clinical exchange article (1), critical review and randomized controlled trial (RCT) (1), pre- post-test design (2), and an ABC repeated measures design (1).

Results

Overstake (as cited in Pierce, 1980) used a randomized controlled trial design to examine the effects that tongue thrust therapy (subgroup 1), or tongue thrust plus speech therapy (subgroup 2), would have on the misarticulation of /s/ (i.e. lisping). 86% of the participants in subgroup 1 that completed the study had corrected the /s/ sound in unguarded, conversational speech (24 out of 28), and 75% of the participants in subgroup 2 had habituated a normal /s/ (15 out of 20).

Ray (2002) conducted a pretherapy – posttherapy comparison study is to examine the influence OMT

has on speech intelligibility and a speech diadochokinetic task, without direct articulatory drills. A Wilcoxon signed rank test was computed, which indicated no significant difference ($z = 0.44$) for sentence and conversational speech. This finding was attributed to sentence length and complexity. Qualitative improvements were, however, reported for sentence and conversational speech intelligibility. Finally, a significant improvement was reported for single words.

Ray (2003) also conducted a pretherapy – posttherapy comparison to examine the effects that orofacial myofunctional therapy (OMT) had on persistent articulation impairments and various co-existing (i.e., previously treated) orofacial myofunctional disorders. All clients were able to maintain appropriate lip and tongue postures, 70% of the time, and heightened awareness of tongue and lip positions was developed. 5/6 subjects revealed:

- 25% increase in single word intelligibility (27/30)
- 15% increase in sentence intelligibility (7.5/10)
- 12% increase for spontaneous speech (175/250)

This data was used to calculate McNemar tests for each outcome measure, revealing significant improvement for single words ($\chi^2 = 7.81$), and spontaneous speech ($\chi^2 = 17.5$). Sentence intelligibility demonstrated no significant improvement ($\chi^2 = 1.07$).

Ray (2003) excluded the data from one subject with a class III malocclusion and developmental apraxia of speech, because the subject failed to perform adequately during the post-treatment measures. Ray (2003) also noted that the client represented a good exemplar of someone with "persistent sound system disorders" or "persistent articulatory impairments" (Powell, 1996; Ray, 2003; Shelton, 1993). Despite this exclusion, however, the author concluded that the study suggest OMT is effective in treating individuals with persistent articulatory impairments and occlusion problems.

Speech intelligibility was reported to improve from 61% to 78.3% of an utterance (based on the method of transcription), and transcription scores were noted to vary significantly from pre- to post-therapy.

Gommerman & Hodge (1995) used an ABC single subject design to investigate the effectiveness of oral myofunctional therapy in eliminating tongue thrust swallowing pattern with mild sibilant distortion, in a 16-year old female patient. They used diadochokinetic rate as a control for maturation, and demonstrated no significant temporal effects, effectively eliminating this bias. Their outcome measures included frequency of tongue thrust swallows, duration of swallows, ease/naturalness of the swallowing pattern, sibilant distortion, tongue strength, and tongue endurance. Their results were as follows:

- Frequency of tongue thrust swallows:
  Baseline – 100%
  OMT – 0% after 1st session
  During articulation therapy – 0%
- Duration of Swallows: A celeration line was used to determine the slope. They found an increase in the efficiency of normal swallows (session 3, 6, and 9 not available due to equipment failure). Phase C (articulation treatment) showed an increase in time and there was sigh session-to-session variability (e.g. 23 sec in session 22 and 36 sec in session 36).
- Ease/Naturalness of swallowing pattern: An increasing trend was found using self-rating.
- Sibilant distortion:
  Baseline – 1-9%
  OMT – 0-9%
  Celeration points indicate a slight increasing trend for both baseline and OMT (session 11&12 no values due to equipment malfunction
  Articulation – 9%(1st session) and 1-3% (in final 3)
- Tongue strength: The IOPI was used to determine strength, and an increase across the 3 phases was seen. They also compared expected strength (based on weight) with the actual strength.
  Phase A – the mean was 34.6 (which is below the expected value) and an increase of 15kPa (49.5kPa) was seen. This affects the interpretation of the increase in measures of tongue strength that was observed in Phase B and C.
  Phase B – an increase in strength was observed
  Phase C – an increase was again found (65kPa which is above the norm).
- Tongue Endurance:
  Phase A – showed an increase in stability at baseline, which may have been due to increased effort or increased familiarity and proficiency with the task.
  Phase B – Increase in endurance
  These results suggest the exercises performed during OMT had positive effects on endurance and possibly strength.

Gommerman and Hodge (1995) also employed an in-home follow-up evaluation, 2 and 4 weeks after completing phase C. Normal swallows were

observed while the subject ate dinner and drank liquids. Another follow-up was conducted 6 months after the end of the study to assess maintenance of skills (swallowing and articulation). A normal swallow was observed on all 10 trials (completed in 22 sec and were judged to be 100% natural) and 0% sibilant distortion was observed. Maximal tongue strength was within the norm for her weight (61.25kPa), but tongue endurance had decreased (from a mean of 21.5 sec at end of phase C to 15.25 sec). This decrease placed the subject below the expected value for children, but above her baseline measures (11-13 sec above baseline). The authors suggest that fatigue or reduced effort may account for the lower values observed.

Conclusions

Gommerman & Hodge (1995) concluded that oral myofunctional therapy was effective in eliminating the subject's tongue thrust pattern. Furthermore, while it did not eliminate the client's sibilant distortion, it may have facilitated her skill in combining appropriate lingual articulatory placement with ear training for undistorted sibilant productions. Ray (2003) concluded that OMT is effective in treating individuals with persistent articulatory impairments and occlusion problems. Speech intelligibility was reported to improve from 61% to 78.3% of an utterance (based on the method of transcription), and transcription scores were noted to vary significantly from pre- to post-therapy.

The existing literature on OMT does not, therefore, unanimously agree on the effectiveness of OMT in treating articulation problems. They do, however, agree that OMT has a significant impact on tongue thrust swallowing pattern. This suggests that a combination therapy, involving OMT for the treatment of structural or physical abnormality, and articulation therapy for the treatment of articulatory disorders.

This review also underscores the importance of identifying structural or physical abnormalities that may impede the success of traditional SLP interventions. It also suggests that working collaboratively with dentists and orthodontists to treat these underlying issues may help to facilitate treatment efficacy in speech therapy. Further research (longitudinal and retrospective) on the use of oral myofunctional therapy in treating swallowing and articulatory disorders, as well as studies examining the efficacy of OMT for articulation disorders (in the absence of orofacial myofunctional disorders), is needed.

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Effectiveness of directional microphones and digital noise reduction algorithms

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This critical review examines the effectiveness of directional microphones and digital noise reduction algorithms in improving speech intelligibility in the presence of background noise. Study designs include: review article, repeated measures within subject design, and meta-analysis. Overall, research suggests that directional microphones are capable of improving the signal to noise ratio of speech in noise; however, digital noise reduction algorithms were not found to significantly improve speech intelligibility in noise.

Introduction

One of the most common complaints of hearing instrument wearers is difficulty listening to speech in the presence of background noise. While hearing instruments allow for the audibility of desired sounds, they do so at the cost of also making unwanted sounds available to the listener. This proves especially problematic for the impaired cochlea. Individuals with sensorineural hearing loss require a higher signal-to-noise ratio (SNR) for speech intelligibility than normal hearing listeners. Furthermore, the greater the degree of hearing loss, the higher the SNR required for speech intelligibility. Therefore, it is necessary to consider hearing instruments technologies that serve to increase the SNR for speech intelligibility in the presence of background noise. There are currently two main approached to noise reduction in hearing instruments, directional microphones and digital noise reduction (DNR) algorithms.

Developments in hearing instrument microphone technology have brought directional microphones from a single microphone two port system to a multi-microphone digital signal processing system. This new era of directional microphones includes both fixed and adaptive array systems. Only fixed array directional microphones will be considered in the present investigation as literature on adaptive systems is limited and evolving. In fixed array systems, two or more omnidirectional microphones are positioned on the hearing instrument. Signal processing algorithms cause sound entering the rear microphone to be delayed and thus out of phase with sound entering the front microphone. When the inputs from both microphones are added together, the phase opposition causes a canceling of the sound collected from the rear microphone.

Digital noise reduction (DNR) algorithms, or single microphone technologies, take advantage of the characteristic spectral and temporal differences between a speech signal and a noise source. Incoming signals can be recognized as either speech or noise, and can be manipulated according to the particular DNR algorithm of the hearing instrument.

It is important as clinicians that we remain abreast of current advances in hearing instrument technologies and the efficacy of such technologies. The issue of listening in background noise is of utmost importance to hearing instrument wearers, and in turn becomes a major concern for the dispensing audiologist. Critical analysis of research on the efficacy of noise reduction technologies allows for informed decision-making during hearing instrument prescription.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of directional microphones and digital noise reduction algorithms in improving speech intelligibility in the presence of noise. The secondary objective is to propose evidence-based practice recommendations regarding the prescription of such technologies in hearing instruments, as well as the counseling of clients making use of such technologies.

Methods

Search Strategy

Computerized databases, including ComDisDome, and PubMed, were searched using the following search strategies:

((directional microphone) OR (dual microphones) OR (multi-microphone)) AND ((hearing aid) OR (hearing instrument))

((digital noise reduction) OR (digital noise reduction algorithm) OR (noise reduction)

OR (noise reduction algorithm)) AND ((hearing aid) OR (hearing instrument)).

The search was limited to articles written in English between 1995 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the effectiveness of directional microphones and/or digital noise reduction algorithms in improving the signal to noise ratio of speech in noise. No limits were set on the demographics of research participants or outcome measures.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: review (4), repeated measures within subjects design (10), and meta-analysis (1).

Observed Methodologies

With such a large body of research, some trends in study design were observed. A repeated measures within subjects design was used in all studies under consideration. Results were generally analyzed using one-, two-, or three-way repeated measures analysis of variance (ANOVA), Tukey's honestly significant difference (HSD) and paired t-tests for investigation of interactions. There are two avenues, objective and/or subjective measures, by which measures of efficacy were obtained in both directional microphone and DNR algorithm studies.

Objective measures used in the literature include the Hearing in Noise Test (HINT), the Speech in Noise (SIN) test, the Connected Speech Test (CST), and various other speech reception tests administered in the presence of noise. These measures provided an indication of the benefit of the noise reduction strategies through an individual's performance on the given task. A SNR can often be calculated from such tests and this then provided a decibel difference indication of the benefit of the technology.

Self assessment scales, administered before and after a noise reduction strategy is implemented, were used to provide investigators with an indication of the technology's benefit. Use of the Profile of Hearing Aid Benefit (PHAB), the Abbreviated Profile of Hearing Aid Benefit (APHAB), and other self-report measures generated by the investigators, was found in the literature. These outcome measures were used to provide an indication of the subjective experience of a particular technology.

Ideal Methodology

When answering the question of how to measure the benefit of a noise reduction strategy, it is believed that an investigator should use both objective and subjective measures of the technology's benefit.

Objective measures, such as the HINT, that allow for SNR assessment of the advantage provided by the technology are preferable. Tests that can approximate real-world situations through their use of sentence material and the ability to vary the noise configuration allow for greater generalizability of results.

Although, many researchers may question advocacy of the use of subjective measures, it is believed that such information is clinically and commercially relevant. Therefore, investigations incorporating subjective measures are not unwarranted. Bentler et al (2003) demonstrated that participants are affected by the labeling of hearing instrument technology. It is therefore suggested that outcome measures, such as the PHAB or APHAB, be conducted in a double-blind manner in order to avoid labeling effects when assessing new technology.

The preferred study design in assessing hearing instrument technology benefit would be a randomized control trial. However, it is often difficult to implement this in audiologic research as matching participants in experimental and control groups is complicated by hearing loss configuration and speech perception abilities. Therefore, a repeated measures within subject design is preferred.

Directional microphones and DNR algorithms should be evaluated using multiple trials under varying reverberation times and noise conditions (ie. number of noise sources, noise source configurations, and noise characteristics). In studying the noise reduction strategy under a variety of conditions, we may develop a better indication of its real-world performance and potential benefit.

Results

When considering the research into directional microphones and DNR algorithms, it is necessary to appraise their contributions based on the degree of experimental control, the generalizability of the results to the real-world, and the appropriate use of statistical analyses. The studies under examination were assessed with regards to the aforementioned criteria and the contributions of each study were weighed accordingly.

Only objective measures of improved speech intelligibility, as expressed as improved SNR, were considered in this investigation. Subjective measures are easily confounded if not conducted in a blinded

manner (Bentler et al, 2003). The studies under investigation could not claim effective blinding.

In any investigation involving the assessment of hearing instrument technology, it is necessary to consider possible involvement of manufacturers in the funding and execution of the research. It is important as a consumer of the literature that one considers any possible biases that may stem from manufacturer involvement. Seven of the eight studies involving research reported funding by a hearing instrument manufacturer.

Directional Microphone Efficacy

The following five studies were considered: Amlani, 2001; Pumford et al, 2000; Ricketts & Dhar, 1999; Ricketts & Mueller, 2000; and Valente et al, 1995. Although all were very similar in experimental design and analysis, save Amlani (2001) which is a meta-analysis, a few studies can be seen to demonstrate good experimental control and generalizability (Pumford et al, 2000; Ricketts & Dhar, 1999; Ricketts & Mueller, 2000). These studies provided the basis for the conclusions drawn about the benefit provided by directional technology. All the studies used appropriate statistical analyses in the form of a one-, two-, or three-way repeated measures analysis of variance (ANOVA), Tukey's honestly significant difference (HSD) and paired t-tests for investigation of interactions.

Through critical analysis of the results of these studies, it is can be seen that directional microphones indeed provide an advantage, as expressed in SNR, over omnidirectional microphones. Directional systems can provide approximately 0.5 to 6.5 dB SNR in moderately reverberant environments and 0.8 to 7.5 dB SNR under anechoic/low-reverberation conditions (Pumford et al, 2000; Ricketts & Dhar, 1999; Ricketts & Mueller, 2000). It is important to note here that Ricketts & Mueller (2000) investigated several factors (threshold slope, high frequency average threshold, and omnidirectional speech intelligibility) for their predictive value in directional benefit. It was found that such factors cannot significantly predict the amount of benefit an individual will receive from a directional microphone system.

Digital Noise Reduction Algorithm Efficacy

The following four studies looking at DNR algorithms were considered in this paper: Alcantara et al, 2003; Boymans & Dreschler, 2000; Jamieson et al, 1995; and Walden et al, 2000. Data regarding the benefit of DNR algorithms can also be found in some of the studies examined above as they analyzed such algorithms as variables (Pumford et al, 2000; Ricketts & Dhar, 1999; Valente et al, 1995). These studies,

and the aforementioned studies, will provide the basis for the conclusions drawn about the benefit provided by DNR algorithms. Unlike the studies on directional microphones, these studies were less similar in experimental design. All the studies used appropriate statistical analyses in the form of a one-, two-, or three-way repeated measures analysis of variance (ANOVA), Tukey's honestly significant difference (HSD) and paired t-tests for investigation of interactions.

These studies evaluated participants' performance under a variety of noise conditions. This is an extremely important consideration in this area of research, as these algorithms seek to eliminate noises with particular characteristics. Overall, the studies considered here do not provide evidence for the effectiveness of DNR algorithms in providing more favourable SNR ratios (Alcantara et al, 2003; Boymans & Dreschler, 2000; Jamieson et al, 1995; Pumford et al, 2000; Ricketts & Dhar, 1999; Valente et al, 1995; Walden et al, 2000).

Although subjective measures were not fully examined in this review, their results are worth mentioning with regards to DNR algorithms. Research consistently shows hearing instrument wearers report greater comfort in the presence of noise with DNR algorithms activated (Boymans & Dreschler, 2000; Jamieson et al, 1995; and Walden et al, 2000).

Conclusions

From this critical analysis of the literature, certain statements can be made regarding the efficacy of directional microphones and DNR algorithms in improving speech intelligibility in noise. The literature has shown that it is only directional microphones that provide this benefit. Directional microphones can provide a SNR improve in the range of approximately 0.5 to 6.5 dB SNR in moderately reverberant environments and 0.8 to 7.5 dB SNR under anechoic/low reverberant conditions (Pumford et al, 2000; Ricketts & Dhar, 1999; Ricketts & Mueller, 2000). DNR algorithms did not significantly improve the SNR (Alcantara et al, 2003; Boymans & Dreschler, 2000; Jamieson et al, 1995; Pumford et al, 2000; Ricketts & Dhar, 1999; Valente et al, 1995; Walden et al, 2000). However, DNR algorithms may provide some benefit to hearing instrument wearers in the form of improved listening comfort in the presence of background noise (Boymans & Dreschler, 2000; Jamieson et al, 1995; and Walden et al, 2000).

Clinicians are 'front-line' in this field and therefore the implications of an investigation such as this should be considered. Recommendations for clinicians address informed prescription of hearing

instruments and their associated technologies, and education and counseling of clients with regards to the expected benefit of these technologies.

As with any area of practice, a clinician needs to take efforts to provide appropriate evidence-based hearing instrument prescription. There is also a need to educate our clients throughout the hearing instrument prescriptive process, as some are enthusiastic consumers of marketing literature provided by the manufacturers. The cost-effectiveness of such technologies needs great consideration and should be shared with the clients. Review of the literature on DNR algorithm has demonstrated a failure to increase speech intelligibility in noise and failure to provide a more favourable SNR. Clinicians who seek to increase a client's speech understanding in noise should therefore not prescribe a high end digital instrument only because it offers a DNR algorithm when a lower end digital instrument with addition of a directional microphone would be more beneficial. As clinicians, we must stay informed of the efficacy of hearing instrument technologies and not be easily swayed by marketing in our hearing instrument prescriptions.

Finally, clinicians are the client's liaison with hearing instrument manufacturers and the research community. As such, it is our responsibility to provide our clients with an unbiased and educated interpretation of the marketing of hearing instrument technologies. Should we prescribe a hearing instrument that offers a directional microphone and/or a DNR algorithm, we need to provide effective counseling regarding the expected benefit of those technologies. It should be made clear to the client that the directional microphone can offer better speech understanding in noise, but that the DNR algorithm only offers a more comfortable listening program. Also, the literature has shown differential performance of directional microphones in high versus low reverberant conditions. Therefore counseling should include discussion surrounding the different benefit that may be experienced in various real-world environments. In addition to counseling surrounding the expected benefit, clinicians should take care to educate clients on the effective use of the technologies. It is important for a clinician to remember that a hearing instrument wearer can only benefit from the technology if they know how and when to implement it.

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Integrating frequency-specific ABR thresholds into the hearing instrument fitting process

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For very young infants, estimates of hearing sensitivity are derived from auditory brainstem response (ABR) measurements. These electrophysiological procedures have not been developed to anticipate the computational requirements of hearing aid prescription algorithms. Consequently, the ABR threshold estimates cannot be entered directly into hearing aid prescription software without correction. Typically, a published correction is subtracted from the ABR (dB nHL) measurements of the infant's hearing sensitivity and the resulting Estimated Hearing Level (dB eHL) is used to calculate the hearing aid prescription.

The results of a laboratory evaluation of ABR corrections for adults with normal hearing and children with sensorineural hearing loss will be presented. The findings indicate that by measuring the acoustic properties of individual ear canals, accurate conversions of nHL to real-ear SPL are possible. In addition, these converted values can be compared to behavioural SPL thresholds with a reasonable degree of accuracy by applying previously determined corrections. This new procedure for predicting the real-ear SPL of ABR test signals will provide a better understanding of their accuracy for use in hearing aid prescription algorithms.

Repeatability of a new technique for measuring the real-ear-to-coupler difference in young infants

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The real-ear-to-coupler difference (RECD) is a reliable and valid clinical procedure used for fitting amplification to infants and young children. With the advent of universal newborn hearing programs, RECDs from young infants are used as part of an accurate intervention protocol (eg., AAA protocol). Measurement techniques developed for toddlers may not be feasible for young infants due to very small ear canals and the position of the child during the measurement. The current study examines a new measurement strategy for obtaining RECDs in infants 6 months of age and younger. The procedure was tested on a clinical sample of infants. Measurements were completed twice on the same ear of each infant to obtain test-retest reliability data. In addition, probe tube insertion depth was examined across subjects to provide a guideline for the infant population. The results of this study indicate that RECDs obtained using a new probe tube insertion strategy can be obtained reliably on infants aged 6 months and younger. A new strategy for probe tube insertion depth will be described.

The effectiveness of group therapy in improving functional communication in adults with aphasia

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This critical review examines the effectiveness of group therapy in improving functional communication among persons with aphasia. Study designs include: one group pretest- posttests, a within-subjects design, and a randomized controlled trial. Overall, research supports that group therapy is found to improve functional communication skills in adults with aphasia; however, identification of one superior therapy in the treatment of persons with aphasia has not yet occurred.

Introduction

Aphasia is described as "impaired comprehension and production of language, usually caused by pathology affecting the language-competent half of the brain" (Brookshire, 2003, p.1).

For persons with aphasia, recovery is most profound within the first 6 months post injury and the initial severity, lesion size, and time post onset are found to be the best predictors of degree of spontaneous recovery (Whitaker, 1998). Spontaneous recovery is the period after an injury during which some degree of recovery of impaired functioning is expected (Whitaker, 1998). Research has suggested mixed outcomes in efficacy studies for group therapy, although numerous studies have demonstrated positive outcomes beyond the period of spontaneous recovery (Aten & et al., 1982; Brumfitt & Sheeran, 1996; Elman & Berstein-Ellis, 1999; Marshall, 1993).

Although individual therapy is the traditional approach used for the treatment of patients with aphasia, it is often limited in facilitating the transfer of skills to more natural settings (Elman & Bernstein-Ellis, 1999). It has recently been reported that Speech-Language Pathologists are looking in the direction of therapy that is geared towards more functional communication gains for persons with aphasia (Brumfitt & Sheeran, 1997).

Treatment groups allow for a more natural environment for communication for adults with aphasia compared to individual therapy, but are controlled and less threatening than day-to-day social situations (Brookshire, 2003). Group therapy is often used to complement individual therapy and is found to provide the following gains over one-on-one treatment: promoting the transfer of skills to functional communication, modeling of communication by peers, and support (Marshall, 1993). It may also increase the clients' self-esteem, encourage further involvement in the community, and it is cost-effective (Elman & Bernstein-Ellis, 1999).

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of group therapy on individuals with aphasia. The secondary objective is to propose evidence-based practice recommendations for future research.

Methods

Search Strategy

Computerized databases, including CINAHL, PsychInfo, and PubMed, were searched using the following search strategy:

((Aphasia) OR (adults with aphasia) OR (aphasics)) AND ((group therapy) OR (group treatment) OR (group program) OR (functional communication therapy)) AND (functional communication).

The search was limited to articles written in English between 1980 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of any type of group therapy program on the functional communication abilities among adults with aphasia. No limits were set on the demographics of research participants.

Data Collection

Due to the limited scope of this assignment, only a small set of articles were reviewed, although further research is available. Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: one group pretest-posttest (2), within-subjects design (1), and a randomized controlled trial (RCT) (1).

Results

Effectiveness of Group Therapy on Functional Communication

Marshall (1993) indicated that 14 out of 25 participants improved on the Porch Index of Communicative Abilities (PICA), showed good participation, and were found to attend most sessions, while those who did not improve were at least four years post-stroke or dropped out of the study.

Aten, Caligiuri, & Holland (1982) compared mean scores pre and post treatment on the PICA and the Communicative Abilities of Daily Living (CADL) (Aten et al., 1982). A t-test analysis for repeated measures was not found to be significant (Aten et al., 1982).

Few changes in means were noted on the PICA between pre and post treatment for the seven participants (Aten et al., 1982). Improvements in means on the CADL at six weeks of therapy and post-therapy compared to pretreatment, were found to be significant, while the mean at six weeks post-treatment was similar to the mean at post-treatment (Aten et al., 1982). There was high variability in CADL scores from pre-treatment to six weeks post treatment, therefore some participants had reduced scores but overall, the means showed improvements (Aten et al., 1982).

Brumfitt & Sheeran (1997) compared differences between scores before and after treatment and reported statistically significant changes in functional communication scores, particularly in the 'speaking' domain of the Functional Communication Profile (FCP) (t = 2.54, p=0.03).

Elman & Bernstein-Ellis (1999) compared group therapy to a control group receiving no treatment and a treatment effect was found for scores on the Western Aphasia Battery (WAB), the CADL, but not on the shortened PICA (SPICA) (p < .05). Greater improvements were noted for more severe patients with fewer changes observed in milder patients (Elman & Bernstein-Ellis, 1999).

The scores on the WAB, the SPICA, and the CADL showed significant changes when comparing intake and pretreatment to 2 months of therapy, and the WAB and the CADL for 2 months and 4 months of therapy (Elman & Bernstein-Ellis, 1999). No significant changes were found at follow-ups (Elman & Bernstein-Ellis, 1999).

The results of this study demonstrated that group therapy is an efficacious treatment for functional communication in adults with aphasia (Elman & Bernstein-Ellis, 1999).

Discussion

Sample Size

The small sample sizes (ranging from 6 to 28) in these studies may limit the generalizability of the results to the population of adults with aphasia as a whole.

Measurement Tools

The measurement tools used to assess functional communication are the following: the CADL (Holland, 1980), the Communication Effectiveness Inventory (CEI) (Lomas et al., 1989), the WAB (Shewan & Kertesz, 1980), the PICA (Porch, 1981), the shortened PICA (Elman & Bernstein-Ellis, 1999), and the FCP (Aten et al., 1982; Brumfitt & Sheeran, 1997; Elman & Bernstein-Ellis, 1999; Marshall, 1993). These tools have been shown to be reliable and valid, and with the exception of the WAB, they have been designed to assess functional communication. Therefore, more confidence can be placed in the results of these measurement tools.

Outcome Measures

Outcome measures included: increases in initiating conversation and exchanging information in whatever means possible (Elman & Bernstein-Ellis, 1999); improvements in communicative competence (Brumfitt & Sheeran, 1997); and improved scores on the CADL (Aten et al., 1982), or the PICA (Marshall, 1993). These measures do not satisfy all areas of functional communication. To respond to the question, a more common definition of the construct of functional communication is required.

Design

One group pretest-posttests (Aten et al, 1982; Brumfitt & Sheeran, 1997), a within-subjects design (Marshall, 1993) and a randomized control trial (Elman & Bernstein-Ellis, 1999) were used. With the exception of the randomized control trial, the designs do not show high internal validity and clinicians cannot be certain that the results are due to therapy. Also, it is difficult to generalize these results to natural settings, indicating poor external validity.

Use of Mean Data

Brumfitt and Sheeran (1997) addressed that one difficulty with comparing mean scores is it may disguise the number of subjects demonstrating actual improvement. Therefore, the means of the results are potentially inflating the positive outcome.

Controlling for Confounds

Elman and Bernstein-Ellis (1999) controlled for social isolation in the control group. They also

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controlled for both time and treatment by comparing changes in scores in the Immediate Treatment group with those of the Delayed Treatment group (Elman & Bernstein-Ellis, 1999). Beyond the randomized control trial, the studies did not control for all confounds (e.g., maturation, history, experimental mortality, selection, etc.) which could be influencing the accuracy of the results (Aten et al. 1982; Brumfitt & Sheeran, 1997; Marshall, 1999).

Conclusions

The research discussed demonstrates clinical relevance and in general, suggests that group therapy is effective in improving functional communication in adults with aphasia. It is recommended that group therapy continue in practice by clinicians as it is found to show only positive outcomes. In fact, group treatment has been shown to bring about significant improvements in functional communication compared to controlled groups who received no treatment, including improvements shown 2 and 4 months after completion of therapy (Elman & Bernstein-Ellis, 1999).

Few studies have determined who receives the greatest benefits from group therapy based on the severity of the aphasia. One study found greater improvements for individuals with severe aphasia (Aten et al., 1982) while Marshall (1993) showed progress in clients with mild aphasia.

Research has shown that beginning therapy immediately post-injury is ideal (Marshall, 1993). It is reported that clients receiving delayed therapy could achieve similar effects, but would require a longer period of therapy (Elman & Bernstein-Ellis, 1999). Even short-term therapy, compared to other terms of group therapy, showed improvements in as few as 10 sessions (Brumfitt & Sheeran, 1996). Aten et al. (1982) found maintenance of skills post-treatment although further research is required to support this.

Overall, the research is lacking some significant information. Therefore, it is recommended that further research be considered when considering practicing group therapy over other treatment options.

This review of the research suggests a need for future research in evaluating the effectiveness of group therapy in improving functional communication in adults with aphasia. Some future considerations should include replication of the randomized control trial by Elman and Bernstein-Ellis (1999). The degree of gains of group therapy comparing short term versus long of term therapy should be considered (Brumfitt & Sheeran, 1997). A comparison between a treatment group and a control group (e.g., the standard treatment such as individual therapy or to other treatment options such as computer-based therapy) would determine whether the effects are due to the treatment, and evaluate which treatment methods are superior in improving functional communication in adults with aphasia. The transfer and maintenance of learned functional communication skills to more natural settings should be evaluated (Marshall, 1993). The influence of the client's own perception of their role in increasing their functional communicative abilities should also be a focus of further research (Marshall, 1993).

Group therapy is an important treatment to consider for persons with aphasia as it has multiple advantages. Group therapy is cost-effective for both the client and the Speech-Language Pathologist compared to individual therapy (Marshall, 1993). Numerous reports by clients and family members supported improvements in positive attitudes and confidence in clients, both during and post-treatment, even when communication may not have shown direct progress (Brumfitt & Sheeran, 1997; Elman & Bernstein-Ellis, 1999; Marshall, 1993).

While no evidence exists to identify one treatment as superior, there appears to be support for group therapy at minimum as an adjunct to other treatments in targeting functional communication skills.

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Evaluation of listener preference and intelligibility for a prototype electrolarynx

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This study investigated the auditory-perceptual (AP) evaluation of electrolaryngeal sentences. Fifteen naïve listeners provided preference and intelligibility judgments of sentences produced by four laryngectomized speakers using a paired-comparison paradigm. Each speaker used a prototype electrolarynx (PEL) and a commercially available device (Servox). Results showed a clear preference for the PEL. Rehabilitation implications are discussed.

Psychophysical evaluation of pleasantness and acceptability for electrolaryngeal speech

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This presentation provides information on the psychophysical, auditory-perceptual (AP) characteristics of electrolaryngeal (EL) speech. Sentence stimuli produced using the Servox EL were assessed by 12 naïve listeners for the perceptual features of pleasantness (PL) and acceptability (AC). Methodological concerns influencing psychophysical measurement and the related clinical implications are discussed.

The impact of PROMPT therapy on communication disorders

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This critical review examines the effects of PROMPT therapy among persons with communication disorders. All of the reviewed studies were identified as single subject, multiple baseline designs. The communication disorders examined in these studies included apraxia of speech and phonological delay. Based on this review, there is evidence to suggest that PROMPT therapy is effective for treatment of apraxia in adult aphasics. There was no evidence that PROMPT treatment was effective for children with developmental phonological disorders. The results of the present review should be interpreted with consideration of the inherent limitations of the methodology and statistical analysis used in the reviewed studies.

Introduction

The Prompts for Restructuring Oral and Muscular Phonetic Targets (PROMPT) system, introduced by Chumpelik (1984) and further developed by Square-Storer and Hayden (1989), is a tactile speech treatment approach that is based on the kinesthetic awareness of movement patterns (Hayden, 1984). The clinician places his/her hands and fingers on the client's face and neck to give sensory feedback about the positions and places of contact of the speech mechanism required for specific speech sounds (West, Hesketh, Bowen & Vail, 2004). Prompts are applied to the face to signal the facial muscles to activate lip retractions and lip rounding, to the mylohyoid to signal the height of the tongue and constriction of the oral cavity, and to the mandible to signal degree of jaw opening. The clinician also prompts the timing of movements between positions and the amount of tension required for each position (Square, 1994). The client moves through PROMPT therapy along a continuum of increasing linguistic difficulty and progressively learns to control the speech-motor system. (Hayden & Square,1994).

Objectives

The primary aim of this paper is to critically evaluate the existing literature regarding the impact of PROMPT therapy on communication disorders. The secondary objective is to provide an evidence-based recommendation about the application of PROMPT therapy with particular client populations in the clinical setting.

Methods

Search Strategy

The studies were found using a computerized database search, including PubMed, Medline, PsychINFO, and Cochrane Library. The following key terms were used:

((language) OR (language delay) OR (language disorder) OR (phonology) OR (phonological delay) OR (phonological disorder) OR (speech) OR (speech delay) OR (speech disorder) OR (articulation) OR (articulation delay) OR (articulation disorder) OR (apraxia) OR (apraxia of speech) OR (apractic) OR (motor speech) OR (motor) OR (communication) OR (communication disorder) OR (communication delay) OR dysarthria)) AND ((PROMPT) OR (PROMPT therapy) OR (PROMPT treatment))

The search was limited to articles written in the English language.

Selection Criteria

Studies that were selected for inclusion in this critical review paper examined the impact of PROMPT therapy on any type of communication disorder. No restrictions related to subject demographics or outcome measures.

Data Collection

The literature search yielded five articles that employed multiple baseline, single subject design.

Results

Impact of PROMPT on Acquired Apraxia of Speech with Aphasia

Four studies were found to support the conclusion that PROMPT can be an effective treatment for the speech difficulties experienced by clients with aphasia and acquired apraxia.

Square, Chumpelik, and Adams (1985) reported that one severely apraxic adult participant with moderate Broca's aphasia achieved 90-100% accuracy when producing phrases, similar success with minimal word pairs and improved intelligibility as measured by the Assessment of Intelligibility of Dysarthric Speech after participating in PROMPT therapy. No improvements were attributed to another treatment: integral stimulation therapy.

Square, Chumpelik, Morningstar & Adams (1986) compared the PROMPT method to integral stimulation therapy in three adult participants with acquired apraxia of speech and Broca's aphasia. They concluded that PROMPT was most effective in helping these participants to accurately produce functional utterances (98-100%), phoneme contrasts that were previously unmarked (i.e., 90-100%) and polysyllabic words (75-100%).

Freed, Marshall, & Frazier (1997) found that a severely apraxic-aphasic adult participant showed maintained production of words and phrases (i.e., 78.2%) after receiving PROMPT treatment.

Most recently, Bose, Square, Schlosser, & van Lieshout, (2001) used PROMPT treatment with an adult participant with Broca's aphasia and apraxia of speech. They found improved production of imperative and active declarative sentences but not of interrogative sentences. Correct production when the participant used imperative forms was as high as 75% (mean 42%) and for active declarative forms of sentences, production scores increased from 10% to as high as 55% (mean 49%). However, correct production of interrogative sentences remained at levels similar to baseline scores (ie., 24%). This was the first attempt by researchers to investigate the effectiveness of motor facilitation using PROMPT therapy for improving control of speech movements in utterances of varying complexity and different sentence types.

Impact of PROMPT on Developmental Phonological Disorder

One study, by Dodd & Bradford (2000), investigated the efficacy of different therapy methods for three boys aged 3-5 years who had two types of phonological disorders (i.e., consistent non-developmental phonological disorder and inconsistent phonological disorder). The therapy methods examined were: 1) Metaphon therapy: Phonological based rules about the contrastive use of phonemes were taught, 2) Core Vocabulary approach: A small vocabulary of words was taught with consistency of production as the goal rather than correct production, 3) PROMPT. Based on The Goldman-Fristoe Test of Articulation (Goldman and Fristoe 1986), phonological analysis, spontaneous speech samples, and the Test for Auditory Comprehension of Language – Revised (TALC-R) (Carrow-Woolfolk, 1985), The researchers determined that phonologically based Metaphon therapy was most successful for the child with the consistent non-developmental phonological disorder. The Core Vocabulary approach was most efficacious for the two boys who had an inconsistent phonological disorder. None of the children showed any improvement as a result of PROMPT therapy. The researchers concluded that therapy involving information about phonetic placement was not found to be effective for children with phonological speech disorders.

The studies in the present review were found to have some methodological and statistical weaknesses when examined. For example, the Square et al (1995) publication was very brief and did not provide enough information for the reviewer to critically investigate its methodology or results in any way. It will not be considered in the following critique.

Single-subject designs allow the researcher to evaluate whether a behaviour change has occurred and analyse whether those changes happened in response to the treatment. Most commonly, researchers plot the data points on a graph and visually analyse the results. It is also possible to statistically analyse the data in order to gain a more quantitative perspective of the data. Of the five research-oriented articles published in the literature, none used statistical analysis. Real data can be so variable that subjective determinations are often weak and unreliable. It is a concern that visual inferences may not be reliable enough to support all clinical decisions (Portney & Watkins,1993).

Mean values should always be shown on a graph of the raw data to reduce misinterpretation in this type of design (Portney & Watkins, 1993). All of the studies met this criterion except for Square, et al (1996); raw data was presented but was not plotted on a graph for visual analysis.

Baseline data should be stable or moving in a trend that is in a direction opposite to that expected during intervention before the intervention begins (Portney & Watkins, 1993). Square et al (1996) did not report sufficient baseline data for the reviewer to determine if this criterion was met. Freed et al (1997) conducted only one baseline probe before

PROMPT treatment began, and collected more baseline data in a sequence throughout the treatment phase of the study. It is not possible to determine the participant's true baseline performance under these conditions. All other researchers were considered to have collected appropriate baseline measures.

Dodd & Bradford (2000), Square et al (1996), and Freed et al (2001) reported interrater reliability using point-to-point reliability. This measure is adequate for use in single subject designs. However, by using the occurrence/nonoccurence reliability measure or by assessing chance agreement using the kappa statistic, the researchers would have found a more reliable measure of interrater agreement. Bose et al (2001) reported mean interobserver percent agreement, which is the least reliable interrater reliability measure available (Portney & Watkins, 1993).

Single subject designs are limited in their external validity. It is difficult to generalize the results of these kinds of studies beyond the behaviour of the single individual. The only way to demonstrate external validity in single subject research is by way of replication using other similar subjects in different settings (Portney & Watkins, 1993). The reviewer found that the literature was lacking in this area. More research needs to be done and published on the topic of PROMPT to increase its external validity.

PROMPT Therapy and Clinical Populations.

Based on the literature reviewed, it appears that a recommendation for the application of PROMPT therapy for use with adult aphasic clients to treat acquired apraxia is warranted. Further research on this topic, which improves on the methodological and statistical weaknesses of past studies, may provide clinicians with greater confidence in this proposal.

The review did not justify a recommendation for the use of PROMPT therapy with children with developmental phonological disorders. Dodd & Bradford (2000) argued that it is doubtful that a therapy method that focused on the motoric production of speech sounds (i.e., PROMPT) would have a significant influence on the speech of children with phonological disorders because it does not afford phonological information; such as the contrastive features of phonemes. This position should be received with the awareness that it is based on only one study and that future research may or may not concur.

Conclusions

The present review is of benefit to the clinical Speech Language Pathologist who intends to gain a better understand of the efficacy of PROMPT therapy and the populations appropriate for its application.

It seems that PROMPT has been effective for treatment of communication disorders involving motoric elements such as the execution of motor movements and motor planning (i.e., acquired apraxia of speech). Perhaps other communication disorders having a possible motoric component can be effectively treated with PROMPT. Future research involving the application of PROMPT for treating communication disorders such as dysarthria, articulation disorder or dysfluency may prove to be remarkable.

Future research should strive to include optimal methodological design and robust statistical analysis. Statistical analysis such as serial dependency and the test of significance using the split-middle technique are suggested. It is also important, especially in single subject design, that enough methodological and measurement information be presented in publications so that other researchers may replicate studies in order to increase the validity of conclusions. (Portney & Watkins, 1993).

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The efficacy of acute stroke dysphagia therapy

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This critical review examines the efficacy of post-stroke dysphagia therapy through analysis of previously conducted research studies. Study designs included: one-group repeated measures, randomized controlled trial (RCT), quasi-experimental design, nested design, and a one-group interrupted time-series analysis. Unfortunately, there is little consensus in the literature regarding the effectiveness of intensive swallowing intervention; evidence directly addressing this issue is lacking and inconclusive. Further research into the area of stroke rehabilitation, specifically dysphagia management and the amount and types of training needed must be explored.

Introduction

Stroke is a common and continuing problem with an annual incidence of affecting 2-4 per 1000 in a given population (Perry & McLaren 2003). As a result, stroke rehabilitation is becoming a considerable area for research involvement; acute stroke programs and clinical care pathways are being implemented in hospitals that include multi-disciplinary teams, "yet the potential of rehabilitation remains only partially realized" (Teasell et al. 2003).

Stroke is one of the most common causes of neurogenic dysphagia. Determined by the timing of assessment and the criteria used to diagnose dysphagia, the incidence fluctuates with most of the available data estimating swallowing abnormalities in approximately 30-65% of stroke survivors. Currently, there are no standard North American guidelines for stroke rehabilitation or dysphagia management; techniques vary across medical facilities.

Difficulties in deglutition can lead to subsequent disabling factors such as aspiration, airway obstruction, malnutrition, dehydration, pneumonia, or in some cases death. Thus, the high incidence of dysphagia in acute stroke when paired with its potential for life-threatening consequences makes identification of these patients, as well as the application of management strategies for assuming a safe oral intake, pertinent.

The management of neurogenic dysphagia consists of many techniques, including direct therapies, such as compensatory strategies (postural adjustments, diet modifications), and indirect therapies, such as oral-motor exercises and thermal-tactile stimulation. The primary goals of therapy are to establish optimal nutritional status and reduce or eliminate the risk of developing confounding medical complications. Unfortunately the efficiency of using training strategies has not been comprehensively explored (Lin et al. 2003).

Objectives

The primary objective of this review is to critically evaluate the current literature regarding the efficacy of dysphagia therapy following acute stroke. The secondary objective is to propose an evidence-based practice recommendation about the implementation of algorithms designed to guide and enhance rehabilitative therapy for the stroke survivor. Such an increase in quality of care will be evaluated in its potential to subsequently decrease inpatient length of stay (LOS) and overall health care costs.

Methods

Search Strategy

A search limited to articles written in English and between the years of 1990 and 2004 was conducted using computerized databases, including PubMed and CINAHL.

Selection Criteria

Studies included in this critical review were required to investigate the impact dysphagia therapy has on patient prognosis or the impact that the presence of dysphagia alone has on overall prognosis.

Data Collection

Results of the limited search produced the following study designs in congruence with the chosen selection criteria: one-group repeated measures (2), randomized controlled trial (RCT) (1), quasi-experimental design (1), nested design (1), and one group time series analysis (1).

Results

Design

The six articles included in this review each addressed one of two questions associated with the efficacy of swallowing therapy. Four of the articles (DePippo et al. 1994, Lin et al. 2003, Elmstahl et al. 1999, Runions et al. 2004) asked whether swallowing

therapy programs alter the prognosis of stroke patients and one article (Finestone et al. 2002) asked whether the presence of post-stroke dysphagia alters the prognosis of stroke patients. The Odderson et al. (1995) study applied a nested research design to address both variables.

A prospective and longitudinal study design was employed in all six studies. In addition, all were large scale designs with sample size varying in number from 30-124 participants. Overall, there was homogeneity of subjects both within and across studies. The average subject was male, in his seventies suffering a hemispheric stroke with an ischemic etiology. This description matches the norm as stroke affects more men than women and often occurs in the 7th decade of life. As well, an ischemic stroke is a more common etiology than hemorrhagic. Since each study used convenience sampling based in the hospital setting, the average stroke patient was validly represented.

Supportive Evidence

Impact of Dysphagia Therapy on Length of Stay

"Research has indicated that implementing clinical guidelines and algorithms improves dysphagia management and patient outcomes" (Runions 2004).

Four months after the implementation of a dietary management algorithm, descriptive comparisons from 30 medical records were reviewed by Runions et al., to assess the appropriateness of dysphagia management as part of a clinical pathway. Both nonparametric and descriptive statistics were used and it was found that patients with dysphagia were hospitalized more than 2.5 times longer than non-dysphagic patients. The differences in discharge dispositions between the two groups were also noted to be statistically significant ($p < 0.01$). Overall, 70.6% of patients improved swallowing function during hospital admission after being placed on an algorithm. Thus, the use of an algorithm was concluded to decrease the risk of complications, decrease LOS, and facilitate timeliness of total intervention (decrease in health care costs).

Although this paper was reader friendly and the findings were displayed in a straightforward fashion, unfortunately it had poor construct validity since it failed to measure what it purported; it did not primarily assess the effectiveness of an algorithm. The algorithm was not compared to any other data; there was no use of a control group or retrospective data from years prior to implementation. As such, maturation bias was not controlled for and it is therefore difficult to parse out what was a result of

the swallowing protocol versus what would naturally happen in any hospitalized patient.

In a similar study Odderson et al. also evaluated a clinical pathway; however its design validated the results more than the previous study. It utilized a nested design that retrospectively evaluated one-group using repeated measures over 3 different time periods (pathway year, pre-pathway year and year prior to pathway), while prospectively comparing dysphagic patients versus non-dysphagic patients along a number of variables.

The dysphagic patients (38.7% of 124 subjects) had longer LOS (2.0 days longer, $p = .05$), and were less likely to be discharged to the community. Overall outcome disposition was significant ($p < 0.05$) between the two groups, where patients without dysphagia were likely to be discharged to the community and patients with dysphagia were twice as likely to be discharged to a nursing home.

Dysphagia management was deemed an important part of acute stroke intervention since it was expected to result in fewer complications and decreased medical costs, while assuring quality of care and optimal outcomes for the patients.

Overall this study was easy to follow and the results were made clear by the data collected; furthermore, these findings were well accounted for as appropriate parametric tests were incorporated into this large scale study (inherently more powerful).

Impact of Dysphagia Therapy on Prognosis

Dysphagia training programs are also noted to improve swallowing function and nutritional status. The remaining studies focused on the physiological impact that dysphagia therapy has on stroke (which affects overall prognosis). For instance, Elmstahl et al. used videofluoroscopy (VBSE) as well as measures of nutritional variables on the same group of subjects at baseline and again after 2 months of swallowing therapy (direct and indirect). The findings from this study were interpreted to indicate an association between dysphagia treatment and improved nutritional outcomes in 60% of stroke patients. Swallowing functions improved after therapy and the overall VBSE score was reduced from 13.5 to 9.9 after treatment ($p < 0.01$). However, it should be noted that there is a potential attrition bias present in this study since the data was assessed using an 'on-protocol' analysis where groups are analyzed where they end up causing the 20% of the sample lost throughout the study to be unaccounted for.

In a double-blinded quasi-experimental study, Lin et al. also confirmed the efficacy of an interdisciplinary training program in improving swallowing function and nutritional status of stroke

residents. Seven hospitals were allocated to have patients be involved as either control subjects receiving no therapy over the eight weeks of the study, or experimental subjects receiving 30 minutes of swallowing therapy a day for 8 weeks.

This study revealed an improvement in swallowing function and speed, an increased body weight, and a decrease in coughing in those patients who received dysphagia management. It is an effective study with a strong design for testing the efficacy of swallowing therapy and valid application of nonparametric statistical tools; conversely, it would never be replicated in western countries where a 'no therapy' control group is deemed unethical. Study limitations were identified and it was pointed out that individual differences in residents were not considered and so some of the participants may have received more training than necessary (which would not be cost-effective).

Opposing Evidence

Standard of Care & Spontaneous Recovery

In addition to the previous intervention studies, the DePippo et al. study measured the efficacy of swallowing therapy using a randomized control trial (RCT). A 'standard-of-care' control group was compared to 2 other groups of subjects receiving graded levels of dysphagia therapy using pathological "study endpoints" as outcome measures. Log rank statistics were used to compare all three groups and it was concluded that some swallowing therapy is necessary; however since there were no significant differences between the 3 groups, intensive therapy may not be appropriate. Only 15% of patients developed any of the 5 target medical complications (endpoints) during their inpatient stay. However, the small number may be due to all patients having received some level of treatment.

Although this study applied the best design (a "gold-standard" RCT), the chosen outcome measures were a definite area of weakness. The dependent variables were all pathological in nature and perhaps additional measures such as qualitative or clinical measures (LOS, subjective reports, body composition, etc.) should have been included.

Finally, Finestone et al. used a one-group repeated measures design to observe the progression of a single group compared over time. This study was unlike the rest as it attempted to define natural recovery of swallowing without intervention. The natural history of swallowing recovery was analyzed on admission, at days 21 and 90. The dependent variables were dysphagia (based on diet type), dysphagia recovery (determined by an upgrading of the diet), and the presence of pneumonia as a complication of stroke. There were no statistical measures reported as this was a purely descriptive report. However, this is not necessarily a weakness of the study since a descriptive design is expected when observing a process such as natural recovery. The findings from this study indicate that 75% of patients will consume their pre-stroke diet by 3 months; therefore therapy is viewed as unnecessary.

Overall, the DePippo et al. study had the best design for addressing the issue of swallowing therapy, but the best outcome measures were included in both the Odderson et al. and Runions et al. studies which used outcome measures both in terms of pathological data, clinical, and qualitative data (LOS, outcome disposition, functional independence scores). The most productive study based on design as well as outcome measures was the Lin et al. quasi-experimental design, but it is unethical to replicate such a study.

Recommendations

Current literature providing evidence pertaining to the efficacy of dysphagia management is lacking. Four of the six articles reviewed were in support of extensive swallowing therapy and two were in slight opposition. However, none of the articles offered data sufficient to issue recommendations.

In the supportive evidence collected, the general recommendation appears to be that a standard swallow screen should be performed within 72 hours post-stroke. The information obtained from this initial screening should then be used to place the patient on a specific care pathway, including extensive dysphagia management as required. Swallowing therapy is collectively deemed a crucial part of stroke intervention since it is noted to decrease complications and improve speed of swallowing function. Increased quality of care is believed to benefit the general well being of patients and also result in a subsequent decrease in LOS and hospital costs.

However, the suggestion of all patients receiving swallowing therapy must be interpreted with caution. Individualized intervention is crucial; unique differences in residences must be applied to care protocol since some patients may end up receiving more training than necessary which is no longer cost effective.

The opposing articles claim that the recovery of swallowing function occurs regardless of the presence or degree of therapy. However, these articles do not provide glaring evidence upon which to base conclusions. In both studies, the patients may have recovered naturally or with standard care according to physiological measures, but other

important factors such as LOS or quality of life issues were not taken into consideration. Conceivably, patients will eventually recover without therapy, but with additional management of swallowing they may recover at a more rapid rate making it a cost effective endeavor in the long-term. A worthwhile undertaking would be for these studies to take their inquiries a step further so to include LOS and cost of care as additional outcome measures.

Conclusions

On the whole, the literature reviewed did not provide strong enough evidence in support of post-stroke intensive dysphagia management; however, it did provide insight as to how to go about further researching this crucial area. Perhaps the best way to determine the efficacy of swallowing therapy would be to apply a RCT design with outcome measures that make pathological as well as qualitative and clinical observations upon which to base conclusions. Additional studies of this magnitude are necessary to identify the effectiveness of various types and amounts of swallowing therapy for the stroke population.

Furthermore, despite the lack of overwhelming evidence in favour of post-stroke dysphagia management, there is sufficient support available in the selected literature to warrant further exploration of post-stroke algorithms that include dysphagia therapy as part of a rehabilitation protocol. For instance, within the current literature there is a noted and growing interest in the area of cost reduction within the health care sector. One of the proposals found in the research aiming to decrease costs is the implementation of care pathways that add structure to patient care and reduce the overall length of inpatient stay, thereby reducing costs. Two of the studies directly addressed this idea and by implementing a post-stroke algorithm they discovered a decrease in patient LOS by an average of 2.25 days. Although this may not seem like a significant reduction, an example may help clarify the potential this may have on individual hospitals: at London Health Sciences Center in London Ontario, the average stroke patient remains in the hospital for approximately 11 days with a full estimated cost of $10,697. This total, minus the one-time expense for ECG and CT ($167 & $268 respectively) can be divided by the amount of days spent in the hospital and gives an estimated average daily cost of roughly $932 dollars per day per patient (www.lhsc.on.ca/casecost/quality.htm). Thus, if only 5% of patients benefited from therapy, the hospital saves close to $10,000. This provides an example of a single hospital using only five patients sent home two days early; the implications this could

have on a decreasing health care costs can be inferred as quite substantial.

Ultimately guidelines should be implemented including a dysphagia management decision-making process to provide the highest quality care for acute stroke patients.

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The impact of subjective thickening methods on individuals with dysphagia

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This critical review examines the effects of subjective thickening methods on fluids for individuals with dysphagia. The studies were either experimental or quasi-experimental, with many of them employing either a repeated measures design or a factorial design. Overall, the majority of the research supports the use of more objective measures for thickening liquids. Specifically, the use of a viscometer or rheometer as an objective tool for thickening liquids was suggested. Alternative suggestions were also provided by some researchers. A cost-benefit analysis needs to be conducted to determine the most effective and feasible recommendations.

Introduction

According to Logemann (1998) videofluoroscopy is the most common method of assessment for the oropharyngeal swallow. It allows one to visualize the movement of a bolus throughout the swallow to assess which consistency of food and/or liquid is deemed the safest for the patient to consume. If the patient is given an unsafe consistency, he/she is at an increased risk for aspiration, and subsequently aspiration pneumonia or other medical complications. During the videofluoroscopic examination, the speech language pathologist (or other team member) prepares the food and/or liquid in a variety of consistencies adding barium to allow for observation on an x-ray. The samples are typically prepared subjectively, using visualization to determine when the product has reached the appropriate consistency.

According to Glassburn and Deem (1998), although clinicians may follow the thickening product's directions carefully, there are still extensive discrepancies in the amount of product that is required to attain a precise consistency. If the consistency achieved were deemed safe for the patient to ingest, due to the unregulated amount of thickener used, it would be difficult to replicate the consistency for the patient's mealtimes. If the videofluoroscopic liquids and mealtime liquids were not identical in viscosity the patient is at an increased risk for aspirating the material. One potential avenue for exploration is the use of objective measures for increasing the consistency for thickening liquids.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of subjective thickening methods on individuals with dysphagia. The secondary objective is to propose evidence-based practice recommendations about specific types of objective thickening methods as well as areas for future research.

Methods

Search Strategy

Computerized databases, including PubMed, and EBM Reviews, were searched using the following search strategy: ((Dysphagia) OR (Swallowing disorder)) AND (thickening) AND (viscosity) AND (objective) AND (subjective) AND ((rheology) OR (rheological))

Selection Criteria

The search was limited to articles written in English between 1992 and 2004. Studies selected for inclusion in this critical review paper were required to investigate the impact of thickening methods and/or types of thickening products on the overall viscosity of a liquid. No limits were set on the demographics of research participants or outcome measures.

Research Design

The studies examined were either experimental or quasi-experimental, with many of the studies employing either a repeated measures design or a factorial design. The studies utilized a moderate sample size ranging from 23 to 66 subjects. Cluster sampling was the most frequently employed sampling method, however in some studies convenience sampling and purposive sampling were used. The subject demographics appear to be lacking sufficient detail in the majority of the studies and were completely absent from others. Each study included a range of one to three outcome measures, and they were both qualitative (ie- 3-point ordinal scale) and quantitative (ie- density, yield stress, viscosity) in nature. Overall, it appears that the overall validity of this subset of the literature is

adequate. Increased outcome measures and information regarding patient demographics may help to increase the validity further.

Results

It was evident that the studies generally used appropriate tests and procedures for the analysis of their data. The studies utilized a combination of parametric and non-parametric tests for their data analysis, focusing on the association and interaction of the variables.

Evidence Supporting the Need for Objective Measurements

Overall, the majority of the researchers provided evidence to support the need for more objective measures for preparing thickened liquids. Glassburn and Deem (1998) and Cichero, Jackson, Halley and Murdoch (2000) established that there was a negative correlation between thickened liquids used for videofluoroscopic and mealtime purposes. It was determined, following a replication reliability analysis, that intrasubject reliability both within the same hospital as well as across hospital settings was poor. Although intersubject reliability was relatively better, there was still a large degree of variability in the resulting consistencies of the products.

Goulding and Bakheit (2000) found that the mean viscosity of the fluids in the control group (subjectively thickened liquids) was significantly higher than that of the study group (objectively thickened liquids). Thus the accuracy of the subjectively thickened liquids was unreliable. Reliability was found to increase when a viscometer was utilized.

The aforementioned studies all agreed that using objective measures were necessary to increase the reliability of thickening liquids. Specifically, they referred to using either a viscometer or rheometer as an objective tool for measuring various aspects of the products consistency. Mann and Wong (1996) also recognized the need for more objective measures for mixing liquids, however they suggested using the line-spread test as a cost-effective means for objectifying the process. Following a two-way analysis of variance they found significant differences between judges' subjective perceptions of various thickened liquids. However, when the line-spread test was employed, it was found that this method demonstrated a high degree of predictive validity, and was thus an effective tool for objectively thickening liquids.

Evidence Supporting Other Areas for Intervention

Although the majority of the examined literature produced data that favors more objective means for thickening liquids, select articles provided other suggestions for evaluation to make thickening liquids more consistent. Steel, Van Lieshout and Goff (2003) reported that objective means for thickening liquids were not completely necessary. They found significant correlations between clinicians' subjective rankings and the independent variables of viscosity, yield stress and density. Therefore, when adequate subjective means are utilized, liquids can be thickened to accurate consistencies.

Pelletier (1997) found significant two-way and three-way interactions following completion of both a one-way ANOVA and a multifactor ANOVA. This suggested that the effect of the thickeners on consistency of the product is based on the combination of time, type of liquid being thickened and the desired thickness of the product. Thus, variations in product consistencies may be present. Development of precise recipes for each type of liquid and each brand of thickener may be required to decrease the variability of the thickened products.

Recommendations for Future Research

The purpose of placing an individual on a modified diet is to provide him/her with a consistency that is safe for him/her to swallow and to reduce the risk of aspirating the material. Upon examination of the literature it is evident that reliability of the consistencies is variable when done using subjective methods, however the majority of the studies did not look at the effect of the bolus inconsistencies on the actual patient. Therefore, future studies should focus on determining the effects that small changes in the consistency of the liquid would have on the patient. Studies of this nature would allow one to determine if spending valuable resources on such tools as a viscometer or rheometer would in fact reduce incidences of aspiration pneumonia and subsequently overall health care costs.

Finally, when conducting research studies it is vital that the findings can be generalized to 'real-life' settings. In much of the literature that was examined, the testing was done when the products were at the 'optimal temperature'. Although this gives us an accurate indication of how the products function in an ideal situation this is not necessarily realistic to the hospital setting. Depending on when the patient receives his/her meal, the temperature may vary from being the 'optimal temperature' to being closer to room temperature. The changes in temperature may affect the consistency of the product and thus

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increase the variability from meal to meal. It is important for future research to examine the effect of time and temperature on the consistency of the product.

Recommendations for Clinical Application

The literature examined provided a lot of information that is directly related to clinical practice. First of all, the evidence from the majority of the studies indicated that more objective means are necessary for thickening liquids. By using subjective methods there were a lot of inconsistencies with intrasubject reliability, and even more vital, with intersubject reliability. Many of the studies indicated that using a viscometer and/or a rheometer greatly increased the reliability of the thickening method. As such, one must consider whether the cost of the solution outweighs the risks associated with subjective thickening methods. The potential costs associated with the inconsistent thickening of liquids may be far greater than the costs of a viscometer or rheometer. If a person begins to aspirate due to receiving a consistency that was not deemed safe, the individual may develop aspiration pneumonia. Medical costs associated with this illness (ie-increased length of stay in the hospital, blood work, swallowing assessments, modified barium swallow studies etc.) will likely far surpass the cost of the viscometer. Thus, even though the initial cost of purchasing a viscometer appears to be considerable, the long-term implications could be immense.

The use of prethickened products should also be considered in reducing variability associated with thickening liquids. Although this is a costly alternative, it ensures that products of reliable consistencies are being given to the patients. In addition, this would reduce preparation time for assessments and meals, allowing the clinicians to attend to more patients. A cost-benefit analysis should be completed to determine if this is in fact a feasible alternative.

Lastly, in the majority of the studies the speech language pathologists were responsible for mixing the liquids used for swallowing assessments. However, when a patient is in the hospital it is often the kitchen staff that is preparing the trays for mealtime purposes. As was previously mentioned, intra-clinician reliability is poor, and as such, one can presume that the reliability between the products produced by the kitchen staff and clinicians is equally poor. In order to minimize opportunities for discrepancies in bolus consistencies between assessment and mealtime fluids, having the kitchen staff prepare all fluids may be a viable option. It is recommended that a select group (that represents

individuals from each shift) be trained on how to accurately thicken liquids, and they will become the 'specialists' and the only individuals qualified to thicken the liquids. Although this will not eliminate the variability in consistencies, hopefully it will serve to decrease the inconsistency of the thickened products.

Conclusions

Upon examination of the results of the studies, it is evident that future research in the area of thickening liquids is necessary to continue to build on the aforementioned conclusions and fill in any gaps in the research. In particular, the effect of small changes in fluid consistency on individuals with dysphagia has not been established. This is important information if one is going to propose the need for funding for more objective tools to thicken liquids. In addition, to ensure the quality of the product does not fluctuate, research examining how time and temperature effect consistency is vital.

Given the overwhelming support from the literature that viscometers and/or rheometers should be used to thicken liquids, it is evident that objective means for thickening liquids should be adopted in the clinical setting. Additional methods of ensuring reliability of the products, such as using prethickened liquids and/or making certain that employees are trained appropriately may increase the uniformity of thickened liquids, however cost-benefit analyses need to be performed to determine the most feasible options.

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Effectiveness of intervention methods for those diagnosed with auditory neuropathy/auditory dys-synchrony

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This critical review examines the effectiveness of hearing aids and cochlear implants on those diagnosed with auditory neuropathy/ auditory dys-synchrony. Study designs include: longitudinal studies, clinical and case studies. Overall, research supports the effectiveness of hearing aids and cochlear implants on some individuals with AN/AD. However, due to complexity of disorder and large individual differences in habilitation, individualized treatment plans are highly recommended.

Introduction

Auditory Neuropathy (AN)/Auditory Dys-synchrony (AD) is a form of hearing impairment where outer hair cell function is intact, however afferent neural transmission is disordered (Rance et. al, 2002). Sininger 2002 estimates that AN/AD occurs in about 1 in 10 children who have hearing loss and severely abnormal ABR. Evidence of outer hair cells is shown through the presence of otoacoustic emissions (OAE) and/ or cochlear microphonics. The synchrony disorder is then indicated through the absence of neural activity at the auditory nerve through an abnormal auditory brainstem response result (Rance et. al, 2002).

Patients with AN/AD can have any degree of hearing loss, however many present a severe to profound loss (Sininger & Oba, 2001). Speech perception for those diagnosed with AN/AD prelingually varies considerably between patients (Rance et. al, 1999). Speech perception scores can be out of proportion to the degree of loss measured behaviorally (Sininger et. al, 2001).

It is fairly easy to predict speech perception and auditory capabilities from an individual diagnosed with a sensorineural hearing loss. This in turn allows for appropriate early intervention strategies to be implemented (Rance et. al, 2002). This intervention plan is prescribed with reasonable confidence based on the behavioral data from the audiogram. Early findings fail to show this correlation for those diagnosed with AN/AD (Rance et. al, 2002).

Due to this difference in hearing impairment, intervention strategies and their effectiveness are of question. Hearing aids and cochlear implants are two methods of intervention that provide benefit for only some individuals with AN/AD. Due to the complexity of the disorder and relatively new diagnosis, various treatment outcomes exist.

Individualized treatment plans are recommended for those diagnosed with AN/AD.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of intervention methods on those diagnosed with AN/AD. The secondary objective is to propose evidence-based recommendations on effective intervention strategies for those with AN/AD based on current literature available.

Methods

Search Strategy
Computerized databases, including CINAHL, PubMed. and PsyInfo.

Selection Criteria
Studies selected for inclusion in this critical review paper focused on benefits of hearing aids and cochlear implants for those diagnosed with AN/AD.

Data Collection
Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: longitudinal studies, clinical and case studies.

Results

Cochlear Implants
A study done by Shallop, Peterson, Facer, Fabry and Driscoll (2001) looked at children's speech perception performance pre-operatively and post-operatively (cochlear implants) in many different assessment techniques. Preoperatively the children were unable to discriminate speech with or without hearing aids. This represents a category 1 on the Early Speech Perception test. It was seen that all of

the children moved from the category 1 to category 4 postoperatively on the Early Speech Perception test. Three of the children had demonstrated open set word recognition on the Glendonald auditory screening procedure test. Four of the children had good EABR results. Therefore there was an improvement shown in speech outcomes postoperatively. The outcome therefore was shown by improvement in the five cases with respect to SAT, SRT, ESP and GASP speech tests used within the study.

Buss, Labadie, Brown, Gross, Grose and Pillsbury (2002) identified four individuals diagnosed with AN/AD between the ages of 2 and 3 years of age. Pre and post-operative speech scores were evaluated in order to measure the effectiveness of cochlear implants and speech perception. Preoperative assessments were conducted and anatomical and physiological differences were noted between subjects. Communication modes preoperatively differed between subjects. The Paden-Brown test was administered to measure speech outcomes post-operatively. Theses scores were then compared to a group of pediatric subjects who were implanted with a cochlear implant at 4 to 6 years of age without AN. Results show that three out of the four subjects fell within or slightly above the confidence interval one standard deviation around the control group mean. One subject fell more than one standard deviation below the mean, which was possibly due to the use of manual communication at home post-operatively (Buss et. al, 2002).

Hearing aids

Rance, Cone-Wesson, Wunderlich and Dowell (2002) performed a study to investigate the unaided and aided speech perception abilities of children with AN/AD and to compare their performance to children with sensorineural hearing loss. Two groups of children were tested, one group of subjects with AN/AD and one group of children with sensorineural hearing loss. Unaided and aided pure-tone tests as well as unaided and aided speech perception scores were measured. The history of amplification use, early intervention and communication strategies were documented.

With regards to speech perception, there was an obvious improvement with aided speech perception for those with sensorineural hearing loss. With regards to those with AN/AD, 7 of the 15 children showed no significant improvement in speech perception with the use of hearing aids. There was a lot of variability of aided speech scores amongst subjects with behavioral thresholds in the mild-moderate hearing loss range.

Conclusions

Auditory Neuropathy/ Auditory dys-synchrony presents many intervention challenges that are very distinct from those with sensorineural, conductive or a missed hearing loss (Doyle, Sininger & Starr, 1998). Amplification via hearing aids or cochlear implants provides assistance for most individuals with various hearing losses. AN/AD on the other hand, is a very complex disorder that is currently being greatly researched especially in the area of management and intervention strategies. "AN/AD is a disorder that affects neural processing of auditory stimuli that will reduce a child's ability to understand speech and may affect the ability to detect sound to various degrees" (Gravel, Hood, Lightfoot, Mason, Sirimanna, Stevens & Wood, 2004). Therefore providing amplification simply through hearing aids and cochlear implants is not successful for all individuals diagnosed with AN/AD.

Recommendations

Cochlear Implants

Research evidence supports the fact that cochlear implants are beneficial for many individuals diagnosed with AN/AD (Shallop et. al, 2001; Buss et. al, 2002). Many individuals with AN/AD who receive implants have similar outcome scores to other pediatric implant patients without AN/AD. Physiologic data suggest that the implant is able to overcome the de-synchronization hypothesized to underlie auditory neuropathy (Buss et. al, 2002).

Finally, all of the research evidence cited seems to agree that the benefits of cochlear implants for those with AN/AD is seen in most individuals. Due to individual differences, audiologists must be aware of the complexity of the disorder and the differences in success of treatment. Children with severe to profound sensorineural hearing loss are routinely implanted and the outcomes in these cases have been consistent with the outcomes of patients with sensorineural hearing loss (Trautwein et. al, 2000; Shallop et. al, 2001). Therefore cochlear implants being a permanent intervention method for those with AN/AD with severe-profound hearing loss, are recommended due to successful outcomes outlined within literature. Should we implant AN/AD children with mild to moderate hearing losses? This is an unanswered question within literature.

Hearing Aids

It is clearly seen that hearing aids do provide benefit for some pediatric patients diagnosed with AN/AD (Rance et. al, 2002). Keeping in mind that speech perception ability cannot be reliably estimated

from the behavioral audiogram in children with AN/AD, hearing aid prescriptions may be of concern when providing AN/AD children with appropriate gain (Rance et. al, 2002). Therefore it is usually recommended that a trial of hearing aids should be advised when counseling parents of these children, even though only some AN/AD children benefit from hearing aids. At this point we do not have a concrete understanding on which individuals will benefit from hearing aids and which individuals will not benefit from hearing aids. Because of this unknown finding, a hearing aid trial is usually advised in all individuals diagnosed with AN/AD. Hood (1998) has suggested that more conservative strategies such as monaural fittings, and/or low gain devices should be prescribed for an individual with AN/AD. This strategy is advised due to the fact that speech perception ability cannot be reliably estimated from the behavioral audiogram in children with AN/AD.

Therefore hearing aids as a non-permanent alterative option is advised for most or even all individuals with AN/AD. Literature has shown that some individuals with AN/AD do gain benefit in speech discrimination and audibility of sounds from hearing aids.

In conclusion, it is strongly recommended that hearing aids be prescribed for most or all those diagnosed with AN/AD. Whether the individual benefits from hearing aids is individual specific. Amount of amplification and degree of loss may have an affect of hearing aids. Based on clinical studies and case studies, conservative hearing prescriptions should be given when programming hearing aid(s) (Hood, 1998). If hearing aids are not providing benefit, research evidence has recommended that cochlear implants are an alternative method of amplification for some individuals with AN/AD.

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Impact of writing therapy on functional communication in persons with aphasia

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This critical review examines the effectiveness of writing therapy in improving functional communication in people with aphasia. Study designs include: single case study, a within-subject control design and single-subject multiple- baseline case series design. Overall, research supports the use of writing therapy to improve functional communication in persons with aphasia; however due to the presence of serious design, methodological and measurement flaws, limitations to this conclusion exist.

Introduction

People with acquired aphasia present with a range of communicative abilities. Some individuals experience difficulties with spoken and written language because common language processes are impaired (Robson et al., 2001). Understanding the language deficit is a prerequisite for therapy and aids in the choice of alternative modes of communication. It is often assumed that writing skills will be as impaired as speech, since it requires access to phonology; however a review of language processing models has shown that writing may be achieved by direct access to orthography without phonological mediation (Jackson-Waite et al., 2003). Research has revealed the importance of writing as an alternative route to communication in people with non-fluent aphasia (Armstrong et al., 2000, Beeson et al., 2002, Jackson-Waite et al., 2003 & Robson et al., 2001).

A range of treatment approaches are available for the remediation of acquired writing impairments in aphasia. These treatments range from cognitive neuropsychological approaches to less traditional computer-based treatments. Four types of writing therapy are addressed herein. These include the use of prosthesis and computerized trials, Anagram and Copy Treatment (ACT) paired with Copy and Recall Treatment (CART), use of a Lightwriter, and Written Naming and Message Therapy to improve written expression. Research has not yet identified a universally superior type of writing therapy that improves functional communication in persons with non-fluent aphasia.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of writing therapy in improving functional communication in individuals with aphasia. The secondary objective is to propose evidence-based practice recommendations about the use of writing therapy in this population.

Methods

Search Strategy

Computerized databases including PubMed, Proquest and Psychinfo, were searched using the following search strategy:

(Aphasia) OR (dysphasia) AND (Writing)
AND (Therapy) OR (Writing) AND
(Functional) AND (Communication)

The search was limited to articles written in English between 1995 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of any type of writing therapy on functional communication in individuals with aphasia.

Data Collection

As per the selection criteria mentioned above, results of the literature search yielded several studies on this topic, however the following types of articles were selected: single case study (1), a within-subject control design (2) and single-subject multiple-baseline case series design (1).

Results

Impact of Prosthesis and Computerized writing therapy on functional communication

Prosthesis trials

The subject's dominant but hemiplegic arm and hand was aided with a mousepen and splint prosthesis, which was used to obtain writing outcome measures. Following prosthesis trials, results from subtest of the Test of Word Knowledge (TOWK) revealed that the subject's word definitions consisted

of longer, ungrammatical sentences with some semantic errors (e.g. 'write' for 'send'). Spelling errors accounted for 18.75% of total words compared to 35% of total words pre-prosthesis trials. The subject's Western Aphasia Battery (WAB) picture description was twice as long as compared to pre-prosthesis, containing 40 words and three sentences (9, 15 and 15 words per sentence) with no spelling errors. Spelling of regular words in the writing subtest of the Psycholinguistic Assessment of Language Processing (PALPA) was slightly better (18/20) than at baseline but the subject's score did not improve on exception words. Many of the errors consisted of letter omissions with only one letter addition. Vowel errors were also evident (Armstrong et al., 2000).

Computerized trials

A word-processing programme that provided auditory feedback and word and grammatical prediction was used to aid written language expression. Results post computerized trials revealed that TOWK word definitions were more complete grammatically and longer than at base-line assessment. Some spelling and grammatical errors were still evident (8% of total words – 10% less than when he was aided with the prosthesis). The subject's WAB picture description was three sentences long (39 words -5, 14 and 20 words per sentence) and contained two errors (5% of total words). His spelling performance on the writing subtest of the PALPA shows a slight improvement for regular words and an almost 100% improvement in his score of exception words (Armstrong et al., 2000).

At follow-up, when evaluating impact of prosthesis versus computerized trials, it was found that the subject chose to use the computer to write letters with the aid of the word-processing program (Armstrong et al., 2000).

Impact of ACT and CART writing treatment on functional communication

Written spelling

Following ACT and CART writing treatment, the subject was re-assessed using the PALPA subtests which included words that had not been trained. All four subjects showed little or no improvement in written spelling for untrained words. However, during treatment, one subject showed a notable increase in his attempts to spell untrained words in the context of group therapy. He showed increasing ability to write the initial portion of words and to spell some words that had not been targeted for treatment (Beeson et al., 2002).

Functional use of writing:

All four subjects showed functional changes in their use of writing for communication. Subject 1 began to copy words from his communication book and other sources in order to communicate specific information. He learned to write the names of his physicians and appropriately communicate an upcoming appointment to his clinician by writing the physician's name. He also showed increased use of his communication book to point to written words to clarify on-line communication with the clinician. At follow-up, clinical records showed the acquisition of an additional 20 words (including nouns and verbs) over the course of 12 weeks (Beeson et al., 2002). Subject 2 increased his attempts to use writing to communicate in group and individual therapy sessions, with improved effectiveness in those attempts. The subject demonstrated increased word form knowledge for untrained words. At a thirteen month follow-up, he continued to target new words to learn and use in written communication (Beeson et al., 2002). Subject 3 showed improvement in spelling that was adequate to get the subject started while using email. The subject copied the spellings for untrained words from written sources or obtained help from family members. He wrote the messages by hand and then typed them into the computer. His e-mails were agrammatic but meaningful, and had the benefit of evoking a response from the recipient (Beeson et al., 2002). Subject 4 increased his use of writing during conversation (Beeson et al., 2002).

Impact of the use of a Lightwriter on functional communication

Access to orthographic information

The increase in treated words correct after therapy (19) compared to pre-therapy (1) was significant (p<.001). No change was seen in the control words. Handwritten words written correctly increased from 1 pre-therapy to 6 post-therapy with 16 items written partially correct. Eight weeks later, performance had declined to 11 treated words correct compared to 19 post-therapy. Nonetheless, this remained significantly better than before therapy (p<.01). The increase in treated words partially correct post-therapy (14) compared to pre-therapy (7) indicates retained access to the orthography of treated words (Jackson-Waite et al., 2003).

Generalization of written vocabulary

After therapy, 20 words from the treated list were correct as compared to only three from before therapy. The difference was significant (p<.001). Partially correct and first letter responses also increased. At follow-up 8 weeks later, the subject

produced 14 items correct which is significantly more than before therapy (p<.01) (Jackson-Waite et al., 2003).

Functional communication with a Lightwriter

In a questionnaire designed to resemble a conversation (e.g. Where are the nearest shops?), the number of questions answered on the Lightwriter increased significantly from 2 before therapy to 12 afterwards (p<.05). Of the 12 correct items, 7 were from a list of untreated words. Nonetheless, the subject needed prompting to use the Lightwriter and rarely made functional use of it outside the clinical setting (Jackson-Waite et al., 2003).

Impact of Written Naming and Message Therapy on functional communication

Written Naming and Message therapy

All six subjects made more correct responses after therapy. Four showed significant gains (p<0.05) on the treated words after therapy and two remained significantly better at follow-up (p<.05). Many errors were approximations to the target word. All subjects made a significant improvement on the number of correct letters in responses (Robson et al., 2001). Only one out of the six subjects failed to show significant gains at the follow-up assessment a month later. No subject made gains on the untreated vocabulary (Robson et al., 2001). After Message therapy all subjects increased their correct responses to treated items, but only the gains of one subject were found to be significant (Robson et al., 2001).

Functional use of writing:

Following therapy, all subjects used writing spontaneously during conversations about contemporary events, holidays and family in therapist-led sessions. Three subjects produced recognizable approximations to treated words, such as the names of a son and grandchild when describing family to a volunteer. On other occasions, subjects used untreated words. At three months follow-up, caregivers reported that subjects were using writing with other conversational partners (Robson et al., 2001.

Discussion

Overall results from these studies support the use of writing therapy to improve functional communication in persons with non-fluent aphasia (Armstrong et al., 2000, Beeson et al., 2002 & Robson et al., 2003). In the interpretation of their findings, some authors provided cautionary notes and addressed issues of clinical versus statistical significance. Essentially this promotes the use of writing therapy clinically. However it is important to note that findings from a critical appraisal of these studies display serious design, methodological and measurement limitations that are significant enough to potentially have a major impact on these findings. These limitations include: the selection of a research design, sample size, outcome measures and measurement tools.

Research Design: The selection of single case studies and single subject multiple baseline research designs provide the lowest level of research evidence. These are subject to numerous threats to validity that the researchers did not control for (Portney & Watkins, 2000). This resulted in the presence of several biases and confounding variables such as the influence of multi-stage treatments and other concurrent treatments, testing effects, subject maturation, experimenter bias and the Hawthorne effect. The uncontrolled threats to design validity present in these studies may show statistically significant positive outcome measures for writing post-therapy, which may not be a true effect of the intervention (Herzberg, 1983). Only two of the four studies clearly stated who administered the therapy (Beeson et al., 2002 & Robson et al., 2001). Therefore, findings from all four studies must be interpreted with caution because of increased risk of subjectivity embedded in its' analysis.

Subject size: Due to the nature of the research designs employed, the very small sample size and lack of control group can only provide evidence for the efficacy of a specific writing treatment with a specific person with aphasia. As a result, these studies do not possess high external validity and the outcomes cannot be generalized to other individuals or situations (Portney & Watkins, 2000).

Outcome measures: Researchers did not include outcome measures of variables that fully encompass functional communication. Measures such as the frequency and/or type of grammatical and spelling errors made, the subjects' success rate in communicating a message through the use of writing, and the use of written communication to share abstract ideas, feelings and emotions were not collected. It is possible that these additional outcome measures were not considered due to the absence of an operational definition of functional communication in the literature.

Measurement tools: There were limitations in the selection of measurement tools to measure written output for functional communication. Some researchers used findings from informal, unstructured clinical interactions to comment on generalization and use of writing for functional purposes with minimal empirical data to support their claim

(Armstrong et al., 2000 & Robson et al., 2001). Since these tests are not standardized their psychometric properties are unknown, moreover the authors did not address this as a concern. Other studies utilized subtests from standardized tools to measure writing outcomes (Armstrong et al., 2000 & Beeson et al., 2002). However, the reliability and validity of the subtests administered in isolation were not stated, therefore the outcome measures obtained cannot be accepted with full confidence. Overall, these measurement tools alone fail to adequately evaluate communication for functional purposes. Researchers did not include rating scales or other tools that would enable the subject and his/her communication partner to evaluate their success in conveying a message through the use of writing. Researchers may not have reported such positive results had they controlled for the design and methodological limitations mentioned above.

Given the research design, sample size and type of outcome data collected, three out of the four studies utilized an appropriate method for analysis of the results (Armstrong et al 2000., Beeson et al., 2002 & Jackson-Waite et al., 2003). Robson et al., (2001) inappropriately employed parametric statistics on categorical data (Portney & Watkins, 2000). Researchers from only two of the four studies explicitly stated cautionary notes about their result findings (Beeson et al., 2002 & Robson et al., 2001). The overall findings for the functional use of writing was predominately restricted to treated words only and required a familiar communication partner and/or context for its' interpretation. This presents with obvious limitations for use in everyday communication. In order to provide evidence based support for the use of writing therapy with this population, future research should adequately address these limitations.

Conclusions

Research has revealed the importance of writing as an alternative route to communication in people with non-fluent aphasia (Armstrong et al., 2000, Beeson et al., 2002, Jackson-Waite et al., 2003 & Robson et al., 2001). Three of the four studies examined report results that suggest the use of writing for functional communication purposes after writing therapy was administered (Armstrong et al., 2000, Beeson et al., 2002 & Robson et al., 2001). However, all four studies had serious design, methodological and measurement limitations that were significant enough to potentially have a major impact on the results reported.

To support the clinical use of writing therapy to improve functional communication in this population, rigorous research that effectively addresses these limitations is needed. Future research should operationally define 'functional communication' so that suitable outcomes are measured. Furthermore, research should implement measurement tools that appropriately measure this outcome. A larger N size would be ideal since it would take in to consideration the level of confidence, margin of error tolerated, and variability in the population studied (Herzberg, 1983). Overall, this cohort would be more representative of the target population and would result in greater external validity and thereby increased general utility (Portney & Watkins, 2000).

In the meantime, it would be recommended to use writing therapy with this population as it provides these individuals with a valuable means to communicate. However, in order to provide evidence based support for the clinical use of writing therapy to improve functional communication in people with aphasia, future research should adequately address the research limitations mentioned herein while reporting positive writing outcomes for functional communication.

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Understanding the constructs underlying narrative comprehension in young children: The role of vocabulary

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This study examined the role of vocabulary comprehension in young children's comprehension of a script-based narrative. Twenty-nine normally developing children between 30 and 70 months completed two vocabulary tests, the PPVT-III, and a story-specific test, a memory measure, and two measures of narrative comprehension. Analyses revealed that story comprehension was more strongly correlated with general vocabulary comprehension than with specific story vocabulary knowledge, a finding consistent with the view that vocabulary comprehension is an index of fundamental language ability. However, when memory was controlled for the relationship between the PPVT-III and story comprehension was nonsignificant, suggesting that memory may be the key construct underlying both abilities in young children.

Written measures of voice handicap:
A concurrent validity assessment of the VHI & VRQOL

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The relationship between two written measures of voice handicap and voice-related quality of life was assessed. Sixty-five individuals seen for initial voice evaluation completed the 30-item *Voice Handicap Index* and the 10-item *Voice-Related Quality of Life*. Correlational analysis between the two instruments indicated a strong relationship. Results will be discussed relative to the clinical application of these instruments.

Quantifying acoustic signal variability in adductor spasmodic dysphonia (ADSD)

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This presentation outlines inherent limitations related to the interpretation of acoustic measures gathered from abnormal vocal signals generated by individuals diagnosed with focal laryngeal dystonia. Contiguous measures from multiple tokens of sustained vowels (/a/, /i/, /u/) were gathered from 6 participants diagnosed with adductor spasmodic dysphonia (ADSD). Data pertaining to standard deviation of fundamental frequency, frequency and amplitude perturbation, and noise-to-harmonic ratio are presented.

Voice-related quality of life in alaryngeal speakers

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This project assessed use of the *Voice-Related Quality of Life* (VRQOL) in a group of 50 laryngectomized speakers. Participants completed this validated, 10-item questionnaire from which social-emotional, physical functioning, and total scores were calculated. Findings revealed differential scores in each domain by alaryngeal speech type and gender. The implications relative to rehabilitation will be outlined.

Music therapy and its effect on verbal expression in dementia

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This critical appraisal discusses the effect of music therapy (MT) on the verbal expression of individuals who have dementia of the Alzheimer's type. The studies include: one group pretest – posttest, and quasi-experimental designs. At this time, strong research evidence to support the use of MT as a means of improving verbal expression in the target population is limited.

Introduction

The number and proportion of individuals over the age of 65 has been climbing steadily in North America due to life expectancy changes and demographic characteristics (Koger et al., 1999). As a consequence there are increasing demands to gain a greater understanding of the specific social, psychological and physical needs of this aging population (Brotons et al., 1997). Dementia is characterized in the American Psychiatric Association's Diagnostics and Statistical Manual - IV (DSM-IV) (1994) as a syndrome comprised of impairment in cognitive functioning, including deficits in language (aphasia), short- and long-term memory, judgment, abstract thinking, and changes in personality. These impairments may interfere with an individual's daily activities (i.e. work, social activities, and relationships). Dementia of the Alzheimer's type (DAT) is the most commonly diagnosed, followed by multi-infarct dementia, and mixed dementia (i.e. combination of DAT and multi-infarct types) (Brotons & Koger, 2000; Grasel et al., 2003). The prevalence of dementia increases with age, and subsequently the elderly make up the largest population affected by it. By the year 2040, it is estimated that 12 to 14 million individuals will be affected by dementia (Brotons et al., 1997). There is no known preventative measure or cure for dementia, and drug therapies have limited effectiveness (Grasel et al., 2003). For these reasons, the examination of the role of non-drug therapies, including music therapy, is critical if health professionals wish to address the needs and quality of life of this growing population.

Music therapy for individuals with dementia consists of a range of activities from passively listening to music to musical improvisation exercises (Grasel et al., 2003). Researchers have found that despite their limitations, individuals who have dementia continue to respond to and sing old songs, and dance to old melodies (Brotons et al., 1997). It is postulated then, that music therapy helps individuals with dementia compensate for their deficits by providing them with a means of expressing themselves (Grasel et al, 2003).

Objectives

The objective of this review is to critically examine a sample of literature focusing on MT as a means of facilitating verbal expression in dementia. Recommendations regarding the use of MT within speech-language pathology, and avenues for future research will also be discussed.

Methods

Search Strategy

Computerized databases were searched, including EBM Reviews, PsycInfo, and ProQuest Psychology Journals. Keywords used include:

> (dementia) OR (Alzheimer's) AND (music therapy) OR (music*) AND (verbal expression) OR (language) OR (communication) OR (social skills).

The search was limited to articles written in English.

Selection Criteria

The studies included in this critical appraisal were required to examine the effect of any type of music therapy on the expressive communication among individuals with dementia of the Alzheimer's type. No restrictions regarding outcome measures were applied.

Data Collection

The results of the literature search yielded the following study types: one group pre-test post-test designs (2), and quasi-experimental designs (2).

Results

In their study, Olderog Millard and Smith (1989) used a single group, reversal *ABABA* design, where condition *A* was a discussion session, and condition *B* a singing session. One of their hypotheses was that

social behaviours, including verbal participation, would be significantly higher during and/or immediately after singing, rather than during or after discussion sessions. Outcomes were measured using a frequency of social behaviour checklist created by the authors. The researchers used a 2-way (*A* x *B* x Subjects) within subjects ANOVA to analyze the data. This analysis revealed that the amount of vocal/verbal participation was significantly higher (p < .05) during therapeutic music sessions than during discussion sessions. No significant increases in verbal behaviours following music therapy versus discussion were reported. Reportedly, the significantly increased verbal participation during music therapy, as compared to the discussion condition, can be attributed to the fact that, although several subjects rarely spoke, they did sing when given the opportunity. The music therapy therefore encouraged the subjects to participate more in the session.

Brotons and Koger (2000) used a within-subjects counterbalanced design to explore the effects of MT versus discussion on language ability outcomes in 26 people with dementia. They hypothesized that MT would significantly affect language functioning as measured by the Western Aphasia Battery (WAB). To analyze the data, the researchers used a 2-way repeated measures ANOVA. They reported significant main effects for music versus discussion (p=.01), with significant improvement in the speech content and fluency dimensions of the spontaneous speech subscale following MT (p=.004). Performance in the fluency dimension was significantly better than the performance in the content dimension across both conditions. This finding supports previous reports of fluency being preserved longer than content in dementia. No significant interaction was calculated between music and conversation conditions. In addition, no significant differences in the Aphasia Quotient or in auditory-verbal comprehension were found. An effect size for overall Aphasia Quotient differences between condition was calculated as r = .257. This effect was not significant; however the researchers hypothesized that this effect may be clinically significant.

Pollack and Namazi (1992) employed a one-group pretest-posttest design to evaluate the effectiveness of MT on social behaviour outcomes, including verbal interaction. A behaviour frequency checklist was used to measure the outcomes before and after treatment. A Chi-square test revealed a significant increase of 24% in social behaviour (p<.001), and a significant decrease in non-social behaviour of 14% (p<.001). When raw scores were compared, increases were observed in all types of

social behaviour, including verbal behaviour. It was not reported whether this increase was statistically significant. The greatest gains were observed for nonverbal social behaviours. Narrative observations that the observer made during MT sessions, revealed that subjects were generally cooperative and displayed increased verbalization and positive verbal feedback. These observations were not quantified by the behaviour checklist.

Sambandham and Schirm (1995) hypothesized that planned music sessions would exert a positive change in subjects' communication and socialization skills. A one-group pre-test-posttest design was used to compare differences in the frequency of social behaviours, including verbal expression. These behaviours were measured using the Music Therapy Assessment Tool before, during, and after music sessions. Statistical analysis was conducted using an analysis of variance (ANOVA). The ANOVA revealed significant differences among subjects' verbal behaviours. Subjects talked less during the music sessions, compared to before and after the sessions. Significantly more resident verbalizations and non-verbal expressions were recorded during the 20-minute observation time-frame, following the music sessions, as compared to before and during the sessions.

Discussion

Appraisal of the Results

At first glance the research evidence appears to indicate that MT does have a positive effect on behaviours related to verbal expression in individuals with dementia. However, numerous issues in regards to subject selection, methodology, and statistical analyses exist in the literature. These issues negatively impact the strength of the evidence.

Subject Selection

The most notable issue with the kind of sampling that the researchers have used in all the studies examined, is that there was a lack of random selection. Without random selection from the dementia population, one must be sceptical as to whether the samples taken were representative of the greater population of individuals who have dementia. This ultimately affects the generalizability of their results.

Methodology

It is important to interpret the results of each study with caution, as there are methodological flaws associated with each study. There are sources of bias that may have influenced the evidence described. For example, in 3 of the 4 studies the investigators did

not use blind observers (Olderog Millard & Smith, 1989; Pollack & Namazi, 1992; Sambandham & Schirm, 1995). The unconscious expectations of the observers may have accounted for the differences displayed in the results. Other explanatory factors introduced by weak research designs may have accounted for some of the results. For instance, in the studies that utilized one group pre-test post-test designs (Pollack & Namazi, 1992; Sambandham & Schirm, 1995) threats to internal validity, or social interaction with the therapist or others, may explain or have influenced the results. Furthermore, it is questionable as to whether the outcome measures used, fully capture the construct of verbal expression, and whether these outcomes are clinically important in terms of the functional communication and quality of life of individuals who have dementia. In addition, the measurement tools used to quantify the outcome measures may not have been appropriate, reliable, or valid. For instance, Brotons and Koger (2000) used the WAB to measure language ability in their subjects following MT. However, the WAB was standardized on individuals with aphasia, excluding those with concomitant dementia. Whether it was appropriate to use the WAB with this population can be called into question.

Statistical Analyses

Some of the investigators may have chosen inappropriate statistical procedures to test the significance of their data. For example, Sambandham and Schirm (1995) conducted an ANOVA on data that was ordinal in nature. A non-parametric test should have been used, such as the Wilcoxon T Test for dependent samples (Morgan & Griego, 1998). Errors such as this weaken the statistical validity of the reported evidence.

Recommendations

It is difficult to have confidence in the evidence described, due to issues in subject selection, methodology, and statistical analyses. It is also challenging to make comparisons across the studies because of differences in MT approach, research design, and selected outcomes. Due to issues found within and across the studies, it is unwise at this time, to attempt to make overall generalizations regarding music therapy's effects on verbal expression in people with dementia. Whether MT is an effective means of improving verbal expressive outcomes in this population needs to be further specified. Until stronger evidence is made available to support its use, it is not recommended that MT be integrated within speech-language therapy for adults who have dementia, for the sole purpose of improving

expressive language. It is recommended that more research, including replication of previous studies, be conducted to clarify this research problem. Furthermore, researchers working in this area are strongly encouraged to:

a) Delineate the optimal type/approach, frequency, and amount of MT required to induce positive change in individuals who have dementia (i.e. operationally define what conventional MT should be for adults with dementia).

b) Use outcome measures that fully encompass the construct of verbal expression, and that are believed to be clinically significant.

c) Employ measurement tools that are reliable, valid, and standardized on the population of interest.

d) Apply data collection practices that minimize potential sources of bias (e.g. blind observers).

e) Utilize strong research designs to minimize possible sources of bias and/or confounding factors.

f) Specify further what symptoms associated with dementia are most amenable to change. For instance, MT may have a more significant impact on aggression, caregiver burden, or social skills, than on verbal expression. Olderog Millard and Smith (1989) and Pollack and Namazi's (1992) results suggest that MT may facilitate social participation.

Limitations

It should be noted that there are limitations to this critical review. First, the review focused on only a sample of the research available. Only studies written in English and available in the published literature were included in the review. This review was by no means exhaustive, which introduces the possibility that some significant research may have been missed. Secondly, the information reported in the literature and discussed above, can only be applied to individuals in the middle/moderate to severe stages of dementia of the Alzheimer's type, who are institutionalized, and not to those with mild dementia, other diseases of the brain, or to individuals with dementia who are living at home.

Conclusion

It can not be said that MT is not a useful treatment, and should never be integrated into speech-pathology practices. The investigators did find significant results. However, it is difficult to

have confidence in the evidence because of issues relating to outcome measures, research design, data collection methods, and statistical analyses. In time, it may be demonstrated that MT is an effective means of facilitating verbal expression in dementia. MT, with further research, could be indicated as a way of improving other communication based outcomes such as social participation and/or verbal fluency (Olderog Millard & Smith, 1989; Brotons & Koger, 2000). Finally, MT may induce positive change in other populations that speech-language pathologists often encounter (e.g. children who have autism) (Bronte-Tinkew & Magill, 2004). MT's utility as a way of improving communication cannot yet be ruled out.

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Is there evidence to support treating language with intensive behavioral intervention programs such as ABA in children with autism?

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This critical review examines the effects of treating language using an intense behavioral intervention program for children with autism. Study designs include: between-subjects, one group pre-test post-test, case study, within-subject longitudinal and comparison study. Overall, research supports that intense behavioral intervention is effective in increasing language and cognitive development in children with autism; however, future research needs to address whether a combination of intervention modalities is as effective as intense intervention alone.

Introduction

In the 1960's Dr. O. Ivar Lovaas from UCLA developed a type of intervention to treat children with autism derived from the principles of behaviorism described by B.F Skinner. He coined the term Applied Behavioral Analysis (ABA) to describe this type of treatment (Rosenwasser and Axelrod, 2001). This type of intervention incorporated terms and principles of behaviorism to treat communicative, cognitive and social impairments, aggressive behaviors as well as any other impairments present in children diagnosed with a pervasive developmental disorder.

Applied Behavioral Analysis is an intense structured teaching program that involves eliciting desired responses from the person with autism. The basic concept of ABA is that responses are taught using repeated trials where the child is presented with a stimulus (like "pick up the toy"). Correct responses and behaviors are rewarded with positive reinforcement such as praise, stickers or treats. When incorrect or undesirable responses occur, they are ignored and appropriate responses are prompted and rewarded (Ogletree and Oren, 2001).

Currently, controversy exists surrounding the behavioral approach to language treatment. Controversy surrounds the amount of time necessary for intervention, the age at which intervention is most effective, home-based vs. school-based and finally, whether these children benefit from a combination of treatment modalities.

Objectives

The primary objective of this paper is to critically evaluate existing literature to determine whether there is evidence to support treating the language of children with autism with intensive behavioral intervention programs such as ABA as well as look at the controversy surrounding this. The secondary objectives are to propose evidence-based practice for future research looking at using an intense behavioral intervention method with children with autism.

Methods

Search Strategy

Computerized databases, including PubMed and Proquest were searched using the following strategy:

> (behavioral intervention) OR (ABA) OR (applied behavioral analysis) AND (language) OR(communication) AND (autism) OR (pervasive developmental disorder).

The search was limited to articles written in English between 1987 and 2004.

Selection Criteria

To be included in this critical review, studies must have investigated the impact of any type of intense behavioral intervention on language outcomes for children autism. No limits were set on the demographics of research or outcome measures.

Data Collection

Results of the literature search yielded the following types of articles: between- subject design (1), one group pre-test- post- test design (1), case study (1), within- subject longitudinal design (1) and comparison study (1).

Results

Impact of Intensive Behavioral Intervention on Language Outcomes

Educational Placement and IQ

Completion of an intense behavioral intervention (40 hours a week for 2 years) looking at educational placement and IQ scores (which includes language

scores) pre and post treatment resulted in significant improvements (p<.001) for educational placement and (p<.01) for IQ in a sample of 19 children aged less than 46 months. (Lovaas, 1987).

Overall, 47% of children in the experimental group passed through normal first grade with an average of 30 points gain in IQ. Lovaas also found that mental age was significantly (p < .03) related to outcome in both groups. These results suggest that a child with a lower mental age (more severe autism) will most likely benefit from intense behavioral intervention.

Home-Based Intervention Rates of Skill Acquisition

Weiss (1999) studied a home-based behavioral intervention approach (with parents trained to provide 40 hours of instruction per week for 2 years) looking at the acquisition rate of non-verbal imitation, object manipulation, identical object matching, receptive commands and receptive labels. Among 20 children receiving early intense behavioral intervention, the acquisition rate of the above variables compared to the overall rate of skill acquisition was (p < .001). The acquisition rate of these variables was correlated with changes in adaptive functioning and in the severity of autism. This suggests that children who learned quickly showed the greatest changes in autism severity and adaptive behavior.

Overall, the study demonstrated that intense behavioral intervention was beneficial for children with autism, however more improvements may have been observed in those children exhibiting difficulty in skill acquisition had intervention incorporated other behavioral approaches such as the Picture Exchange Communication System (PECS).

High-risk children and language development

A Case Study by Green et al. (2002) was done to determine whether intense behavioral intervention would improve the intellectual functioning of a child with high-risk of developing autism. Over the course of 4 years, the child made large gains in receptive and expressive language as well as social and cognitive skills. She progressed from exhibiting substantial delays in multiple areas to functioning at or above age level in all areas. These results suggest that intense behavioral intervention was successful in increasing the child's intellectual and cognitive abilities to a level of function appropriate to her chronological age (Green, Brennan & Fein, 2002).

Intellectual Functioning and Home-Based Intervention

Sheinkopf & Seigel, (1998) evaluated the impact of intense behavioral intervention on IQ scores on children with autism when implemented by parents. Comparisons of IQ scores between 11 children between the ages of 23-47 months yielded results of (p < .01) post-treatment. This suggests that intense behavioral intervention is effective in treating children with autism, even when implemented by parents trained in behavioral intervention.

Behavioral vs. Eclectic Intervention with older children

Eikeseth et al. (2002) compared results of behavioral intervention implemented at school vs. other traditional intervention methods such as Project TEACH and sensory-motor therapies for children with autism aged 4-7 years. The results yielded significant differences for IQ (p < .01), language (p <.05) and adaptive behavior (p<.05) for the behavioral group. This suggests that those children treated with a behavioral approach did significantly better than those treated using other intervention methods (Eikeseth, Smith, Jahr & Eldevick, 2002).

Critical Appraisal of Research

Strengths

Each article reported significance with very small sample sizes (between 9-20 subjects) and had appropriate statistical measurement and interpretation of results, which lends credibility to the results.

Weaknesses

Most articles displayed weaknesses in the generalizability of research participants, and discriminant validity measures as well as effect size, clinical significance and "goodness of fit" tests. However, research evidence is strong enough to support the use of intense behavioral intervention in spite of methodological and statistical flaws since each study found approximately the same final result (that ABA was effective in treating language and other cognitive problems in children with autism) and that there were no flaws in the appropriateness of the statistical tests used.

Conclusions

The research on intense behavioral intervention has been consistent in regards to the effectiveness in treating language delays as well as other intellectual and cognitive delays in children with autism. However, several things need to be considered before administering this type of intervention. It is important that research looks at the general population in a more random, un-biased way in order to assess whether children from other SES and ethnic backgrounds will achieve the same results as those

reported in the studies. It is also important that researcher's compare their results of testing with other researchers in order to determine whether rater bias accounts for observed results. More importantly, ABA type intervention would perhaps be more clinically significant if it were used in combination with other methods. All the studies administered intense therapy requiring approximately 20-40 hours per week. It is unrealistic in practice to devote this much time to therapy. Perhaps, a combination of other traditional speech therapy methods as well as behavior based interventions such as the Picture Exchange Communication System (PECS) would have more clinical applicability and thus, more relevance.

Future studies should look at various treatment modalities, as mentioned above, and how these compare to those of equal or lesser intensity. Future studies should also look at whether results of therapy remain successful outside the therapy setting in order to determine the success of the intervention.

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The effectiveness of linguistic specific treatment on patients with agrammatic Broca's aphasia

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This critical review examines the effectiveness of Linguistic Specific Treatment (LST) among persons with agrammatic Broca's aphasia. Studies employing single-subject multiple baseline designs were analyzed to determine the clinical effectiveness of LST. Overall, research supports the clinical effectiveness of LST in patients with agrammatic Broca's aphasia; however, the treatment is limited to those with mild to moderate aphasia and to specific sentence types.

Introduction

A common feature of patients with Broca's aphasia is the loss of grammatical structures in speech, also known as agrammatism. These patients will typically produce simple canonical (e.g subject-verb-object (SVO)) sentences, but not complex non-canonical sentences. Past treatment approaches have focused on training patients on the production of simple sentence types and moving toward more complex sentences. These programs have shown to be useful in improving sentence production in patients with Broca's aphasia; however, little generalization is seen beyond the trained sentence type. Linguistic Specific Treatment (LST) supports the treatment of more complex non-canonical sentence forms, which will in turn allow for an increased amount of generalization to other sentence forms that have similar syntactic structure (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993)

LST is based on the theoretical framework that patients with Broca's aphasia have difficulty in assigning thematic roles to verbs and processing sentences with moved constituents. The formation of non-canonical sentence types requires part of a sentence (e.g. a noun phrase (NP)), to move from its normal position in the SVO structure to a new position in the sentence (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). When this occurs, a trace is left where the noun phrase has moved, forming a trace-antecedent chain (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). This chain allows one to maintain the thematic roles of the NP in the non-canonical form. The movement of the sentence constituent (i.e. noun phrase) is called the move alpha (Thompson et al, 1997). Two types of movement have been studied in the literature in regards to the treatment of agrammatic speech. These are wh-movement and NP-movement

(Thompson et al, 1997). .In wh-movement, the constituent is moved from an argument position (e.g. direct object position) to a non-argument position at the beginning of the sentence (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). For example, changing the SVO sentence from, "The dog bit the cat' to a 'wh' question form ,'Who did the dog bite?' requires movement of the direct object 'cat' to the initial position in the form of 'who'. 'Cat' no longer holds the direct object position. In NP-movement, the noun phrase moves from an argument position (e.g. direct object) to another argument position (e.g. subject) (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). For example, changing the SVO sentence, "The dog bit the cat" to the passive form, "The cat was bit by the dog. The direct object 'cat' moves to the subject position of the sentence. .

By increasing knowledge of thematic roles and trace relations of moved constituents, there will be improved sentence production for more sentence types. LST will in turn improve the informativeness and efficiency of the language production of patients with aphasia (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). Training one sentence type that follows wh-movement rules will result in learning of that sentence type as well as other sentence types that follow wh-movement rules. The same can be said of NP-movement rules. As a result, one will see greater generalization than previous treatment approaches. If LST proves to be an effective and more time-efficient treatment approach to agrammatism, it holds important clinical implications.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of Linguistic Specific Treatment in

treating agrammatism in patients with Broca's aphasia. The secondary objective is to propose an evidence-based practice recommendation about Linguistic Specific Treatment for patients with agrammatic Broca's aphasia.

Methods

Search Strategy

Computerized databases, including CINAHL, PubMed, and Cochrane Library, were searched using the following search strategy:

((Broca) OR (Broca's)) AND (aphasia) AND ((agrammatism) OR (speech)).

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the improvement in sentence production of patients with agrammatic Broca's aphasia using LST. No limits were set on the demographics of research participants or outcome measures.

Data Collection

Results of the literature search yielded four single-subject multiple baseline design studies.

Results

Sentence Production

Ballard and Thompson (1999) trained five participants on wh-movement rules and tested generalization to other wh-movement sentences as well NP-movement sentences. As predicted, all five subjects showed an improvement in production of trained wh-movement sentences; however, only three out of five subjects showed the predicted generalization to improvement to another wh-movement sentence.

Jacobs and Thompson (2000) trained subjects on the production of wh-movement and NP-movement sentences. They did not assess whether generalization occurred to other sentence types similar in movement structures, but they looked at whether training production would increase comprehension and whether training comprehension would increase production. Two subjects were trained on sentence production and showed improvement for production of trained sentence types but not comprehension of these sentences. Two other subjects were trained on comprehension and showed improvement in comprehension and production of trained sentence types.

In Thompson et al. (1997), two subjects were trained on either wh-movement or NP-movement sentences. Subject 1 was trained on both wh-

movement and NP-movement rules. This resulted in improvement for both trained and untrained sentence types, as expected for both movement types. Subject 2 was only trained on NP-movement rules, as the subject was already producing 'wh' questions during baseline testing. Improvement was seen for both trained and untrained sentence types, as predicted.

In Thompson et al. (1993), two subjects were trained on the production of wh-questions. It was predicted that by training one question, the subjects would generalize to others. Subject 1 improved in trained 'what' questions but generalization was not seen to 'who' questions. Subject 2 showed improvement in both trained 'who' questions and untrained 'what' questions. Therefore, only 1 out of 2 subjects showed the predicted generalization to untrained sentence types.

Overall, nine patients were trained on wh-movement rules and tested for generalization to other sentence types that followed wh-movement rules. Six of these patients showed improvement on trained sentence types as well as generalization to other sentence types (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). Therefore, six out of nine subjects trained on wh-movement structures generalized outside of the trained sentence. Two patients were trained on NP-movement rules and tested for generalization to other sentence types. Both of these subjects improved in trained and untrained sentence types using this treatment method (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993).

Impact on Discourse Skills

The impact of LST on discourse skills is important, as it demonstrates how effective LST is outside of structured situations and provides further evidence of increased generalization. All of the subjects that showed improvement in untrained sentence production also showed improvement in their discourse skills; however, changes were minimal (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). Improvement was noted by an increase in the number of correct information units (CIU) used during a narrative language sample as well as an increase in the mean length of utterance. CIUs are defined as a word that is accurate and informative for the stimulus presented (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993) Therefore, LST can impact everyday discourse skills; however, the extent of improvement needs further exploration.

Conclusions

The studies reviewed indicate that Linguistic Specific Treatment (LST) is an effective treatment approach for agrammatism in some patients with Broca's aphasia. It is recommended that LST be considered as a treatment approach for patients with mild to moderate aphasia and when training wh-movement structures. LST is not recommended to be used as a proven treatment approach for all patients with agrammatic aphasia, as the literature has too many limitations.

Results have indicated that severity of aphasia is an important factor in the effectiveness of LST as a treatment approach. LST has resulted in improved sentence production for trained and untrained sentences as well as improve discourse skills in patients with mild to moderate aphasia (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). Therefore, generalization was seen in these patients beyond the trained targets. The patients who demonstrated more severe aphasia symptoms did not show improvement in sentence production beyond the specific trained sentence type or improved discourse skills (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). These results indicate that LST is only effective for patients with mild to moderate Broca's aphasia.

The number of subjects investigated using this approach within the literature is also of concern. Several subjects have proven the effectiveness of LST when training the rules required for wh-movement structures; however, only two subjects have been investigated when training NP-movement rules (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). It is recommended that LST only be used to train wh-movement structures at this time. Further research is needed in training NP-movement rules before it should be recommended as a treatment approach. It is also recommended that when LST is used for training wh-movement structures, the clinician keep accurate and detailed records in order to add to the existing literature.

Further, a formal comparison between LST and other treatment approaches has yet to be performed. To date, all studies completed have been single-subject designs (Ballard and Thompson, 1999; Jacobs and Thompson, 2000; Thompson et al, 1997; Thompson et al, 1993). The results can provide evidence that LST does cause an effect in patients with agrammatic Broca's aphasia, but cannot demonstrate that it is more effective than other proven treatments. It lies in the hand of the practicing clinician to determine what treatment approach may be best for each individual client. Due to the complex nature of LST, the clinician may choose another treatment approach simply because it is easier to learn. LST, although useful and effective, is more complex than previous approaches used. LST requires effort and research on the clinician's behalf to study the grammatical aspects of speech and learn how these sentences are formed. In today's busy workplace, clinicians may not have the time needed to devote to learning this approach in order for it to be implemented effectively.

Continued research is warranted to further investigate the effectiveness of LST; however, it is clear that LST has shown clinical improvements in some patients. It should be noted however, that this critique contained few articles and all articles were from the same group of authors. The use of LST as a treatment approach has important clinical implications. Any treatment approach that can provide more time-efficient treatment and increase generalization is worth investigating. Further research should focus on increasing the sample size investigated, proving the effectiveness of LST compared to other treatment approaches and increasing the amount of research by various authors.

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Efficacy of the Fast ForWord-Language intervention program

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This critical review examines the effects of treatment with Fast ForWord on the language skills of children with language-learning impairments. Study designs include: one group pretest/posttest, pretest/posttest with control designs, case study, multi-probe single-subject, and longitudinal no-contact control. Overall, the research demonstrated that Fast ForWord may produce gains in some areas of language development but these gains are modest and may not be long-lasting. Given the high cost and considerable time involved in this program and given that other similar or less intensive programs have yielded similar results, intervention with this program is not warranted.

Introduction

Fast ForWord (Fast ForWord-Language) is a computer based language intervention program developed by the Scientific Learning Corporation (Troia & Whitney, 2003). It is commercially available for a fee on the Internet using CD-ROM software. The program is provided through certified providers who have been trained in the program (Friel-Patti, Frome Loeb, & Gillam, 2001). This program is designed for children between 4 and 14 years of age and training usually lasts 4-6 weeks (Troia & Whitney, 2003). Fast ForWord (FFW) provides training in auditory perceptual and spoken language comprehension skills that are believed to be critical to communicative competence, and ultimately, academic success. It has seven interactive game-like activities to train verbal and nonverbal sound discrimination, vocabulary recognition, and language comprehension (Troia & Whitney, 2003). Children receive feedback for correct and incorrect responses after each trial (Friel-Patti et al., 2001). Therapy is intensive at approximately 1 hour and 40 minutes a day. This program uses acoustically modified stimuli that progress toward natural, unaltered speech. These training stimuli are used to address the presumed auditory temporal processing deficits of at least some children with primary language impairments and other types of language-based disabilities (Troia, & Whitney, 2003).

Since 1996, FFW has been delivered to thousands of children in public and private settings at the cost of considerable time and money. The developers of FFW (Merzenich, Tallal and their colleagues) have claimed that children with language-learning impairments present gains of 1-1 1/2 years on standardized tests of language skills after 6 weeks of training. They attribute these gains to improvements in the brain's ability to represent rapidly successive sounds with greater clarity and sharper distinctions (Gillam, Frome Loeb, & Friel-Patti, 2001). It has been hypothesized that one cause of children's language disorders is poor temporal processing (Troia, & Whitney, 2003). The FFW program was designed on the assumption that this hypothesis is true, however a great deal of controversy surrounds this topic and the debate is far from being resolved. However, it is still possible that FFW could be an effective intervention regardless of the true nature of the difficulties of children with language impairments and reading problems (Troia, & Whitney, 2003).

Given the high cost and time commitment involved in implementing the FFW program, a review of the literature was conducted in order to determine if there is evidence to support treating children with FFW. It is important to determine if treatment with FFW (or any particular intervention) is warranted. As professionals, Speech-Language Pathologists (SLPs) have an obligation to provide their clients with interventions that have evidence to support their use in order to ensure their clients are getting the best possible service.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of FFW training on the language skills of children with language-learning impairments. The secondary objective is to propose evidence-based practice recommendations for SLPs concerning implementation of the FFW program.

Methods

Search Strategy

Computerized databases, including PsycINFO and PubMed, were searched using the following search strategy:

(Fast ForWord) AND (intervention) OR (language).

The search was limited to articles written in English.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of the FFW program on the language skills of children with primary language impairments and other types of language-based disabilities. No limits were set on the demographics of research participants or outcome measures.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: one group pretest/posttest (1), pretest/posttest with control designs (2), case study (1), multi-probe single-subject (1), and longitudinal no-contact control (1).

Results

Impact of FFW on Language Skills

Verbal and Nonverbal Sound Discrimination

According to the studies conducted by the developers of the FFW program, children with language-learning impairments demonstrated significant improvements (p<.05) on norm-referenced tests of speech discrimination following intervention with FFW (Tallal, Miller, Bedi, Byma, Wang, Nagarajan, Schreiner, Jenkins & Merzenich, 1996). Moreover, children in the experimental treatment condition displayed significant gains (p<.05) in nonverbal auditory sequential perception, whereas those in the comparison treatment did not (Tallal et al., 1996).

In addition to the studies conducted by the developers of FFW, several other investigations have been conducted. Frome Loeb, D., Stoke, C. and Fey, M. (2001) used a case study design to examine the effectiveness of FFW outside experimental settings. Three of the four children completed the FFW program successfully in their homes with their parents serving as monitors, and all made gains on some of the same standardized measures used by Tallal et al. (1996). Frome Loeb et al. (2001) revealed that the improvements observed were generally smaller than those previously reported by Tallal et al. (1996) and may not be long lasting.

Hook, Macaruso and Jones (2001) reported that students who had been treated with FFW made significant but similar gains (p<.05) in phonological awareness and reading to a similar intervention, the Orton-Gillingham (OG) multisensory alphabetic training program, suggesting that other similar interventions may produce outcomes comparable to those of the FFW program.

Expressive Oral Language

Gillam, Crofford, Gale and Hoffman (2001) determined that FFW led to observable improvements in spontaneous language. They compared the FFW program to a bundle of intervention programs published by Laureate Learning Systems (LLS) and reported strikingly similar gains between the two programs. They suggested that these similar gains may suggest that FFW is no more effective than other computerized intervention programs. According to the study by Gillam et al. (2001), all four participants in their study made significant gains on standardized tests of expressive language regardless of the intervention (FFW or bundle by LLS). Gains were also made in terms of increased mean length of utterance (MLU) for two of the children who received the LLS software and one who received FFW (Gillam et al., 2001).

Troia and Whitney (2003) reported that except for performance on a measure of expressive oral language, on which the children in the control group achieved significantly greater gains (p<.05) than those in the control group, changes in test scores from pretest to posttest were equivalent for the two groups. However, they suggested that when just comparing the lowest performing students, the treatment group demonstrated superior gains in expressive oral language, syllable and sound blending, and a reduction in problem behaviours (Troia & Whitney, 2003).

Language Comprehension

Tallal et al. (1996) reported that as a group, performance on norm-referenced tests of language comprehension improved significantly (p<.05).

The study by Gillam, Crofford, Gale and Hoffman (2001) revealed that all four participants in their study (two who received FFW and two who received the bundle by LLS) made significant gains on standardized tests of receptive language.

Pragmatics

According to the study by Frome Loeb et al. (2001), all children made gains on measures of pragmatic performance following intervention with FFW.

Conclusions

According to the available literature, FFW may produce gains in some areas of language development but these gains are modest and may not

be maintained over time. The gains are certainly not as promising as those originally proposed by the developers of the FFW program.

Of the articles reviewed, all reported that intervention with the FFW program resulted in some gains in the language skills of children with language impairments. However, with the exception of the developers of the FFW program, who reported substantial improvements, all of the other studies reported modest gains that may not be long lasting. Furthermore, two of the studies suggested that similar or less intensive programs have yielded similar results to FFW. After reviewing the available literature in this area, it is clear that the FFW program resulted in modest improvements at best in the language skills of children with language-learning impairments.

Although all of the studies did report at least minimal gains, treatment with the FFW program is not recommended by this author for a few reasons. First of all, it is a very costly program to administer. The program itself costs about nine hundred dollars plus the cost of administration by SLPs. Secondly, therapy is intensive at one hour and forty minutes a day, which is a considerable time commitment, especially for younger children and those who have lower attention spans. Thirdly, most studies suggested that the FFW program resulted in only minimal gains and that these gains may not be maintained. Finally, two of the studies reported similar gains following intervention with similar or less intensive computer intervention programs.

Many of these study findings have yet to be subjected to the scrutiny of the research community through peer review or independent replication. Few experimentally controlled studies of the efficacy of FFW training have been conducted and a large-scale clinical trial is recommended to fill the current gap in the literature and serve to determine with clinical significance the efficacy of the FFW program. Given the limitations of the FFW program discussed above, this program should not be recommended by SLPs unless it is proven with clinical significance in the future to be an effective intervention.

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Efficacy of melodic intonation therapy to increase functional communication in adults with nonverbal aphasia.

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This critical review examines the efficacy of Melodic Intonation Therapy (MIT) in increasing functional communication for people with nonverbal aphasia. Study designs include: single-subject pre-test, post-test designs and a case study. Overall, the research does not strongly support the use of MIT to increase functional communication; however, results have been shown to increase verbal productions in a clinical setting and future research is still needed.

Introduction

Aphasia is an impairment in language that results from damage to the brain caused by injury or disease. It occurs most often as a consequence of a cerebral vascular accident (CVA) or stroke. "It is characterized by reduction in or an impaired ability to access language content or meaning, language form or function, and the cognitive processes that underlie and interact with language" (Chapey and Murray, 2001, p55). Speech and language are lateralized primarily in the left hemisphere; therefore, when an interruption to blood flow occurs in the left hemisphere, speech and language are susceptible to become disordered. One pattern of disorder that can occur is a difficulty with expression which is also known as nonverbal aphasia, where a patient has difficulty speaking.

Melodic Intonation Therapy (MIT) was originally introduced in 1973 (Sparks, 1973). It was formulated from the basic observation that people with aphasia due to left hemisphere strokes have historically been able to sing even though they may not be able to speak. Interestingly, musical tonal ability is a function found in the right hemisphere (Benson, 1994). Therefore, Sparks (1973) proposed the use of the unimpaired right hemisphere to introduce new pathways into damaged areas of the left hemisphere through the use of the musical aspects of language, namely prosody and intonation.

Sparks et al. (1974) developed a specified multi-level program to follow for the use of MIT. In this program, short phrases are embedded into simple melody patterns (Albert, 1973). There is a strict criteria for patient selection which has been developed through various research studies showing both the ineffectiveness with certain patients and the effectiveness with others (Berlin 1996). Patients reported to have the most success with MIT had severe nonverbal expression difficulties with normal-mild auditory comprehension (Sparks, 1974).

Sparks states that the goal of MIT is the "basic recovery of (the) ability to use some language accurately" (2001, p. 703) and in 1974, he reported that MIT results in "recovery of some propositional language"(p. 303). Laughlin et al. also report that the "goal of MIT is to facilitate formulation of propositional language" (1979, P. 319). Therefore, the proposed goals of MIT can be linked to having an effect on increasing a patient's verbal competence in communication, particularly increasing the functionality of patient's communication.

Over the course of the last 30 years, studies have been completed worldwide on the use of MIT in various languages such as Romanian, Japanese and French. (Popovici et al., 1992; Seki K, Sugishita M,1983; Van Eeckhout et al., 1982) Studies have also been done to examine the brain after successful or non successful melodic intonation therapy with PET and CT scans (Berlin, 1996; Naeser & Helm-Estabrooks, 1985).

Objectives

The primary objective of this paper is to critically evaluate the literature regarding the efficacy of MIT in increasing functional communication for people with nonverbal aphasia. This literature has not been critically appraised for its efficacy and it is uncertain as to whether functional outcomes are being measured. The secondary objective is to be able to provide evidence based recommendations regarding the use of MIT with nonverbal aphasics.

Methods

Search Strategy

Computerized databases, including PubMed, PsychInfo, Combined Health Information Database (CHID) online, Cochrane Library, Proquest and Medline- OVID were searched using the following search strategy:

Melodic Intonation therapy) OR (MIT)
AND (aphasia) OR (aphasia rehabilitation)
OR (adults).

The search was limited to English language articles.

Selection Criteria

Studies selected for inclusion in this review were studies that investigated the MIT technique with adult nonverbal aphasics to increase functional communication or studies examining the MIT technique versus regular speech.

Data Collection

The literature search found the following studies examining treatment outcomes: case study (1) and single subject designs (3). Other types of studies found: retrospective (2).

Results

Increasing verbal expression using MIT

Albert et al. (1973) provided examples of three patients that had undergone MIT after achieving limited success in language therapy over a period of two to three months. The researchers reported anecdotal evidence of success in those three patients. The most common finding was an increase in meaningful propositional speech. The authors measured treatment outcome with observation and this could have caused the results to be biased. Also a case study does not have controls and therefore, this limits the ability to draw conclusions from the reports and to generalize.

Sparks et al. studied the use of MIT with eight, right-handed severely nonverbal adults with left hemisphere aphasia. The authors concluded that six of the eight patients had shown "recovery of some appropriate propositional language" (1974, p. 314). The results of the statistical analysis of these six patients found significant results for three verbal tests in the Boston Diagnostic Aphasic Examination (BDAE); the most significant result occurred in an increase in phrase length (p<0.003). There was also a visual analysis of pre- and post-test scores that showed improvements in the subjects test scores. This study contains various methodological flaws. In terms of design, this study did not have a control group to be able to eliminate the important factor of time spent in therapy. The subjects were not randomly selected and they did not control for any subject variables. Consequently these flaws decrease the validity and reliability of the study. Also the subject size was small and therefore, limits the generalizability of the results. An advantage of this study was the use of a standardized test to measure

outcomes. When looking at the results the authors obtained, it is important to note that the results were presented in an unclear manner, some data was unaccounted for and inappropriate statistical tests were used for the nature of the design. Therefore, caution needs to be taken when interpreting these results.

MIT vs regular speech

The 1979 study by Laughlin and Naeser examined three syllable durations: regular speech, MIT with a 1.5 sec. duration, and MIT with a 2.0 sec. duration. They studied the use of MIT to increase phrase production with five adults with nonverbal aphasia. The researchers hypothesized that prolonged syllable durations would improve the subjects' verbal performances within the MIT technique. They observed successful results when looking at means across conditions and they also performed statistical analyses and found statistically significant results to show that phrase production was significantly affected by the syllable duration (p<0.001). They also found that there was a significant interaction between syllable duration and MIT step (p<0.001). Overall both syllable durations in MIT were significantly better than regular speech (duration 1.5 sec. p<0.005 and duration 2.0 sec. p<0.001). Therefore, these results were able to demonstrate that the patients had more success with the MIT technique Vs regular speech. In terms of methodology, this study lacked a control group, it had a small sample size with no random selection. These factors limit the validity and generalizability of this study. The researchers reported some subject variables but they did not control for these variables; therefore, there may have been confounding effects. In terms of collected data, they had a lot of data points which adds reliability to the outcomes. In terms of the results they found, the statistical tests they employed were appropriate for the type of data collected; however the power of the tests was limited because a parametric test was used for non-parametric data. Overall this study had a stronger methodology than the other studies looked at; unfortunately, this study only examines the difference between using MIT and regular speech it does not examine using MIT as a treatment for aphasia. Therefore, the usefulness of this study is limited when looking at the question stated above.

MIT vs regular speech and increasing verbal expression using MIT

Goldfarb and Bader (1979) examined the use of MIT with a 50- year old man with severe language deficits due to two left hemispheric strokes. This patient had shown little progress in language therapy. MIT was administered both in the clinic and at home.

The authors demonstrated success with the MIT program using descriptive statistics. They showed an increase in the patient's ability to imitate. They also demonstrated that scores acheived through MIT were consistently higher than normal speech scores. The authors cautioned the effectiveness of MIT in environments outside the clinic. This study did not control for amount of time spent in treatment and therefore, it cannot be ruled out that any treatment provided with this intensity and frequency would not have had similar results. The generalizability of the results is low because there was no replicability due to the subject size. It was an advantage that the researchers administered pre-treatment measures that were standardized; however, unfortunately they did not re-administer these tests post-treatment. Also the stimuli that was used for pre-treatment baselines was also the stimuli used during treatment and for post-treatment results. There was no report on how the stimuli were developed or their psychometric properties. This lack of reliability or validity in the outcome measures causes uncertainty in the overall validity and reliability of the results. The results were descriptive therefore no interpretation about the generalizability of the results can be obtained. Clinical significance was demonstrated because progress across the treatment time was shown in the clinic; however this study is limited in determining functional communication gain because of the artificial circumstances in which it was studied.

Conclusions

Consequently, even though two of the studies found statistical significance and three studies demonstrated clinical significance, a strong recommendation cannot be made to support the use of MIT to increase functional communication. This conclusion is based on the observation that there were consistent limitations throughout the studies and these limitations were significant enough to have a major impact on the findings. The most common limitation was the lack of validity and reliability in the methodology and outcome measures. This impacts the generalizability of the results to the aphasic population. This is a serious flaw and limits a clinicians confidence in using the technique with her patients to increase functional communication. Furthermore, the lack of current published research for this technique also causes doubt about the current clinical relevance of this technique.
Sufficient evidence was not found for the carryover of the results to functional communication situations; therefore, a recommendation cannot be made for MIT being an efficacious treatment to increase functional communication in adults with nonverbal aphasia.

Considering the evidence in these four articles, MIT can show change in clinical settings by increasing verbal output for adults with expression difficulties that only have mild to moderate comprehension difficulties. More studies demonstrating transfer of increased verbal output to everyday communication setting would increase the reliability and generalizability of this technique. Additionally, studies that have control subjects and control for confounding variables would be better able to rule out confounding effects. Current therapy has seen an increase in the importance and significance of incorporating functional communication into language therapy goals. Therefore, if clinical and statistical results can be shown to have functional communication value then MIT may have promise for adults presenting with severe nonverbal aphasia with mild to moderate comprehension difficulties.

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The role of dysphagia and prandial aspiration
as predictors of aspiration pneumonia

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This critical review examines the role of dysphagia and prandial aspiration as key predictors of aspiration pneumonia. Overall, research supports a relationship among these three variables. However, other predisposing conditions have also been identified. Because aspiration pneumonia appears to be a multi-factorial phenomenon, an effective management strategy should consider *all* relevant risk factors.

Introduction

Aspiration pneumonia is an inflammation of the lungs and bronchial tubes that is caused by the inhalation of foreign material, such as food or drink, from the mouth into the lungs (Tomblin, 2000). Many predisposing conditions have been cited in the literature including reduced levels of consciousness, gastric reflux, tube feeding and altered neurological status (Teasell et. al, 1996). Although dysphagia has long been recognized as a risk factor for aspiration, the relationship between dysphagia and the development of aspiration pneumonia is less clear.

The impact of aspiration pneumonia is widespread. The nature of this condition is relevant to many health care professionals including primary care physicians, nurses, speech language pathologists, clinical dieticians, respiratory therapists and physiotherapists. Therefore, the professionals working directly with this population need evidence to guide their clinical management decisions. The 'greying' of the population has also provided motivation to identify the risk factors associated with aspiration pneumonia (Marik & Kaplan, 2003). Preventative initiatives are becoming increasingly important. Another driving force behind this investigation is the movement away from the traditional medical model of health. Health care professionals are no longer motivated to simply treat symptoms and eradicate disease. They are also interested in improving the quality of their patients' lives. Therefore, if a relationship between dysphagia and the development of aspiration pneumonia cannot be consistently established in the literature, the conventional measures of withholding oral feedings and modifying a patient's diet are questionable.

It is obvious that aspiration pneumonia places an enormous burden on the health care system in terms of morbidity, mortality and expenditure. However, some controversy remains regarding its etiology. Predictors that warrant further investigation include prandial aspiration and dysphagia.

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding the relationship between prandial aspiration, dysphagia and the development of aspiration pneumonia. The secondary objective is to propose evidence-based practice recommendations with regards to the prevention of aspiration pneumonia.

Methods

Search Strategy

A computerized database (PubMed) was searched using the following strategy:

> (Aspiration pneumonia) OR (Pneumonia) AND (risk factors) OR (predictors) OR (dysphagia) OR (swallowing impairment) OR (Deglutition disorder) OR (swallowing disorder) OR (aspiration)

Selection Criteria

The search was limited to articles written in English between 1994 and 2004. No limits were set on the demographics of research participants or outcome measures. Studies selected for inclusion in this critical review paper were required to investigate prandial aspiration and/or dysphagia and pneumonia development.

Research Design

All of the studies obtained through this literature search were quasi-experimental and best classified as either case-control (prospective) or cohort (retrospective) studies. Most of the studies used large samples obtained via convenience sampling in either long-term care facilities, outpatient clinics or various inpatient acute care wards. Due to inconsistent inclusion/exclusion criteria, participants had various different underlying medical conditions (i.e.- stroke, dementia, Parkinson's Disease etc.) and represented a wide age range (i.e.- 19 – 99 years).

In most cases, baseline measures were obtained through Modified Barium Swallow studies, observation and/or via chart reviews. Outcome measures typically included a combination of qualitative (i.e.- chest pain) and quantitative (i.e.- chest x-rays) indicators of pneumonia. All of the researchers reported associations after conducting correlation and/or multiple regression analyses.

Overall, external validity for this subset of the literature is satisfactory when the studies are viewed as a whole rather than individually. This is because the samples included different populations (i.e.- medical conditions, age groups) obtained from various different settings (i.e.- nursing homes etc.). However, the lack of a consistent operational definition of aspiration pneumonia is an inherent limitation of this subset of the literature. In addition, the use of informal assessments to obtain baseline information in some studies is potentially problematic due to the possibility of silent aspiration and other swallowing disturbances that cannot be readily observed.

Results

Supporting Evidence

Overall, the supporting evidence is based on sound methodology and appropriate statistical analyses. Many of the studies used large samples and prospective research designs.

Prandial Aspiration/Dysphagia

After conducting bivariate analyses, Teasell and colleagues (1996) reported that individuals who aspirated were significantly more likely to develop pneumonia than individuals who did not aspirate.

Several other groups of researchers investigated the relative importance of multiple predictors of pneumonia by conducting multivariate analyses. Vergis and colleagues (2001) reported that witnessed aspiration was independently and significantly associated with pneumonia frequency. In addition, both Loeb and colleagues (1999) and Langemore and colleagues (2002) found that dysphagia was a significant and unique predictor of pneumonia.

Degree of Swallowing Impairment

Pikus and colleagues (2003) reported that the likelihood of developing pneumonia was directly related to the degree of dysphagia. Individuals with no laryngeal penetration, regardless of whether they had normal or abnormal swallowing, had the lowest risk of developing pneumonia. Individuals with laryngeal penetration were at a significantly higher risk and individuals with tracehobronchial aspiration

were at an even greater risk for developing pneumonia.

Bolus Volume

Holas and colleagues (1994) found that individuals who aspirated more than 10% of the bolus had an increased likelihood of developing pneumonia. However, Schmidt and colleagues (1994) did not find a significant relationship with regards to bolus volume and pneumonia risk.

Silent Aspiration

Both Holas and colleagues (1994) and Pikus and colleagues (2003) reported that silent aspirators were significantly more likely to develop pneumonia than individuals who aspirated overtly (Holas et. al, 1994 & Pikus et. al, 2003).

Bolus Consistency

Langemore and colleagues (1998) found that aspirated solids were more significantly associated with pneumonia frequency than aspirated liquids. Schmidt and colleagues (1994) also reported that individuals who aspirated thick liquids and/or solids had an increased risk of developing pneumonia when compared to individuals who aspirated thin liquids only. Although this finding just fell short of reaching statistical significance (p = 0.06), Schmidt and colleagues (1994) suggested that this was a reflection of their small sample size.

Disputing Evidence

Bivariate Analyses

Both Croghan and colleagues (1994) and Feinberg and colleagues (1996) concluded that aspiration did not accurately identify individuals at an increased risk for developing pneumonia. However, Croghan and colleagues (1994) conducted a power analysis and reported that the number of participants in their study was too small to detect *all* statistically significant differences. In addition, Feinberg and colleagues (1996) only investigated the relationship between aspiration of *liquids* and the development of pneumonia. Therefore, the conclusions based on both studies are inherently limited.

Multivariate Analyses

Langemore and colleagues (1998) and Riquelme and colleagues (1996) found that dysphagia was a significant predictor of pneumonia according to bivariate analyses. However, both groups of researchers reported that dysphagia was *not* a unique and significant predictor of pneumonia after conducting multivariate analyses. Langemore and colleagues (1998) stressed that the results do not

necessarily imply that dysphagia and prandial aspiration are not important predictors. They suggested that dysphagia and prandial aspiration are highly correlated with other risk factors that had better predictive value (i.e.- dependence for feeding).

Other Relevant Predictors

Several groups of researchers investigated multiple predictors of aspiration pneumonia. Although the results varied from study to study, several key predictors emerged. Variables that were significantly associated with aspiration pneumonia at the multivariate level included (but are not limited to) dependence for feeding, dependence for oral care, number of decayed teeth, number of medications and mobility status (Langemore et. al, 1998, Langemore et. al, 2002 & Vergis et. al, 2001).

Recommendations

Aspiration Pneumonia Prevention

Based on the findings from the reviewed studies, it appears that no single predictor (including dysphagia) causes aspiration pneumonia by itself. Likewise, no single strategy will likely prevent this disease. Therefore, any initiative designed to prevent aspiration pneumonia must focus on *all* relevant risk factors (Langemore et. al, 1998). Although traditional swallowing therapy (i.e.- diet modifications, compensatory maneuvers and postural adjustments) is crucial, the evidence suggests that an effective intervention program must go beyond the direct treatment of the swallow (Langemore et. al, 1998).

Feeding Programs

Many individuals who cannot feed themselves are often fed by untrained personnel who do not understand dysphagia and are under time pressure to feed as many patients as they can in a short period of time (Langemore et. al, 1998). Therefore, it is imperative that nurses, volunteers and family members receive adequate training with regards to safe feeding techniques. More efficacy studies are also needed to promote widespread adoption of these training programs.

Oral Hygiene

It is essential to evaluate oral hygiene in all patients with dysphagia on a regular basis regardless of dental status. Regular tooth brushing in dentate patients and regular cleaning of the oropharynx with antiseptic mouthwash in edentate patients are two essential measures (Oh et. al, 2004). Because many individuals cannot maintain oral hygiene

independently, training and support must be provided to nurses, volunteers and caregivers.

Medications

It is imperative that speech language pathologists carefully review each patient's medication list when planning intervention. If it is determined that a patient is taking medications that reduce salivary flow, medications that have a sedative effect, and/or a large quantity of medications, the speech language pathologist should consult with the attending physician immediately. In some cases, the physician may be able to prescribe alternatives and/or reduce the total number of medications taken by the patient (Langemore et. al, 1998). In-service education opportunities provided by the speech language pathologist to physicians, residents and nurses may increase awareness and promote more team collaboration within this area.

Mobility and Independence

Speech language pathologists should work closely with other team members (i.e.- physiotherapists, occupational therapists and recreational therapists) to encourage increased patient mobility in order to facilitate pulmonary clearance and increase the patient's immune defenses. It is also essential to work closely with these professionals (particularly occupational therapists) to promote and support the patient's independence in terms of activities of daily living (i.e.- feeding and oral hygiene).

Instrumental Assessments

Silent aspiration and bolus volume are two important factors to consider when determining a patient's risk of developing aspiration pneumonia. These findings underscore the value of instrumental assessment tools such as Modified Barium Swallow studies. Clinical bedside evaluations do not provide sufficient information with regards to these two predisposing factors.

Conclusions

Despite some variability in the literature, research has demonstrated that individuals with dysphagia are at an increased risk of developing pneumonia. Research has also confirmed that aspiration pneumonia is a multi-faceted problem. Therefore, it is imperative to consider the individual's functional status (i.e.- mobility), medical status (i.e.- medications), dental status (i.e.- oral hygiene) and swallowing status (i.e.- silent aspiration) when planning intervention.

Future studies in this area should utilize prospective research designs and sample sizes should be determined via power analysis. In addition, baseline measures should be obtained via instrumental assessment tools and outcome measures should reflect a consistent definition of aspiration pneumonia. Additional studies that extend the current knowledge base by investigating the interaction of several known risk factors would be invaluable. In addition, more studies are needed to evaluate the efficacy of various combined management approaches.

Although it is impossible to completely prevent aspiration pneumonia, the application of combined intervention strategies could potentially make a difference for both society and the individuals directly affected.

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Is gastrostomy a safe feeding alternative
for children with neurodevelopmental disabilities?

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This critical review examines the effects of gastrostomy-tube (G-tube) feeding on children with neurodevelopmental disabilities. Study designs include: quasi-experimental designs and observational studies. The results of this review illustrate that there is little consensus on the appropriateness of G-tube feeding with this population. Overall, the literature indicates that gastrostomy does not prevent aspiration pneumonia in individuals with neurodevelopmental disabilities. Additionally, G-tube feeding may cause or exacerbate gastroesophageal reflux (GER) in these children. The possibility that G-tube feeding is associated with excess mortality in children with neurodevelopmental disabilities is also implicated.

Introduction

Children with neurodevelopmental disabilities, such as cerebral palsy, are often afflicted with dysphagia. Symptoms vary from child to child depending on degree of oral, pharyngeal and esophageal involvement. Some difficulties may include reduced lip closure, the presence of a tongue thrust or tonic bite, reduced movement and coordination of the tongue, and severe oral-motor difficulties resulting in reduced tongue base retraction and/or reduced laryngeal elevation (Logemann, 1998). These difficulties can result in significantly increased mealtime duration, difficulty achieving adequate nutritional intake and increased risk for aspiration pneumonia. Children with severe dysphagia due to neurodevelopmental disability can bypass the swallowing process and obtain their nutrition through tubefeeding. G-tube is one tubefeeding option that has become widely used for this purpose (Razeghi, 2002). Gastrostomy feeding is associated with increased weight and decreased family stresses at mealtimes. Unfortunately, this procedure is also associated with serious complications and can lead to decreased quality of life (no oral food intake), making it confusing for families and professionals who will make the decision of whether a child will have a G-tube placed or continue to be fed orally. To further complicate the issue, there is controversy as to whether gastrostomy prevents aspiration in children with severe disabilities. It is also suggested that gastrostomy can worsen the feeding outcomes, such as increased GER, or even lead to increased mortality for children who have the tube placed.

Objectives

To determine the benefits and risks for G-tube feeding compared to oral feeding for children with neurodevelopmental disabilities. To emphasize the need and make recommendations for well-conducted research on this topic.

Methods

Search Strategy

Computerized databases, including PubMed and Medline were searched using the following search strategy:

> ((G-tube) OR (gastrostomy)) AND (children) AND ((neurodevelopmental disabilities) OR (cerebral palsy) OR (neurologic impairment) OR (mental retardation)) AND ((aspiration) OR (pneumonia) OR (gastroesophageal reflux) OR (GER)).

The search was limited to articles written in English.

Selection Criteria

Selected for inclusion were relevant studies based on the search strategy above. *Participants*: children with neurodevelopmental disabilities. *Intervention*: use of G-tube feeding for nutrition. *Outcome*: outcome measures included aspiration or aspiration pneumonia, GER, and death.

Results

Does gastrostomy prevent aspiration pneumonia in neurologically disabled patients?

Although it is generally agreed upon that gastrostomy produces some health benefits such as improved hydration and weight gain, the literature indicates that gastrostomy does not prevent aspiration pneumonia in individuals with neurodevelopmental disabilities.

Bui et al. found that postoperative aspiration pneumonia occurred in 18.6% of patients with gastrostomy alone and in 8% of patients who had gastrostomy and fundoplication. Furthermore, after gastrostomy, the incidence of aspiration pneumonia improved in only 45% of subjects with preoperative GER.

Hassett et al reviewed the frequency of aspiration pre and post gastrostomy. Overall, at one year after gastrostomy, the frequency of aspiration had not significantly improved. Additionally, it was found that a number of patients who had not experienced aspiration pneumonia prior to tube placement, demonstrated aspiration pneumonia at one year post-gastrostomy. Prior to G-tube placement 29 of 87 patients experienced aspiration; after gastrostomy, it was noted in 35 of 87 patients.

Does gastrostomy produce or exacerbate GER in children with neurodevelopmental disabilities?

It is not entirely clear from the results of the literature, whether gastrostomy placement can cause, maintain or worsen GER in children with severe neurological disability. Four of the five articles reviewed, concluded that gastrostomy can, at minimum, cause GER to *persist*, and at maximum, cause GER to *develop* in children with no history of GER (Berezin et al, 1986; Heine et al, 1995; Mollitt et al, 1985; Samuel et al, 2002).

Mollitt et al. reported, that 25% of patients with an initial negative reflux evaluation experienced GER after gastrostomy alone. Additionally, 10% of patients with a history of GER, experienced recurrent reflux after having gastrostomy and fundoplication. Of the five children studied by Berezin et al., none had notable GER prior to G-tube placement. All of the children (5/5) were found to have GER after gastrostomy tube placement and continued to experience GER after one year of continuous gastrostomy tubefeeding. Heine et al. found that there was a significant increase in the clinical severity of GER after gastrostomy placement (p < .005). Samuel et al found that no GER pre-PEG is predictive of a favourable outcome with respect to GER; GER pre-gastrostomy resulted in persistence or worsening of GER and overall, gastrostomy does not

exacerbate the prevalence of GER (all 3 conclusions at *P* < .05).

In contrast, Razeghi and colleagues conducted a prospective study investigating the notion that gastrostomy may influence the development of GER in children. The data in this study suggests that, in general, gastrostomy does not provoke GER (p < .02).

Can tubefeeding contribute to the mortality of children with severe neurodevelopmental disabilities?

To test the suggested notion of an association between tubefeeding and mortality, Strauss et al used a retrospective analysis of children with severe disabilities. When no study variables were controlled for, there was a significant difference in mortality rates between children who were tubefed compared to those who were not with a higher mortality rate for those who were tubefed (p <.01). When controls were used, there was no significant difference in mortality rate between tubefed, and not, for children with very severe disabilities (p < .01). But, for children with less severe disabilities, there was an approximated doubled mortality rate for children who were tubefed compared to those who were fed orally. It was proposed that all the children were aspirating more frequently with "overly vigorous nutritional maintenance and subsequent aspiration after tube placement" and that only those with very severe disabilities had also undergone tracheotomy, and therefore, had ventilation and suctioning, preventing mortality.

Critical Discussion

The sampling type, subject selection, research design and data collection of these seven studies differ considerably from each other. Each of the studies has weaknesses that may call validity, reliability and the ability to generalize into question.

Sample

Of the seven papers reviewed, all used the same sampling type: purposive sampling. This type of sample was used due to the specific phenomenon of interest (children with neurodevelopmental disabilities who are also g-tube fed). While random sampling is the preferred method, it is clearly impossible to randomly assign *disability* and the ethics of randomly assigning subjects to the treatments *G-tube* or *no G-tube placement* are questionable. The lack of a random sample limited the ability to use parametric statistical tests for these researchers. It is also difficult to rule out possible

confounding variables, such as severity of impairment.

Subjects

There was significant variability of known subject demographics when comparing these seven studies. The following subject demographics were included: sex (4/7 articles); diagnosis or type of disability (5/7); g-tube placement procedure (3/7); IQ (1/7); weight (1/7); and severity of disability (2/7). Two of the articles gave very little information about their subjects. This is problematic because the population that the results apply to is unclear. Additionally, these demographics, as well as other variables, for example, feeding position and method, must be kept constant if the outcomes are to be attributed to the intervention.

Design

All of the studies examined here are examples of quasi-experiments as none used random assignment and most did not use a control group. More specifically, six of the seven studies are *one-group pre-test post-tests*. This type of quasi-experiment is weakened by the fact that there is no control group. The other study (Strauss et al) is an example of a *non-random post-test only* design. While this study has a 'control group' (no g-tube), the groups were not randomly assigned and the subjects receiving gastrostomy were likely the more severely afflicted group.

Data Collection

The outcome measure 'presence of aspiration' was measured by two of the studies. One study (Bui et al) relied solely on medical charts and mentioned nothing else and the other (Hasset et al) confirmed aspiration by "the characteristic roentgenologic appearance of a new pulmonary infiltrate, leukocytosis, fever and response to therapy."

Five articles used 'presence of GER' as an outcome measure with a range of definitions and methods of confirmation. Three of the seven studies used clinical measures such as gastric contents observed in the mouth, two studies used qualitative measures (a parent questionnaire) (Samuel et al; Heine et al), and all five used different combinations of quantitative measures. Quantitative measure included: 24-hour pH-monitoring; gastro-intestinal endoscopy; esophageal biopsy; and barium esophagram.

Only two of the studies described the person administering tests. Because experimenter bias is a potential threat to internal validity, the other articles leave the reader questioning the experimenters' credentials and the agreement between experimenters

if there were more than one. No mention of blind testing was found in any of the articles.

Conclusions

The present research findings do not provide evidence as to whether gastrostomy is a safe feeding alternative for children with neurodevelopmental disabilities. The decision to place a gastrostomy tube (or not) can be confusing for professionals and parents because of the conflicting views and recommendations of researchers on this topic. We can, however, use some of the information provided in the literature to make some clinical recommendations for the present. What *is* clear is the urgent need for a thorough, prospective study, considering many important variables, to come to any certain conclusions regarding this issue.

Recommendations

Although the existing research does not provide evidence for or against gastrostomy for children with disabilities, it does identify the need for a properly controlled experiment. The issue is ethically controversial, yet ideally, a prospective, randomized, controlled-trial experiment is recommended. This experiment is warranted because it is not clear as to whether gastrostomy is a beneficial or potentially harmful treatment for this population as previous research has supported both of these possibilities. Therefore, GER and aspiration should be compared pre and post gastrostomy tube placement but also to a randomly assigned, orally fed control group. Another possible comparison would be gastrostomy tube versus jejunum placed tube. The sample would also need to be more representative of the population of children with neurodevelopmental disabilities and contain a range of children in respect to age, gender, disability, geographical location, type of living situation, etc. And we would, of course, want to consider these as variables in the study. Other variables that need to be controlled for, that have rarely been considered in past studies (probably because they were retrospective) are: severity of disability (cognitive and physical needs); nutritional and growth status of the patient; type of measurement used to measure GER and aspiration; type of feeding tube and its surgery procedure; use of antireflux procedure; feeding method, rate and position; position after feeding; and whether the procedure was prophylactic or necessary. It is also recommended that future studies use objective, clinical and qualitative measures for aspiration, GER, death, quality of life, and parental stresses.

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The significance of age at cochlear implantation

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This critical review examines the effects of age at cochlear implantation on subsequent speech and language development. Overall, although there are methodological flaws in the current research, there is a general consensus that early implantation, particularly during the critical language-learning period, up to age 5, has far-reaching effects on a child's linguistic development. However, the actual *degree* of effect as well as an *ideal* age have yet to be determined.

Introduction

Over the past two decades, over 25,000 people have received a cochlear implant (Rubinstein, 2002). These figures will continue to soar due to continuous advances in knowledge and technology. As more people are receiving these devices, researchers, clinicians, and parents alike are questioning the significance of age at implantation. Until recently, children were not eligible for an implant until at least 2 years of age due to surgical concerns. The only exception was when a child had been deafened by meningitis since ossification following meningitis may interfere with electrode insertion (Anderson et al., 2004). However, due to hypotheses about a critical language-learning period, the U.S. Food and Drug Administration (FDA) have lowered the age of eligibility from 2 years of age in 1990 to 1.5 years in 1998 to 1 year in 2000 (Geers, 2004). In fact, some cochlear implant groups support early implantation so strongly that they have been implanting infants under a year of age (Snik et al., 1997).

Researchers have consistently been finding a negative correlation between age at implantation and auditory-verbal abilities, thereby supporting the notion that early implantation is beneficial to speech and language development. It should be noted, however, that there is some question about the reliability of the current body of research in that most studies are limited in their data due to incomplete statistical evaluations, non-homogeneity of variance, and a lack of consistency in the methodologies employed. Thus, further research is warranted to determine the *precise* effects of early implantation on communication skills, as well as an *ideal* age for receiving a cochlear implant.

Objectives

The primary objective of this research paper is to determine whether receiving a cochlear implant at an earlier age significantly impacts a child's speech and language development. A secondary objective is to determine the actual effects of early implantation and whether there is an *ideal* age. Clinicians require such pertinent information so that they may guide parents in making informed decisions for their children to ensure adequate speech and language development.

Methods

Search Strategy

Computerized databases, including PubMed, PsycINFO, and Cochrane Library were searched using the following strategy:

> ((Effects) OR (significance) OR (importance) OR (impact)) AND ((age) OR (early)) AND ((cochlear implants) OR (cochlear implantation)) AND (language) AND ((speech) OR (verbal)) AND (auditory) AND (development)

Twelve articles were reviewed, all of which were published between 1997 and 2004.

Research Design: Subjects

Although there is a general lack of consistency in the methodology, there are some similarities in criteria with regards to subject selection. These include the following:

- Etiology of deafness
- Prelingually deafened
- Lack of concomitant medical problems

However, there are a number of confounding variables, which should have been accommodated for through appropriate and thorough statistical testing, such as Analysis of Variance (ANOVA), Analysis of Covariance

(ANCOVA), and Factor Analysis. Some of these confounding variables include:

- Age at onset of deafness
- Duration (and consistency) of cochlear implant use
- Educational stream → special education or mainstream
- Mode of communication before and after implantation → Oral Communication (OC) or Total Communication (TC)
- Amount and nature of speech and language intervention
- Concomitant psychological problems, including a low Intelligence Quotient (I.Q.)
- Family issues, such as emotional support and socioeconomic status
- Timing & nature of initial intervention, e.g. was the child (properly) fitted with hearing aids?
- Hearing aid use → whether the child was wearing a hearing aid in the other ear during testing

Research Design: Testing

Actual testing materials used to assess the children's speech and language abilities over time varied across studies; however, there were some similarities in the nature of testing, such as:

- *Quasi-experimental designs*→ These are far more appropriate than Randomized Controlled Trials (RCT) since it would be unethical to deny an implant to control subjects in a study due to the irreversible negative impact it could have on their subsequent speech and language development.
- *Regular testing schedules* → Subjects were tested pre-, peri-, and post-implantation at 3 or 6 month intervals to track their development over time.

Ideal Research Design

Some recommendations for future research are as follows:

- Quasi-experimental designs
- Longitudinal studies
- Thorough statistical testing, especially to account for all the possible confounding variables previously discussed

Results

Results should be interpreted with caution due to a lack of methodological consistency and minimal use of statistical testing. Nevertheless, there was a general consensus in the literature that early implantation has far-reaching effects for a child's overall linguistic development. This, in turn, may impact on social, emotional, and academic development. Specific advantages include:

- *Central Auditory System* → Electrical stimulation provided by a cochlear implant minimizes the amount of auditory deprivation to the peripheral auditory nervous system (Hassanzadeh et al., 2002)
- *Language delay minimized* → Although there will inevitably be a language delay, earlier implantation may reduce the extent of this delay (Miyamoto et al., 2003)
- *Improved reading skills* → Reading levels may exceed those generally expected of deaf students (i.e. grade 4 level) (Rubinstein, 2002).
- *Superior voice control* (Rubinstein, 2002).
- *Improved auditory attention* (Rubinstein, 2002).
- *Interaction* → more effective parental interaction (Rubinstein, 2002).

Conclusions

Although the obvious solution appears to be to implant a deaf child as early as possible, there are a number of ongoing concerns surrounding the issue. To begin, there are always risks involved in surgical procedures, particularly when an infant or child is involved (Anderson et al., 2004). Another issue relates to the reliability of hearing tests to accurately diagnose the degree of hearing loss. A related concern involves accurate programming of the implant, as well as the ability to predict the benefit the child is likely to receive from the device (Anderson et al., 2004). It may be noted that the latter two problems may be minimized with improved behavioural and physiological technologies. Lastly, the family must not be overlooked since it is not just an 'ear' that is being treated. It is natural for families to require a period to accept the diagnosis and explore their options before deciding what is best for their child (Geers, 2004).

Overall, the general consensus in the literature is that early implantation, particularly during the critical language-learning period (up to and including age 5), significantly impacts a child's speech and language development, as early implantation facilitates the development of 'core listening skills' (Geers et al., 2003). These skills are expected to aid in the development of speech and language by enabling the child to make use of the critical period (Anderson et al., 2004). Moreover, adequate language development will likely have a positive impact on the child's social, emotional, and academic development. In developing such skills, these children are presumed to have superior opportunities in life, beginning with access to mainstream education.

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The accuracy and reliability of blue dye tests for predicting aspiration

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This critical review examines the usefulness of the blue dye test as a screening tool for aspiration. Overall, blue dye tests seem to be more accurate when their results are positive rather than negative. More research is needed in this area to make any definitive conclusions.

Introduction

Tracheostomy tubes are normally used for patients with upper airway obstructions or respiratory problems (Logemann, 1998). A tracheostomy tube places a person at risk for aspiration because it may cause reduced saliva and secretion management, disruption of airway pressures, "…reduced laryngeal elevation, reduced pharyngeal sensation, reduced cough response, and disuse atrophy of laryngeal musculature" (Brady, Hildner, & Hutchins, 1999, p. 146). An inflated cuff is designed to prevent aspiration, but it is generally not left fully inflated for long periods due to tracheal irritation. Even with a fully inflated cuff, "…a patient may still aspirate…due to severe dysphagia or a tracheostomy site placed too high" (Brady et al., 1999, p. 146).

Sophisticated procedures, such as the modified barium swallow (MBS) study, the fiberoptic endoscopic examination of swallow safety (FEES), and the video nasal endoscopic examination of the swallow (VEES), are useful in identifying aspiration. However, they are often expensive, time consuming to perform, difficult to access, and may expose patients to radiation. Due to these potential problems, a less sophisticated test is needed.

The Evan's Blue Dye Test (EBDT) and the Modified Evan's Blue Dye Test (MEBDT) are screening tools for aspiration for patients who have tracheostomy tubes. The EBDT helps determine if patients are aspirating on their own saliva, whereas the MEBDT screens for aspiration of food and liquids. These blue dye tests "…can be conducted at the patient's bedside and in a timely fashion, they are relatively inexpensive, with as few as one team member and only suctioning equipment needed, and they do not expose the patient to any radiation" (O'Neil-Pirozzi, Lisiecki, Jack Momose, Connors, & Milliner, 2003, p. 32). Although blue dye tests have numerous advantages, their "…accuracy has been questioned since the 1980s" (O'Neil-Pirozzi et al., 2003, p. 32).

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding the accuracy and reliability of blue dye tests for predicting aspiration. The secondary objective is to propose evidence-based practice recommendations about whether or not blue dye tests should continue to be conducted.

Methods

Search Strategy

The computerized database PubMed was searched using the following search strategy:

(aspiration) AND (tracheostomy)
AND (blue dye) OR (colored dye)

The five selected articles, between 1999 and 2003, all examined the usefulness of blue dye tests for predicting aspiration.

Subjects

All of the subjects, attained through consecutive convenience sampling, had tracheostomy tubes and were referred for a swallowing assessment.

The number of subjects ranged from 15-37. Each subject participated in the research study once, except in the O'Neil-Pirozzi et al. (2003) study. They allowed subjects to participate up to three different times, giving a total of fifty procedures, because each procedure was considered independent of the other forty-nine.

Approximately 70% of the total subjects were male. The age range between the studies was wide (13-87 years), and the diagnoses of the patients were variable within the studies.

Design

The studies used multiple single-subject designs. There were two independent variables in each study: the blue dye test (BDT) and the sophisticated procedure. The dependent variable was aspiration. For the blue dye tests, any blue dye in the tracheal secretions indicated aspiration. For the sophisticated

procedures, each study indicated what constituted as aspiration with the MBS, FEES, or VEES.

Procedures

Two studies performed the MBS simultaneously with the BDT (O'Neil-Pirozzi et al., 2003; Brady et al., 1999). Peruzzi, Logemann, Currie, & Moen (2001) administered a short, preliminary MBS study simultaneously with the blue dye test, and then performed a complete MBS immediately afterwards. One study conducted the blue dye test simultaneously with the VEES (Donzelli, Brady, Wesling, & Craney, 2001), and another administered the FEES within 24 hours of the last administration of the blue-dyed bolus (Belafsky, Blumenfeld, LePage, & Nahrstedt, 2003).

The studies that performed the sophisticated procedure simultaneously with the BDT provided stronger evidence because a patient's aspiration status can change over a short time period. For example, a patient may not aspirate on the first test, but may "…aspirate later due to fatigue, poor following of directions, inappropriate bolus consistencies, or unknown causes" (Leder, 1996, p. 80).

Extraneous Variables

The following variables may have influenced the results in some of the studies: the cuff status or the removal of the tracheostomy tube, the frequency of suctioning the tracheostomy tube, and bolus consistency and size.

Results

Descriptive analyses were primarily used, and two studies included non-parametric tests as well.

High False-Negative and Absent False-Positive Rates

According to Brady et al. (1999) and Donzelli et al. (2001), the blue dye tests had a 50% false-negative error rate for detecting aspiration. When the blue dye tests did detect aspiration in these studies, they detected greater than trace amounts, but not trace aspiration.

Peruzzi et al. (2001) reported that the positive predictive value of the BDT was 100% and the negative predictive value was 47% ($\pm$8%). The MBS detected a significantly greater frequency of aspiration than the BDT ($p < 0.05$).

High False-Negative and Low False-Positive Rates

O'Neil-Pirozzi et al. (2003) examined the *overall* aspiration agreement and the *consistency-specific* aspiration agreement between the MBS and BDT. In the overall aspiration agreement, the BDT's false-negative and false-positive rates were 38.1% and 20.7%, respectively. In the consistency-specific aspiration agreement, the BDT's false-negative and false-positive rates were 71.4% and 20.7%, respectively.

Low False-Negative and High False-Positive Rates

Belafsky et al. (2003) reported that the BDT had a false-negative rate of 18%. The BDT had an overall sensitivity of 82% and specificity of 38%. The sensitivity increased for patients receiving mechanical ventilation but the specificity remained low regardless if the patient was receiving mechanical ventilation or not.

Impact of Specific Variables

O'Neil-Pirozzi et al. (2003) analyzed specific variables to determine their effect on the aspiration results. Statistically significant results ($p < 0.05$) were found only with tracheostomy tube conditions: there was higher MBS-BDT agreement with a deflated cuff.

Conclusions

There is no consensus among the current literature as to whether blue dye tests can accurately and reliably predict aspiration. Four of the five studies demonstrated that the blue dye tests had an absent or relatively low false-positive rate and a high false-negative rate. This suggests that if blue dye is present in the tracheal suctioning, then the person is likely aspirating. However, if blue dye is absent in the tracheal suctioning, the person may still be aspirating. According to two of these studies, blue dye tests are more likely to show false-negative results for trace aspiration versus greater than trace aspiration. Based on this information, a possible recommendation for clinicians is to perform a sophisticated procedure whenever the blue dye tests indicate negative results in order to reveal if the person is truly aspirating. Otherwise, unsafe recommendations, such as deflating the cuff and putting the person on a monitored diet, may be made if the results suggest that a person is not aspirating when he/she really is.

More research is needed in this area, and future studies should incorporate useful features from the previous studies and make changes to improve the research design. Useful features include performing the sophisticated procedure simultaneously with the blue dye test, videotaping the sophisticated test, and having multiple people independently rate the aspiration severity on the blue dye test and the sophisticated test. Possible changes that can be made include using larger sample sizes, random sampling from multiple locations and time periods, controlling

extraneous variables, using the kappa correlation coefficient for inter-rater reliability, and calculating statistical significance. In addition, future studies should investigate the impact of different factors (e.g. bolus characteristics, tracheostomy tube conditions) on the blue dye tests' accuracy and reliability, as well as the tests' reliability in detecting trace aspiration versus greater than trace aspiration.

Due to the advantages that blue dye tests have over sophisticated procedures, clinicians should continue to conduct the bedside evaluation with a blue dye test rather than without one. The blue dye tests may provide valuable information when the results are positive. Clinicians still have to be cautious, however, when making recommendations based on blue dye tests' results, particularly when the results are negative. It is imperative that clinicians use their experience and clinical skills during the bedside evaluation to make important decisions and to determine if the patient should be referred for a sophisticated test of aspiration.

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Impact of long-term pediatric tracheostomy
on speech and language development

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This critical review examines the relationship between early long-term tracheostomy and speech and language development. The research studies reviewed include quasi-experimental designs and a single-subject longitudinal design. Overall, the research suggests that children with a history of long-term tracheostomy are at risk for speech and language problems. Further research needs to be conducted, however, in order to systematically document the speech and language characteristics and difficulties demonstrated by this population.

Introduction

Advances in the medical management of respiratory compromise in preterm and medically fragile infants have led to increased numbers of children undergoing early tracheostomy. Tracheostomy involves the surgical placement of an opening, or stoma, and the insertion of a tube, or cannula, into the trachea at the base of the neck. With the cannula in place, the breath stream is diverted to and from the lungs through the stoma, bypassing the upper respiratory tract. As a result, there is a significant alteration in the physiological functioning of the upper airway. Perhaps the most significant alteration in terms of normal growth and development is the restriction in voice use. Although not all tracheostomized infants are aphonic (unable to produce sound), most are severely restricted in their ability to vocalize (Kertoy, 2002; Simon, Fowler & Handler, 1983).

It has been postulated that early vocal play and babbling provide the necessary oral-motor practice and auditory feedback to develop correspondences between speech sounds and specific oral-motor movements (Oller, Wieman, Doyle & Ross, 1975; Vihman, Ferguson & Elbert, 1987). Due to the voicing restrictions imposed by the cannula, tracheostomized infants are limited in their opportunities to engage in such early speech practice and auditory monitoring. Given both the documented increase in the number of children undergoing early tracheostomy (i.e. prior to 13 months of age) and the increase in the average period of cannulation (i.e. typically longer than 12 months), there appears to be a growing number of children suffering lengthy voice restrictions during a crucial developmental period (Singer, Kercsmar, Legris, Orlowski, Hill, & Doershuck, 1989). Consequently, the need to investigate the impact of long-term tracheostomy on the speech and language development of these infants

has become an issue of significant clinical importance.

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding the impact of long-term pediatric tracheostomy on speech and language development. The secondary objective is to propose an evidence-based practice recommendation about the type of approach that should be adopted when working with these 'at-risk' children.

Methods

Search Strategy

Computerized databases, including CINAHL, Cochrane Library, PsycINFO and PubMed were searched using the following search strategy:

> ((tracheostomy) OR (trach*)) AND
> ((pediatric) OR (paediatric) OR (infant*)
> OR (child*) AND (communication) OR
> (speech) OR (language)).

The search was limited to articles written in English between 1980 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper examined the impact of early tracheostomy on speech and/or language development. No limits were set on the demographics of research participants or outcome measures.

Data Collection

The literature search yielded five articles, four of which employed quasi-experimental designs (4), and one which utilized a single-subject longitudinal design (1).

Results

Impact of Long-term Pediatric Tracheostomy on Language

Kaslon and Stein (1985) addressed the effect of chronic tracheostomy on the acquisition of speech and language skills in ten children who were tracheostomized prior to 12 months of age and prior to "meaningful vocal communication" (mean age at tracheostomy: 4.6 months). At the time of testing, the children ranged in age from 16 and 41 months. These children were found to demonstrate delays in both their expressive and receptive language skills as evidenced by their scores on the Sequenced Inventory of Communication Development (SICD). The authors reported an average of 4.8 months delay in receptive language skills and 9 months delay in expressive language skills. Moreover, they reported deficits in oral/vocal speech and voice production based on clinical perceptual ratings. They also suggested that the majority of children assessed as language delayed responded favourably to speech and language intervention.

Simon, Fowler and Handler (1983) also examined the impact of long-term tracheostomy on language development. Their study consisted of 23 children who were tracheostomized for periods lasting 6 months to 6.9 years. These children were categorized as 'prelinguistic' or 'linguistic' depending on whether or not they had opportunities vocalize consistently prior to the placement of the tube as well as their level of language development at the time of decannulation. Speech and language assessment included both standardized and subjective measures (see Appendix II for a list of the tests utilized). The results of testing indicated that children who were decannulated during the prelinguistic stage, "prior to acquisition of true expressive language," had language skills commensurate with their overall intellectual functioning. By contrast, 7 out of 9 children who were decannulated later during the linguistic stage (i.e. when word production emerges) evidenced expressive language delays; 3 had severe delays of several years or more while 4 showed delays of approximately 4 to 10 months. Given these findings, the authors proposed that the age at decannulation and length of tracheostomy with respect to early periods of language development are crucial to the observed outcomes in this population of children. They also reported that direct speech and language intervention during the linguistic stage is crucial for maximizing the communication skills of these children.

Impact of Long-term Pediatric Tracheostomy on Speech

Simon, Fowler and Handler (1983) also investigated the impact of long-term tracheostomy on the development of speech. Commensurate with their findings in the area of language, they noted that children who were decannulated during the prelinguistic period demonstrated near normal phonological skills post-decannulation. By contrast, children who were decannulated during the linguistic stage showed enduring phonological difficulties post-decannulation. Again, these results seem to suggest that the timing and duration of tracheostomy are critical to the observed developmental sequelae in these children. That is, cannulation extending into the linguistic stage may be particularly detrimental to speech and language development.

Hill and Singer (1990) also documented widespread articulation difficulties in 61% of their sample. Their sample consisted of 31 children who were tracheostomized between the ages of 2;1 and 8;6 years (mean age at cannulation: 4.2 months; mean duration of cannulation: 31 months). Given that articulation impairments were noted up to 8.5 years of age, these results suggest that tracheostomized children may experience long-lasting difficulties.

In their longitudinal study of a single subject, Locke and Pearson (1990) examined the sound development patterns of a tracheostomized child from 16 to 21 months of age (age at tracheostomy: 5 months; age at decannulation: 21 months). They found that during this period and immediately post-decannulation, the child's rate of canonical syllable production (i.e. consonant-vowel syllables) and the size of her consonant inventory were significantly reduced from normal. Indeed, both were reportedly approximate to those of an infant less than 6 months of age. However, during follow-up testing at 4 years and 4 months, they reported that she had attained near-normal speech production. These findings suggest that early, long-term tracheostomy may be associated with severely restricted speech production abilities at the time of decannulation, but that these skills may 'bounce back' in the months/years following tracheostomy.

Finally, in their 1999 study, Kertoy, Guest, Quart and Lieh-Lai examined the speech production and phonological skills of 6 tracheostomized children who ranged in age from 2;8 to 6;8 years (mean age at cannulation: 3 months; average length of cannulation: 30 months). The speech production patterns of these children were documented at two different points in time using detailed phonetic, phonological and acoustic analyses (approximately 3 months separated experimental analyses). These authors found that while each child demonstrated a unique pattern of

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speech production difficulties, all the children exhibited excessive use of one or more phonological processes. The most frequently observed processes were Stridency Deletion (e.g. omitting /s/ in "house"); Liquid Deviation (e.g. substituting /w/ for /r/ in "rabbit") and Cluster Reduction (e.g. omitting /l/ in "please"). These types of processes involve phonetic classes and sound distinctions that are acquired later in the sound sequence. This may indicate that these children are simply delayed in their sound acquisition skills (i.e. do not show an atypical pattern of sound development), and that these skills are gradually acquired following removal of the tracheal tube.

Overall, the research indicates that early, long-term tracheostomy may be detrimental to the speech and language development of children. However, the reviewed studies have some methodological weaknesses that make interpretation of their results somewhat problematic. To begin, all of the reviewed studies relied on non-probability sampling procedures for subject recruitment. Subjects were chosen on the basis of availability (i.e., convenience sampling). Although these non-probability methods are appropriate given the research question at hand, because subjects were not selected at random, it cannot be assumed that the obtained samples provide a valid representation of population characteristics of tracheostomized infants as a whole.

The sample sizes also tended to be small. Although Hill and Singer (1990) and Simon et al., (1983) included 31 and 23 subjects in their sample respectively, the remaining researchers only had 10 or fewer subjects. Smaller samples are less likely to provide an accurate representation of population characteristics. This, in turn, leads to a reduction in power and well as a reduction in the generalizability of the results (i.e. the findings may not pertain to all children with a history of tracheostomy, but only a subset with characteristics equivalent to those represented in the sample).

Subject data were also often poorly described. For instance, two of the studies did not clearly specify the age at which the children were tracheotomized (Hill & Singer, 1990; Simon et al., 1983). Rather, they indicated large age ranges during which their subjects underwent tracheotomy (0-13 months and 0-24 months, respectively). Without more specific information on the age of cannulation, it is difficult to predict the amount of pre-speech practice these children may have experienced prior to tracheostomy. Indeed, those children who were cannulated at 24 months in Simon et al.'s (1983) study likely progressed through the babbling stage and into the linguistic stage prior to tracheostomy. This would undoubtedly distort the results. In

addition, Hill and Singer, (1990), Simon et al., (1983) and Kaslon and Stein (1983), failed to clearly specify the age at which the children were decannulated. In fact, in Kaslon and Stein's study, it is not clear if all subjects are decannulated at the time of testing. Without more specific information on the ages of decannulation, it is difficult to predict the extent of the imposed voicing restrictions experienced by these children and by extension, to interpret the results based on these data.

Several researchers also grouped their subject data, despite the fact that the subjects had been cannulated for disparate lengths of time (Hill & Singer, 1990; Simon et al., 1983). That is, they treated children with considerably different histories and opportunities for speech/language use as a homogeneous group. Again, this wide within-group variability makes interpretation of the influence of voicing restrictions on speech and language development difficult.

Moreover, there are a number of coexisting risk factors associated with pediatric tracheostomy that may have influenced the observed pattern of speech and language in these children. These include: prematurity, low birth weight, periods of anoxia, developmental delays, long-term or recurrent hospital stays, concurrent illnesses, and Otitis media. These factors could not be easily controlled for given the population of infants under investigation. Kaslon and Stein (1985) failed to control for any such factors. Other researchers made more rigorous attempts, but were unable to eliminate them completely. For instance, Hill and Singer (1990) excluded infants from their study who evidenced primary neurological impairments, severe physical disabilities, or mental retardation. However, 50% of the infants included were born prematurely, 25% weighed less than 1500 g at birth and 29% evidenced mild neurological problems. This lack of stringent control is also apparent in Kertoy et al.'s (1999) and Simon et al.'s (1983) studies. It is not clear, then, whether it is tracheostomy itself, or the impact of tracheostomy in concert with other variables that is responsible for the observed speech and language difficulties in these children.

While Locke and Pearson's single case study (1990) provided insight into the changes in one child's speech development preceding and following decannulation, a single data set may not be representative of the population as a whole. The findings need to be replicated before any firm conclusions can be drawn regarding the observed pattern of results.

Finally, the majority of studies used general standardized indexes to assess the speech and language abilities of these children. While these tests

are reliable and valid, and therefore, appropriate, information about specific patterns of errors and difficulties would provide an invaluable addition to these more broad observations.

Implications for Practitioners working with Children with a History of Long-term Tracheostomy

Given the methodological issues present in the reviewed studies, the interpretations that can be made must be somewhat tempered. However, some tentative conclusions can be drawn. Taken together, the reviewed studies indicate a general pattern of delay. While it is unclear whether the speech and language skills of these children 'rebound' following decannulation, there is sufficient evidence to suggest that these children are, at the very least, at risk for speech and language difficulties. This may be particularly true for those children who are cannulated into the linguistic period.

This information is crucial for guiding practitioners in their work with this population and their families. Outcome data will allow practitioners to inform families about the potential developmental implications of tracheostomy and help them develop realistic expectations for their child's speech and language progress.

Given that these children represent an 'at-risk' population, it is recommended that practitioners adopt a proactive approach in working with them and their families. Ongoing monitoring and possible referral for services are required if their speech and language skills are to be optimized.

Further research documenting specific patterns of speech and language demonstrated is warranted. It would allow practitioners to be alert to specific difficulties experienced by these children and guide early identification and intervention efforts.

Conclusions

Research has demonstrated that early long-term tracheostomy may have a negative impact on speech and language development. Overall, it seems to lead to a general delay in speech and language skills, rather than an atypical presentation of communication abilities. Further research is necessary to determine whether these observed delays are long-lasting impairments, or whether, with speech and language practice, the children acquire these skills gradually.

Future research should focus on detailing the specific speech and language characteristics of this population. Moreover, systematic studies evaluating the efficacy of specific intervention procedures would be helpful in guiding practitioners in their treatment of these children. Such outcome data would

help to close "the current knowledge-practice gap" faced by practitioners and help them to support and encourage the emerging speech and language of these young children (Kertoy, 2002, p. xii).

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Efficacy of treatment approaches in developmental apraxia of speech

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This critical review examines the efficacy of treatment approaches in Developmental Apraxia of Speech (DAS). Overall, research in this area is not extensive and fails to provide a strong evidence base for efficacious treatments in DAS. Recommendations are discussed, including the need for more research.

Introduction

For the purposes of this paper, DAS is defined as an inability to carry out movement of the speech articulator(s) in the absence of impaired neuromuscular function (Sussman, Marquardt, & Doyle, 2000). DAS is also known by many other names including developmental verbal apraxia, apraxia of speech in children, and childhood apraxia of speech.

Children diagnosed with DAS characteristically have difficulty with volitional movements and as a result they do not respond well to traditional speech and language treatments (Powell, 1996). It is important for speech-language pathologists to gain a full understanding of the available treatment options in order to best meet the unique needs of children with DAS.

Objectives

As a clinical professional there is a growing need to make informed clinical decisions based on the available research and evidence base. The potential of having to make decisions based on questionable and sometimes weak evidence is alarming and reduces clinicians' confidence in those decisions. The integrity of clinical and professional practice is dependent on the evidence base. The current author reviewed research regarding the efficacy of treatments in developmental apraxia of speech (DAS).

Search Criteria

Computerized databases including PsychInfo and M e d l i n e were used to search apraxia OR dispraxia/dyspraxia OR developmental apraxia OR apraxia of speech OR AOS OR developmental apraxia of speech OR DAS OR paediatric apraxia OR paediatric motor speech OR verbal apraxia OR apraxia of speech in children OR childhood apraxia of speech AND treatment. Articles selected had the

following criteria: (1) they examined DAS; (2) they studied treatment for DAS; (3) they made conclusions about treatment for DAS.

Articles Reviewed

Ballard (2001)

Ballard (2001) conducted a critical review of studies that examined treatment efficacy in DAS and made clinical recommendations for treatment. However, it is unclear how many studies were considered for review, how many were actually reviewed, and how the selected articles were chosen. One cannot be sure that those articles selected for review were representative of the best and most current literature within the field. Additionally, there was no description of how the studies were reviewed, no outcome measures, and no procedure was outlined. Without this information the paper presented as a positional paper rather than a critical review. Opinion cannot be evidence itself because it lacks empirical data.

Although not a critical review, Ballard presented clear statements about how practice in DAS treatment needs to be modified to include more recent advances in research, and she included some valid clinical implications surrounding task complexity and patient characteristics.

In light of Ballard's weak methodology and opinion-based results, the study cannot be considered rigorous enough to contribute to the evidence base of research regarding treatment efficacy in DAS.

Powell (1996)

Powell (1996) examined stimulability considerations in the phonological treatment of a child with DAS. As Powell's research design was a case study results would be difficult to generalize to other children; this one child cannot be representative of the population with DAS. Powell used multiple outcome measures from four domains: neurological, adaptive and intellectual, language, and speech production. Overall, the study's outcome measures

had mediocre psychometrics and it is unclear why so many were used. Lengthy testing can easily fatigue a participant, potentially altering test scores because the child may not have been performing at full potential. Over testing can also result in the subject learning behaviours and responses expected of him (i.e. 'teaching to the test'). This may produce skewed scores that are not representative of the participant's abilities, potentially altering the results of treatment effects.

There were procedural and experimental control concerns in this study because multiple examiners, facilities, and testing dates were used. Not only would the procedures be difficult to replicate, the lack of control leaves readers uncertain if the reported changes in phonetic inventory were due to experimental treatment, other treatment, or maturation.

Powell stated the increase found in phonetic inventory could not be due to maturation because of the participant's history of slow phonological development. This suggests the author believes phonological development is linear, when in fact it is often dynamic; slow phonological development at one point in time is not predictive of continual slow phonological development.

In summary, it is difficult to have confidence in this study in light of the issues surrounding generalizability, replicability, unjustified over testing, and confusing research design. Without confidence in this research study we cannot definitively say that it contributes to the evidence base of treatment efficacy in DAS.

Strand and Debertine (2000)

Strand & Debertine (2000) used an across behaviours multiple baseline single subject design to determine if the integral stimulation approach introduced by Rosenbek, Lemme, Ahern, Harris, & Wertz (1973) could be efficacious in the treatment of DAS. The study did not employ outcome measures but claimed that prior to treatment their 5-year-old participant had normal receptive language, good cognition, excellent pragmatic skills, and was 10% "comprehensible" indicating what they considered a pure DAS case. However, without outcome measures no psychometric data is available and furthermore, there is no basis for their pure DAS claim or their treatment results based on this claim. In addition, the article admitted their measure of comprehensibility was "rough"; a roughly measured criterion is subject to the tester's perception rather than empirical evidence. It would be difficult to note change as a result of the treatment when using only a "rough" measure and therefore we cannot necessarily attribute their results to the treatment itself.

Overall, Strand and Debertine's lack of outcome measures reduces any confidence that could be placed in their results. In light of their methodology, this study's contribution to the evidence base is diminished as a result of one's reduced confidence.

The critical review of results revealed the authors noted differences in speech production and they attributed changes to treatment effects. However, there is some concern as to the amount of confidence the reader can have in their results due to the following. First, to analyze their data Strand & Debertine developed a binary scoring system that appeared to be arbitrary in nature. The authors established the criteria for "significant" results; this indicates experimenter bias as their investment in their results may have influenced how their data was scored. Second, they reported values of "about 0.25 to about 0.8"; the term "about" leaves the reader unsure of the authors' own confidence in their scoring system and results. Third, no conventional statistics were reported even though performing an ANOVA would have been appropriate. In addition, Strand & Debertine included numerous graphs depicting their results. These graphs were very detailed and appeared to contain all of their data but were extremely hard to interpret. It would have been more valuable to use less complex graphs so the reader could clearly understand the results being demonstrated.

Without statistical data or clearly presented graphs it is very difficult for the reader to have confidence in the authors' statement about treatment effects. Therefore, this study does not contribute to the evidence base of treatment efficacy in DAS.

Sussman, Marquardt, & Doyle (2000)

Sussman et al. employed a between-subjects research design to examine acoustic analysis of phonemic contrastiveness in DAS. They age matched five normally developing children with five children with DAS. It is not clear why only ten children were studied and there was no mention of a power analysis. With so few participants, significant results are more difficult to achieve and as such, there may have never been the potential for significance in this study. Another methodological weakness was their use of a speech acoustic outcome measure, locus equation (LE), to quantify acoustic forms of stop + vowel utterances. The authors attempt to describe LEs and what they are used for, but used overly complex language and detail. This lack of clarity in methodology decreases its rigour leaving the reader unsure if the study can contribute to the evidence base. If the reader is not familiar with the function of LE, he/she cannot interpret any results provided, or

understand the greater purpose of Sussman et al.'s study.

Examination of the authors' results revealed reports of exact slope values, results in graph format, and the inclusion of waveforms. If, as above, the reader is lacking sufficient background knowledge in speech acoustics, it is difficult for the reader to interpret results without having to consult additional resources. This is not practical for clinicians as it is very time consuming; it is likely that the article would be discarded before embarking on further investigation.

Furthering the reader's uncertainty of the study's statistical analyses, it appears Sussman et al. abandoned their research design part way through their investigation. They had intended to compare a normally developing group to a DAS group that were age-matched. Instead, they compared the differences between the groups against a single adult subject's results. While Sussman et al. found that the DAS did not approximate the formant values of the adult subject, the normally developing group did. However, the authors only discussed the results of three of the five normally developing group members. This failure to include data on the other two participants leaves the reader to believe that the data may not have been favourable. This lowers our confidence in results because they excluded data without explanation, thereby jeopardizing internal validity. Therefore, Sussman et al.'s failure to provide rigorous results decreases the reader's confidence that the study contributes to the evidence base of treatment efficacy in DAS.

Recommendations

Review of selected literature regarding efficacy of treatment in DAS has revealed weaknesses, flaws, and inconsistencies. Overall, the articles reviewed reported little to no statistical analysis, and weak and often vague methodology. Therefore, there is a need for more rigorous research of treatment efficacy in DAS. In absence of a rigorous evidence base, it is difficult to know where treatment should go from here; the needs of the individuals with DAS on our caseloads must be managed. It is recommended that a Delphi survey of clinicians practicing in the area of DAS be conducted to establish the current state of treatment.

However, more pressing than the issue of treatment is that of diagnosis as discovered when determining search criteria for this critical review. Current diagnosis criteria presents as inconsistent; two of the four articles reviewed acknowledged vague diagnosis criteria. This acknowledgement demonstrates the authors' awareness that their

findings needed to be interpreted with caution because they used formal diagnosis of DAS as basis for participant inclusion. If formal diagnosis of the disorder itself is questionable, then it is difficult to determine if the authors were even able to conduct research examining its treatment. Conversely, the remaining studies did not address diagnostic concerns. This is problematic because one has to question if the authors accounted for problems in formal diagnosis within their own research.

Development of more reliable inclusion/exclusion criteria through research will help us identify those characteristics that identify DAS. It is essential to clearly identify DAS and its salient characteristics before discussions regarding treatment options and their efficacy can take place. Essentially, treatment cannot be efficacious if diagnosis remains questionable.

In conclusion, it is the recommendation of this author to look to similar disorder areas rich in evidence to establish acceptable treatment for these individuals with DAS. For example, in motor learning theory, repetitive practice of small chunks of information and is emphasized. Similarly, acquired apraxia of speech (AOS) encourages repetitive learning that establishes small gains over longer periods of time. Frattali, C., Bayles, K., Beeson, P., Kennedy, M.R.T., Wambough, J., and Yorkston, K.M. (2003) as part of a committee commissioned by The Academy of Neurologic Communication Disorders and Sciences (ANCDS) reviewed the literature surrounding AOS in attempt to develop guidelines based on research evidence. They made several recommendations, which included the identification of three categories of clinical characteristics important to ensure accurate and consistent diagnosis of AOS. Category one characteristics are those necessary for a correct diagnosis (e.g. slow speech rate, speech sound distortions); category two characteristics are nondiscriminative in terms of differential diagnosis (e.g. articulatory groping); and category three are those inappropriate for diagnosis (e.g. anticipatory sound errors). Overall, Frattali et al. (2003) concluded "evidence supporting various approaches to the treatment of AOS appeared to be meagre and rather weak" (p. xiii). Suitably, a similar committee recently initiated a comparable study with DAS but results were not available at the time this review was conducted.

Research in apraxia, like the above article, is essential to determine efficacious treatment approaches for DAS. If Frattali et al. had been able to provide a good evidence base of treatment efficacy for AOS we could have extrapolated recommendations for DAS. However, it appears as

though the AOS evidence base shows similar weaknesses to that of DAS. This further supports this author's recommendations that at present, treatments of DAS are not efficacious and more research in treatment and predominantly diagnosis, needs to be conducted.

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The efficacy of different treatment approaches for Parkinsonian dysarthria

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This critical review examines the effectiveness of the three main treatment approaches for Parkinsonian dysarthria. Study designs include: review article, single-subject pretest-posttest design, multiple-baseline design, single-subject multiple-baseline design, pretest-posttest with control group design, and group pretest-posttest design. Overall, research supports the use of all three approaches for treating individuals with Parkinsonian dysarthria. However, due to use of different variables, designs, and statistical analyzes in the various studies, the most efficacious approach has not been determined.

Introduction

Parkinson's disease (PD) is a progressive, degenerative disease that results from a reduction in the release of dopamine within the striatum of the basal ganglia. Symptoms such as tremor, rigidity, akinesia, and postural abnormalities lead to the differential diagnosis of PD. In addition to these symptoms, PD can affect the speech mechanism, a problem classified as Parkinsonian dysarthria or hypokinetic dysarthria. Hypokinetic dysarthria has speech characteristics including reduced stress, monopitch, monoloudness, short rushes, variable rate, imprecise consonants, breathy voice, and harsh voice (Schultz & Grant, 2000).

A range of treatment options are available for the remediation of speech symptoms related to Parkinsonian dysarthria. These treatments range from traditional speech therapy approaches to less traditional surgical treatments. Three types of treatment methods are addressed herein. These are: intensive speech therapy (including the use of therapeutic devices, and treating speech prosody), pharmacological treatment, and surgical treatment. Research has not yet identified the best intervention for improving voice and speech symptoms in these dysarthric speakers.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the efficacy of different treatment approaches for Parkinsonian dysarthria. The secondary objective is to propose evidence-based practice recommendations about the effectiveness of treatment for this population.

Methods

Search Strategy

Computerized databases, including PubMed, Medline and CINAHL, were searched using the following search strategy:

((Parkinson's disease) AND (dysarthria)) AND ((Treatment) OR (Therapy)).

The search was limited to articles written in English between 1983 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of any type of treatment for Parkinsonian dysarthria, on speech and voice symptoms.

Data Collection

The results of this constrained literature search produced the following types of articles: review article (1), single-subject pretest-posttest design (1), multiple-baseline design (1), single-subject multiple-baseline design (1), pretest-posttest with control group design (1), and group pretest-posttest design (1).

Results

Impact of Speech Therapy on Parkinsonian Dysarthria

Wearable Biofeedback Device:
Rubow & Swift (1985) conducted a single-subject pretest-posttest study evaluating the impact of biofeedback information on a subject's speech intensity. Results were broken down into three main categories: perceptual ratings, acoustic analysis, and microcomputer vocal intensity.

In terms of *perceptual ratings*, a more rapid improvement for reading was found, compared to

conversation. The *acoustic analysis* found improvements, revealed by visible periodic oscillations and scattered aperiodic energy. The *microcomputer vocal intensity* calculated the average time between low-intensity alarms from the microcomputer during spontaneous speech, both inside and outside the clinic. It was found that during the second phase of treatment, the alarm intervals were greater than those during the first phase (indicating that there was a longer time between alarms in the second phase).

Delayed Auditory Feedback:

Hanson & Metter (1983) utilized a multiple-baseline design (n=2) to examine the effect of delayed auditory feedback on Parkinsonian speech. For each patient, a statistical comparison between normal auditory feedback (NAF) and delayed auditory feedback (DAF) measures were made using a t-test for correlated observations (paired). Data was analyzed for both reading and conversation on five main dimensions: speaking rate, intensity, mean fundamental frequency (Fo), intelligibility, and maximum phonation time.

Patient A demonstrated statistically significant improvements in three of the five dimensions. For *speaking rate,* DAF was shown to produce a significant change (t = 9.49) in overall slowness of reading. For *intensity* in both reading and conversation, there was a significant increase in vocal intensity with the use of DAF (t = 7.59 and t = 9.06, respectively). For *intelligibility*, statistically significant improvements were seen for both reading and conversational measures (t = 12.99 and t = 12.12, respectively).

Patient B demonstrated statistically significant improvements in four of the five dimensions. For *speaking rate*, a slowness of rate was documented in both reading and conversational situations (t = 4.67, and t = 3.29, respectively). For *intensity*, an increase was documented during the reading condition (t = 4.75). For *mean Fo*, an increase in fundamental frequency was found to be statistically significant (t = 10.50) in the reading condition. For *intelligibility,* a statistically significant increase was documented with DAF in the conversation condition (t = 4.99).

Intensive Speech Therapy:

LeDorze, Dionne, Ryalls, Julien, & Ouellet (1992) conducted a single-subject multiple-baseline design to examine the effect of intensive speech therapy on speech prosody in dysarthric speech. Results were divided into three main sections: acquisition of treated behavior, maintenance effects of therapy, and generalization.

The *acquisition of treated behavior* revealed that the subject was found to: increase frequency range between declarative and interrogative sentences, increase mean Fo in declarative sentences, and decrease speech rate. The *maintenance effects of therapy* revealed that the patient was able to maintain all treated behaviors 10 weeks later. The *generalization measures* were determined through the use of (a) the dysarthria profile, (b) social validity measures, and (c) intonation measures. The dysarthria profile revealed noted improvements in respiration; but did not note changes in phonation, facial musculature, diadochokinesis, or articulation. Social validity was determined by having judges complete sentence transcription of pre-treatment and post-treatment sentence pairs; then classify sentences as declarative or interrogative. For intonation, the accurate identification of pre- and post-treatment sentence pairs was found to be statistically significant (t = 6.413).

Impact of Pharmacological Treatment on Parkinsonian Dysarthria

Goberman, Coelho, and Robb (2002) implemented a pretest-posttest with control group design (n=18) to examine the effects of the ON and OFF states of drug treatment on Parkinsonian patients. Three main hypotheses were tested, and results were classified into two categories: (a) UPDRS motor score results and (b) phonation results.

The *UPDRS scores* showed that PD patients were most impaired in the OFF state (low dopamine levels), shown by high UPDRS scores; and least impaired in the ON1 state (high dopamine levels), shown by lower UPDRS scores. The *phonation results* were analyzed through: descriptive analysis, effect size analysis, and statistical significance testing.

Hypothesis 1 predicted that there would be a difference between the control subjects and the PD subjects (in their OFF state) on all measures. It was found that there was moderate-high support based on vowel, reading, monologue Fo's, and intensity range. Pairwise analysis showed a significant difference between the PD subjects and controls for: Fo in reading and monologue tasks, and SDFo in prolonged vowels and intensity range.

Hypothesis 2 stated that the PD subjects would improve on all measures of phonation in the ON1 compared to OFF state. Descriptive analysis revealed low support for this hypothesis in all measures of phonation. Few subjects demonstrated decreased mean Fo in the ON1 compared to OFF state. Most subjects demonstrated comparable values in the ON1 compared to OFF state. Effect size analysis revealed low support in all measures as well.

Repeated measures and ANOVA results indicated non-significant effects for Fo in vowels, Fo in monologue, Fo in reading, and intensity range (p>0.05).

Hypothesis 3 stated that there would be no difference between the ON1 and ON2 state phonation measures. Descriptive analysis found variable support for this hypothesis, based on the mean Fo data from the ON1 and ON2 states, but was calculated to be moderate-high support overall. In addition, effect size analysis also found moderate-high support for all measures. The ANOVA comparisons revealed no significant differences (p>0.05), leading to little overall support for this hypothesis.

Impact of Surgical Treatment on Parkinsonian Dysarthria

Gentil, Pinto, Pollak, & Benabid (2003) utilized a pretest-posttest design (n=16) examining the effects of bilateral subthalamic nucleus (STN) stimulation on speech production in dysarthric speakers. Subjects were studied in two conditions: during bilateral stimulation, and 30 minutes after stopping stimulation. Results were divided into three main categories: UPDRS scores, force assessment, and acoustical analysis.

For the *UPDRS scores*, motor disability improved with bilateral stimulation 30-95%. Speech impairment improved on average from a score of 2 before stimulation, to a score of 1 after stimulation (where 0=normal, and 4=unintelligible).

The *force assessment measures* analyzed data of the upper lip, lower lip, and tongue. Statistical t-tests showed that the unstimulated condition yielded significantly smaller maximal forces then the stimulated condition (upper lip – t=5.34, p<0.01; lower lip – t=4.94, p<0.01; tongue – t=3.92, p<0.01). For all three articulatory organs, the mean reaction time in the stimulated condition was significantly shorter (upper lip, t=6.88; lower lip, t=6.60; tongue, t=4.88, all at p<0.01) than in the unstimulated condition. The force rise time for all stimulated patients was also significantly shorter (p<0.01) than when unstimulated, regardless of the target interval. For the hold phase, during the stimulated condition, patients were closer to the target (whatever its level), and therefore were significantly more precise (p<0.01) than in the unstimulated condition with each articulatory organ. As indicated by greater standard deviation (SD) in statistical testing, the hold phase during the unstimulated condition was not as steady as that of the stimulated condition.

Acoustical analysis revealed that when stimulated, patients showed the following: longer maximum phonation time of /a/ and /i/; shorter

duration of the repeated word /pataka/ at a fast rate; shorter pause duration; and larger relative intensity during a 30 second phrase repetition. Fundamental frequency (Fo) measures revealed that when stimulated, patients showed larger variability between the beginning and end of each phase production, as well as greater stability of Fo during sustained vowels. Analysis of intensity in sustained vowels revealed stability of intensity in both unstimulated and stimulated conditions.

Discussion

The research evidence from these studies supports the implementation of each intervention, with some important cautionary notes. With the exception of Goberman et al. (2002), each of these studies employed a quasi-experimental design, where there was no random assignment, and no control group. Another issue was that each of the studies reviewed used a small convenience sample. Results based on few participants may be problematic from an external validity standpoint, and so one might not be able to generalize to other PD patients. Furthermore, the variability of the disorder, and the severity of the disease in the subjects studied, may impact on the external validity of any research project.

Further research needs to be done to examine the efficacy of each intervention. The effectiveness of each intervention should be compared using similar variables, designs, and statistical analyses. When considering which of the three treatments is most efficacious, one must consider some of the limitations of treatment, such as motor fluctuations during drug treatment (i.e., inconsistent ON and OFF periods), and the inherent heterogeneity of the Parkinsonian population (i.e., patients differ in their age, age of disease, duration of disease, severity of symptoms, and responsiveness to treatment).

Recommendations

In conclusion, it is not possible (or advisable) to recommend one treatment over another, solely on the basis of the evidence reviewed herein. As previously mentioned, this literature review has shown that each treatment method targets different variables of speech. Furthermore, it is evident that speech therapy has been shown to improve speech characteristics such as prosody, vocal intensity, rate, and intelligibility. Pharmacological treatment has resulted in improvements for speech and voice in some PD patients. Regardless of its impact on speech, drug treatment is required to control the motor symptoms of PD. Surgical treatment has

demonstrated improvements in increased force measurements of the articulators, increases in intensity and fundamental frequency variability. Moreover, if a patient presents with specific speech and voice symptoms, clinicians can use the information outlined in this review to determine the method of treatment that is best suited to their patients.

Future research should employ a pretest-posttest experimental design, in the examination of a large group of Parkinsonian subjects. Patients should be randomly assigned to a treatment condition in which there would be individuals representing all stages of the disease (early, middle, and late). Finally, all research in this domain needs to consider the heterogeneity of the Parkinsonian population, and strive to control demographic variables when creating comparison groups.

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Acoustic Signal Processing Research at the National Centre for Audiology

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A vast majority of current generation hearing aids, assistive listening devices, and augmentative communication devices employ sophisticated digital signal processing (DSP) techniques for speech and audio processing. However, there is a limited body of work on systematically evaluating the relative performance these techniques. Our research attempts to fill this gap by performing both instrumental and subjective evaluations of DSP technologies, with the goal improving their overall performance. Specific projects include : (a) evaluation and development of digital noise reduction algorithms in hearing aids, (b) evaluation of speech coding technologies in cellular and voice over internet communications, and (c) evaluation of directional hearing aids and multi-microphone arrays.

Perceptual awareness and speech therapy treatment
for patients with Parkinson's disease

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This critical review examines the effects of perceptual awareness difficulties among persons with Parkinson's disease. In addition, it examines the effects of various speech therapy treatments on this population. Study designs include: 4 experimentally designed studies on the speech and language therapy techniques used for Parkinson's disease patients, and two quasi-experimental studies on the perceptual awareness of speech in this population group. Ultimately, this literature review proposes to suggest the best approach to treating the speech and language disorders of patients with Parkinson's disease. Overall, There is considerable evidence to support that some PD patients exhibit impairment in the perceptual awareness of their speech. However, the identification of one exemplar therapy for persons with Parkinson's disease, who have sensory perceptual problems, does not yet exist. Therefore, the findings raise the question as to whether clinicians should use therapy techniques that require PD patients, noted to have impaired self-perception, to use these skills to have success in therapy.

Introduction

Parkinson disease is a progressive neurological disease caused by dopamine deficiency in the substantia nigra (Ramig et. al, 2001). This movement disorder has primary physical symptoms (tremor, rigidity, akinesia, and postural stability), which ultimately have been seen to affect the muscles involved in speech (Ramig, 1998). Researchers believe that as many as 50-90% of individuals will develop speech and voice disorders in the course of their illness (Ramig, Fox and Sapir, 2004). These effects, on both speech and voice production, form a group of disorders classified as hypokinetic dysarthria (Stemple *et al.,* 2000). As has been described, (Darley*,* Aronson, & Brown*,* 1975) hypokinetic dysarthria includes a group of related speech disorders that are due to disturbed muscular control over the speech mechanism. The classic description of the speech of these patients includes reduced loudness, monotony of pitch, short rushes of speech, and imprecise consonants. There are also numerous other characteristics that have an affect on the speech of individuals with PD including: reduced stress, monoloudness, inappropriate silences, rapid rate, harsh voice, breathy voice, and low pitch (Darley, Aronson and Brown, 1975).

Historically there have not been many clinical research studies that address the use of behavioural speech therapy for patients with PD. In the past, there were no indications of a standard therapy approach, which may suggest why speech treatment for Parkinson disease patients was not prevalent. This problem may still exist since in 1996 in the United States, reports suggest that only about 4% of patients with Parkinson's disease received treatment for their speech (Ramig *et al.,* 1996).

One of the many problems that have been encountered with speech therapy with PD patients in that past is that the techniques learned in therapy are not easily transferable to everyday use. In fact it has been said, "changes that occur in the speech treatment room disappear on the way to the parking lot" (Stemple, 2000). Maintaining the improvements of speech therapy and carrying them over to daily life situations is one of the major concerns of clinicians. For example, one of the most common initial speech symptoms is the perception of reduced loudness. Patients often complain that they are becoming soft spoken (hypophonic) and are becoming frustrated by frequent requests to repeat themselves (Adams, 1997). The problem with carryover of therapy may be that a patient may sound like they have adequate loudness in a quiet clinic room but fail to compensate to noisier situations.

Therefore, three varying behavioural therapy techniques used to treat different speech problems in the Parkinson disease patients were examined. A specific behaviour therapy in speech and language conducted by Scott and Caird (1983) focused on the speech prosody of PD patients. The prosodic exercises that were used as a therapy technique (Scott & Caird, 1983) aimed at increasing the patient's awareness of the abnormal prosodic features in his/her own speech. The general theoretical idea behind this technique is one of sensory awareness and self-awareness driving the improvement in speech difficulty.

Another behaviour therapy that focuses on increasing the respiratory effort of PD patients is

termed respiratory effort therapy (RET). This treatment technique looks at changing the physiological mechanism that is disordered rather than targeting a perceptual difficulty. The RET treatment focuses on physiologic changes in muscle activity (i.e. increased inspiratory and expiratory muscle activity) to increase subglottal air pressure and respiratory volume. As a result, the perceptual change in loudness occurs (Ramig et al., 2001).

Lastly, Lee Silverman Voice Treatment or LSVT® is a very intensive and specific speech therapy program that focuses on the disordered voice of individuals with Parkinson's disease (Ramig, 1998). The LSVT® program follows five basic concepts that include: (1) thinking loud; (2) high speech effort; (3) intensive treatment; (4) recalibrating loudness level; (5) quantifying improvements (Steeple *et al.,* 2000). By using LSVT® speech-language pathologists encourage patients to produce a loud voice at all times in addition to using all the effort they can (Ramig, 1998). The theoretical idea behind LSVT® includes both physiological change as well as perceptual awareness in its training.

Comparing the theoretical construct of these various therapy techniques is important because it questions whether speech-language pathologists should be using techniques that rely heavily on perceptual skills. Research suggests that sensory kinesthetia problems may be a factor in the speech and voice disorder observed in individuals with PD (Ho et al., 2000). The same authors (1999) compared voice loudness perception in individuals with idiopathic Parkinson's disease with hypophonic dysarthria with neurologically normal speakers. They found that unlike normal speakers the PD patients over-estimated the loudness of their speech during both reading and conversation (Ho et al., 1999).

Objectives

The objectives of this study are to critically evaluate the research literature regarding the perceptual abilities of PD patients and to further assess the effectiveness of various speech treatments with patients with PD.

Search Strategy

Relevant experimental studies were identified by electronic searches of MEDLINE, CINAHL, HealthSTAR, PsycINFO, PubMed, and the Cochrane Library. These were searched using the following search strategy:

((Parkinson's disease) OR (parkinsonism)) AND ((speech-langauge therapy) OR (speech therapy) OR (voice therapy) OR (communication) OR (speech treatment) OR (voice treatment) OR (speech-language treatment)).

The search was limited to articles written in English between 1980 and 2004.

Results

Perceptual Awareness

Two of the research studies reviewed deal with the perceptual skills of patients with PD. One of the research studies looks at various conditions in which patient's perceptual awareness can be tested. Researchers look at the patient's regulation of speech volume for reading and conversation with (i) background noise (ii.) instantaneous auditory feedback and (iii.) an attention cue given by the clinician (Ho et al., 1999). The other study (2000) looks at the patient's perceptual ratings of volume immediately after speaking and after their speech is played back to them under three conditions: they are told to speak quietly, loudly, and normally.

In Ho et al. (1999), the first experiment found that controls significantly decreased their volume with increasing IAF, but PD participants demonstrated minimal decrease for both reading and conversational speech. The researchers found a main effect for group, where PD's were seen to read and conversed, more softly than controls. Also found a main effect for volume (p=0.0001). The control group gradually decreased reading volume as auditory feedback volume increased and heard their own voice getting louder. In the second experiment, controls significantly increased their volume with increasing BGN (p=0.014; partial eta-squared=0.675), but PD participants (p= 0.0001; partial eta-squared=0.243) demonstrated minimal increase for both reading and conversational speech. In the last experiment, the researchers found that both groups increased reading volume from soft to loud to very similar extents although controls achieved a slightly greater range (p= 0.05).

The general findings in Ho et al. (2000) concluded that control participants were louder than PD participants overall. Control participants increased volume to a greater extent than PD participants did for normal and loud instructions (p<0.001, p<0.001). For the measure of immediate perception, they found that PD participants consistently overestimated volume relative to controls (p<0.01). In addition, in the playback perception researchers reported that PD participants consistently overestimated volume relative to

controls (p<0.001). Therefore, although patients spoke more quietly than control subjects, they perceived (immediately and on playback) that their speech was louder than controls.

Speech Therapy

Two of the research studies involve direct comparison of the LSVT® speech and language therapy technique versus respiratory effort treatment (RET) in patients with idiopathic Parkinson's disease. One concentrates on the immediate effects (Ramig et. al, 1995) and the other looks at patients after a 2-year period (Ramig, et al., 2001a). Another study compares treatment of voice disorders in PD individuals using LSVT® to PD patients who receive no treatment and to normal age-matched controls (Ramig et al., 2001b). Lastly, a "traditional" therapy approach, which focuses on studying the effects of prosodic exercises versus prosodic exercises with visual feedback, is examined (Scott & Caird, 1983).

Ramig et al. (1995, 2001*a*), evaluated a number of outcome variables including these instrumental measures: intensity, maximum duration of sustained vowel, fundamental frequency and variability, rate and utterance duration, pause duration. In addition, perceptual ratings included self-ratings of loudness, monotonicity, hoarseness, initiating conversation, and intelligibility; family-ratings of *l o u d n e s s, monotonicity, hoarseness, initiating conversation, and intelligibility;* and depression and quality of life scales. Overall, Ramig et al (1995, 2001*a*) found that the Lee Silverman Voice treatment (LSVT®) resulted in significant improvement in mean SPL (volume) and STSD (pitch) for the three speech tasks from pre-treatment to post, and from pre-treatment to 24 months. They also concluded that respiratory effort therapy (RET) showed improvement in SPL and STSD from pre-to immediately post-treatment during Rainbow passage, however no significant differences from pre-treatment to 24-month follow-up occurred in any of the tasks.

In addition the outcome findings a repeated ANOVA revealed no significant difference between the two groups at baseline for: age, stage of disease, motor portion of UPDRS score, glottal incompetence, and severity of speech disorder. Authors attributed the unequal n sizes due to "lack of subject compliance with pre- and post-treatment assessments." The authors also did not analyze their data on an intention to treat manner. Patients that withdrew from the study were simply withdrawn from the data.

Family members' assessments of the patient's speech was only measured at baseline and immediately after therapy, and they did not say how they chose the 12 LSVT patients, and the 8 patients in the RET group for this measure. Intra subject reliability was tested by including 58% of subjects in a second pre-treatment voice recording, 36 % of subjects in a second post-treatment voice recording. The authors do not state why all the patients are not included in these measures, and how these patients were chosen to be re-tested.

The various methodological deficits affect the quality of evidence presented in the Ramig et al papers. Generally, the small number of patients, the unequal group sizes, and questionable randomization pose problems. In addition, the possible publication bias affects the interpretation of results.

In the literature completed by Scott & Caird (1983), the general findings suggest that both groups studied (Group A: prosodic exercises (PE) and Group B: PE with visual cues) showed an improvement (p<0.005, p<0.001). They noted the most improvement occurred in the group that received prosodic therapy *without* visual feedback.

The results showed no significant difference in scores for both groups pre-treatment. As for the comparison between the groups, groups A and B showed little difference in their scores from pre-treatment to immediately after treatment. There was no significant difference within group B from assessment 3 to 4. At best guess this is probably why group B got an extra 2 weeks of therapy and assessment. There was also a significant decrease in the prosodic abnormality scores (noted improvement) between assessments 3 and 5 (group A) and assessments 4 and 5 (group B). Group A showed a greater change of the mean scores on both of the outcome measures. In addition group B was stated to have "maintained benefit" as seen in the decrease of scores from assessments 2 and 5.

No homogeneity of variance was reported. The authors reported that patients included in this study are *probably* representative of patients with the speech disorder typical of PD, in respect of age, duration of disease and current therapy treatment groups.

Recommendations

There is considerable evidence shown through the rigorous studies on the perceptual awareness skills in PD patients to say that patients with considerable perceptual deficits should be treated appropriately. However, there isn't enough evidence in the literature reviewed to say which treatment reviewed is most effective for these types of patients.

Therefore, this raises the question of whether clinicians should use therapy techniques that require PD patients (noted to have perceptual problems) to use these skills to have success on a therapy goal.

Ultimately, clinicians should not stop training these skills. In fact, treatments like LSVT® that focus on training these specific awareness skills may be the most successful for maintaining learned skills. Emphasis on self-monitoring is an important part of the treatment in all PD patients. It would be useful to look at additional comparisons between groups of patient's receiving various treatments (LSVT® vs. other standard treatments) to see the long-term effects of this training. Keeping in mind that methodological quality is improved.

The implication of this review on clinical practice is that as clinicians we should be aware of the perceptual deficit that some of these patients exhibit. Therefore, clinicians may spend time assessing and probing this aspect of perceptual awareness of their voices before investing the time and effort into an intensive treatment program. Modulating current therapy programs to include perceptual awareness tasks may be another possible solution.

Ultimately, speech-language pathologists may need to evaluate many different situations to determine how their speech improvements made during therapy can be maintained long term. One of the many problems that have been encountered with speech therapy with PD patients in that past is that the techniques learned in therapy are not easily transferable to everyday use. Look at various settings for treatment, to improve on the real life difficulties that may be encountered. These concerns of perceptual awareness deficits may lead researchers and clinicians to look at other approaches to treatment such as instrumental devices (e.g., visual/auditory feedback devices) to maintain carryover from speech and language treatment.

The implication for further research and development of speech treatments for dysarthric patients with PD is needed. Moreover, further research should focus on improving methodology such that the results of the studies can guide us to answers regarding the outcome of treatment of dysarthria in Parkinson's disease.

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Identifying and confirming the presence of auditory neuropathy/dys-synchrony

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This critical review examines the tests currently used to identify and confirm auditory neuropathy/dys-synchrony. Study designs include: critical review and case control. Overall, research supports the use of otoacoustic emission and auditory brainstem response screening tests as means to identify this disorder, and otoacoustic emission, auditory brainstem response, middle ear muscle reflex and cochlear microphonic testing for confirmation of auditory neuropathy/dys-synchrony.

Introduction

Auditory neuropathy/dys-sychrony (AN/AD) is a condition whereby the patient presents with auditory characteristics consistent with normal outer hair cell function, and abnormal neural function at the level of the vestibulocochlear (VIIIth) nerve. Moreover, many of these patients exhibit various degrees of hearing impairment, as well as significant difficulty hearing in noise, well beyond what would have been predicted from their pure tone audiogram (Berlin, Hood, Morlet, Rose, & Brashears, 2003). In addition, other audiological tests reveal normal tympanograms, absent middle ear muscle reflexes, no masking level difference, and no efferent suppression of transient evoked otoacoustic emissions in response to one or both ears (Berlin et al., 2003; Hood, 1998).

The auditory responses typical of auditory neuropathy have led some authors to recommend renaming this condition to auditory dys-synchrony as it may provide a more accurate description of what is occurring in these patients. For example, otoacoustic emission (OAE) testing, which is sensitive to outer hair cell function, is normal in these patients. However, absent auditory brainstem response (ABR) and middle ear muscle reflexes, without a site of lesion, as well as temporal disruption, reveals dys-synchrony of the VIIIth nerve (Hood, 2002).

The actual abnormality present in these patients is unknown. The disorder could be at the level of the inner hair cells, the synapse between the inner hair cells and VIII nerve fibres, the ganglion neurons, the nerve fibres, or any combination of the above (Starr, Picton, Sininger, Hood, & Berlin, 1996). Rance, Beer, Cone-Wesson, Shepherd, Dowell, King, Rickards, & Clark, (1999) state that "a number of authors have suggested that AN could be associated with a loss of myelin and could be localized to the Type 1 afferent auditory nerve fibres" (p.246). However, normal outer hair cell function, as demonstrated by the normal OAEs, and abnormal neural function seen in ABR tests, suggests the pathology may be at the level of the inner hair cells or their synapse with Type 1 auditory nerve fibres. This suggested site of pathology cannot be ruled out however, as there are no tests currently available for this purpose (Rance et al., 1999; Rapin & Gravel, 2003; Starr et al., 1996).

Since AN/AD is characterized primarily as having normal outer hair cell function and abnormal/de-synchronous auditory nerve function, tests that are sensitive to both cochlear function and auditory nerve function are a necessity for proper identification of this disorder. To assess outer hair cell function, OAE testing is the most sensitive, and ABR testing is the most sensitive to auditory nerve dysfunction (Berlin et al, 2003, Dolphin, 2004, Hood, 1998).

Used independent of one another, OAE and ABR test results will not provide adequate information to diagnose auditory neuropathy. However, when used concurrently, these tests "offer insight into preneural as well as neural function in the auditory system and thus may form the most sensitive combination" (Hood, 1998, p. 13).

In addition to the OAE and ABR tests, other clinical tests exist which are sensitive to cochlear function and auditory nerve function. These include cochlear microphonics (CM), middle ear muscle reflexes (ipsilateral and contralateral) (MEMR), masking level difference (MLD), efferent suppression of transient evoked otoacoustic emissions (TEOAE), and word recognition testing with an ipsilateral competing noise (Hood, 1998).

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the current tests being used to identify and confirm the presence of auditory neuropathy/dys-synchrony. The secondary objective is to propose evidence-based

practice recommendation about a best-practice protocol for screening and confirming the presence of this disorder in patients.

Methods

Search Strategy

Computerized databases, including PubMed and Cochrane Library, were searched using the following search strategy:

> ((Auditory neuropathy) OR (Auditory dys-synchrony)) AND (screening) OR (identification) OR (confirmation) OR (diagnosing)).

The search resulted in a collection of articles written in English between 1971 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate auditory neuropathy/dys-synchrony, the types of tests being used to screen for the disorder, and the tests being used to confirm the presence of the disorder. No limits were set on the demographics of patients.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: critical review (9), and case control (4).

Results

A Review of Test Methods

Although the OAE and ABR test combination is widely accepted as the standard tests required for identification of AN/AD (Berlin et al., 1998; Dolphin, 2004; Hood, 1998), it is worthwhile to review the clinical tests that have been used or suggested for use in identifying and confirming auditory neuropathy/dys-synchrony in the articles that were included in this critical review.

OAE and ABR testing is recommended in each article as a necessary part of the procedure for identifying and confirming the presence of AN/AD. Some authors (Berlin et al., 2003; Hood, 1998; Katz, 2002; Rapin & Gravel, 2003) also recommend additional tests, such as cochlear microphonics and middle ear muscle reflexes in order to properly confirm this disorder.

According to the current Infant Hearing Program protocol and guidelines for audiologic assessment in Ontario, cochlear microphonics and the ABR are the recommended tests to use for confirming the presence of this disorder. However, it also states that:

> *"The appropriate course of action, given a probable AN, is at the discretion of the individual IHP audiologist. An ancillary protocol that will address additional diagnostic procedures, as well as management issues, is in preparation"* (p. 21).

There are many issues to consider regarding the most appropriate tests to use for these patients. Part of the difficulty arises in the diversity seen among these patients, particularly in regards to their hearing thresholds, which can range between near normal to severe to profound (Berlin, Hood, Morlet, Rose, & Brashears, 2003). As well, there is no actual site of lesion.

Screening for Auditory Neuropathy/Dys-synchrony

The implementation of newborn hearing screening programs has enabled OAE screening of all infants, and ABR screening on those infants that do not pass the OAE screening, and high risk babies. The combined use of OAE and ABR screening on all high risk infants does indeed provide the required information to identify auditory neuropathy. However, for infants without any risk factors, the current infant hearing program protocol used in hospitals will not identify a child with auditory neuropathy. This is due to the two-stage screening protocol, which does not require an ABR screening test if the infant presents with normal OAE's. This process will therefore not identify auditory neuropathy in the infant since, by definition of the disorder, he or she will have normal OAE test results.

Without a complete screen of the auditory pathway, an infant with auditory neuropathy may go undetected for years, and the child is at risk for misdiagnosis of either mental retardation or central auditory processing disorder, due to hearing and language difficulties despite normal outer hair cells (Berlin et al, 2002). AN/AD is currently not included as a disorder targeted for identification through newborn hearing screening programs in the current Joint Committee on Infant Hearing Year 2000 Position Statement, although it does recommend audiologic and medical monitoring of infants considered to be at risk for AN/AD.

Confirming the Presence of Auditory Neuropathy/Dys-Synchrony

As there are currently no tests available to assess inner hair cell function or their synapses with VIII nerve fibres, the next best option is the OAE and ABR tests. In addition to the OAE and ABR tests, there are several other tests available that can provide additional information about cochlear and neural functioning which can aid the audiologist in

diagnosing AN/AD. These include cochlear microphonics (CM), middle ear muscle reflexes (ipsilateral and contralateral) (MEMR), masking level difference (MLD), efferent suppression of transient evoked otoacoustic emissions (TEOAE), and word recognition testing with an ipsilateral competing noise (Hood, 1998).

Some debate does exist in regards to whether the OAE or CM is a more appropriate test of cochlear function (Rance et al., 1999; Rapin et al., 2003). First, although OAE testing is time efficient and sensitive to outer hair cell function, OAEs may be absent due to external or internal middle ear dysfunction, such as otitis media, whereas the CM response will not be affected. Second, the CM response is more robust than the OAE response, and is less sensitive to cochlear damage than are OAEs (Rance et al., 1999; Rapin et al., 2003).

It is advantageous for the audiologist to collect as much auditory information as possible with these patients to avoid misdiagnosis. OAE and ABR testing may be sufficient for screening purposes, but with all of the technology available, more measures are needed to differentiate true auditory neuropathy from retrocochlear/brainstem pathologies and thalamo/cortical disorders (Rapin et al., 2003).

Conclusions

Auditory neuropathy/dys-synchrony is a disorder found in patients of all ages who present with normal outer hair cell function and abnormal/dys-synchronous auditory nerve function. They exhibit various degrees of hearing loss, and have significant difficulty hearing in noise, far beyond what can be predicted from the patient's pure tone audiogram.

Although this disorder is hypothesized to be localized to the level of the inner hair cells or their synapse with Type 1 auditory nerve fibres, this suggested site of pathology cannot be ruled out as there are no tests currently available for this purpose (Rance et al., 1999; Rapin & Gravel, 2003; Starr et al., 1996).

Therefore, it is necessary to have in place a set protocol, which outlines the most sensitive yet efficient tests, both cost and time effective, for proper identification and confirmation of this disorder, for those with and without risk factors to enable proper management.

Since AN/AD is characterized primarily as having normal outer hair cell function and abnormal/de-synchronous auditory nerve function, tests that are sensitive to both cochlear function and auditory nerve function are a necessity for proper identification of this disorder.

In order to screen for this disorder, the infant must be given both the screening OAE and ABR tests. If only the first stage of the screening process is completed (OAEs), the disorder will remain undetected. Only with the combination of the two screening test results will an infant be identified.

Without a complete screen of the auditory pathway, an infant with auditory neuropathy/dys-synchrony may not be identified until that child fails to demonstrate expected developmental milestones, such as responding/startling to sound or localization of sound. An older child may be at risk for misdiagnosis of either mental retardation or central auditory processing disorder, due to hearing and language difficulties despite normal outer hair cell function (Berlin et al., 2002).

Once a child has been referred for confirmation of auditory neuropathy/dys-synchrony, it is recommended that more than just the OAE and ABR tests be used. Although these two tests do provide an assessment of the auditory pathway, specifically cochlear and neural function, it is recommended that two additional tests be included in the assessment. These include cochlear microphonics to assess cochlear function, and middle ear muscle reflexes to assess neural function.

The additional information that these two tests will provide to supplement the OAE and ABR tests results will reduce the possibility of misdiagnosis, and help the audiologist to be confident that the patient does indeed have auditory neuropathy/dys-synchrony.

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Efficacy of thermal-tactile stimulation in dysphagia management

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This critical review examines the efficacy of thermal-tactile stimulation in dysphagia management. Study designs include: repeated measures design and ABAB single subject withdrawal case design. Overall, there is some evidence to support the effectiveness of thermal tactile stimulation; however, the evidence comes from studies that use healthy, normal volunteers. Therefore, it is not possible to state directly that thermal tactile stimulation is an effective therapeutic technique in dysphagia management. More experimentation is needed using persons with dysphagia.

Introduction

In the United States, it was estimated that each year, there were approximately 250,000 new cases of individuals who had a stroke, 30%-50% of these individuals also exhibited dysphagia (Rosenbek, Roecker, Wood & Robbins, 1996). A common sign of dysphagia resulting from stroke is a delay in triggering of the pharyngeal swallow which can lead to an increased risk of aspiration or choking. A therapeutic procedure that has been used for patients with delayed pharyngeal swallow is thermal-tactile stimulation.

In thermal-tactile stimulation, also known as thermal stimulation or sensitization, the clinician places a small mirror in ice until it is cold. The chilled probe is then used to stroke either one or both of the anterior faucial pillars 5 to 6 times (Rosenbek, Robbins, Fishback & Levine, 1991). The patient is then asked to swallow.

Thermal stimulation is recommended for patients who exhibit "delayed triggering of the swallowing reflex" (Rosenbek, et al., 1991, pg 1257). The term used to describe this delay is "Duration of stage transition" (DST). DST refers to the "time between the arrival of the head of the bolus at the posterior margin of the ramus and the beginning of maximum elevation of the hyoid bone during the swallow" (Rosenbek, et al., 1996). A long DST is one of the criteria needed to receive thermal stimulation (Rosenbek, et al., 1996). According to Logeman, the purpose of thermal sensitization "is to heighten the sensitivity for the swallow in the oral cavity so that when the patient voluntarily attempts to swallow, he or she will trigger a reflex more rapidly" (Rosenbek, et al., 1991 pg 1257).

More than 50% of Veterans Hospitals in the United States use some form of thermal stimulation as a technique to improve dysphagia (Rosenbek et al., 1996). However, data demonstrating the effectiveness of this technique is limited.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of thermal-tactile stimulation in triggering a pharyngeal swallow. The secondary objective is to propose evidence-based practice recommendations that can guide future research in refining the method of thermal stimulation in order to obtain more precise results.

Methods

Search Strategy

Computerized databases, such as EBM Review (all), PubMed and Medline, were used to search for articles using the following key words:

> ((thermal) OR (thermal stimulation) OR (thermal sensitization) OR (thermomechanical stimulation) OR (mechanical stimulation) OR (cold) OR (touch)) AND ((gustatory stimulation) OR taste)) AND ((deglutition) OR (deglutition disorder) OR (swallowing disorder) OR (dysphagia)) AND ((anterior faucial pillars) OR (faucial pillars)).

The search was limited to articles written in English between 1991 and 2003.

Selection Criteria

Studies selected to be critically evaluated were required to investigate the effectiveness of thermal tactile stimulation. Limits were not set on the demographics of the participants.

Data Collection

The articles that were critically evaluated had the following experimental designs: repeated measures design (7) and ABAB single subject withdrawal case design (1).

Results

Several studies have been conducted to determine the effectiveness of thermal stimulation as a therapeutic procedure to improve a delayed pharyngeal swallow; however, the findings have not provided a definite answer to this question.

The studies analyzed revealed that thermal stimulation does not play a role in triggering a pharyngeal swallow. Rosenbek et al. (1991) studied the effects of thermal stimulation on patients who had

a stroke, as well as its long-term effects on dysphagia. Long-term effects using this technique failed to be shown. Two out of three judges agreed that two subjects had a decrease in DST after thermal stimulation was used; however, the amount of aspiration and penetration did not change. This evidence leads to weak support for the effectiveness of thermal stimulation.

Two other studies looked at the effects of thermal stimulation on healthy participants. Bove et al. (1998) and Ali et al. (1996) were interested in determining the effects of a cold stimulus on the pharyngeal swallow. Both studies revealed that a cold stimulus did not facilitate a pharyngeal swallow.

Other studies have shown that thermal stimulation resulted in an improvement in the pharyngeal swallow. The earliest data were provided by Lazzara et al. (1986), who observed that "stimulation improved triggering of the swallowing reflex in 23 of these 25 neurologically impaired patients on swallows of at least one consistency" (Rosenbek, et al., 1996 pg. 226).

Rosenbek et al. (1996) conducted another study that assessed the short term effects of thermal stimulation in patients who have had a stroke. Participants who received treatment had a shorter DST than participants who did not receive treatment. It should be noted however the authors only studied the effects of temperature (i.e. a cold stimulus) on triggering a pharyngeal swallow. Therefore, thermal stimulation was effective in improving the pharyngeal swallow.

Two other studies looked at variables beyond effects of temperature on the pharyngeal swallow. Kaatzke-McDonald et al. (1996) and Sciortino et al. (2003) investigated the effects of temperature, taste and mechanical stimulation to the anterior faucial pillars. Both studies used healthy participants. The main results of these studies were similar. The application of cold stimulus to the anterior faucial pillars facilitated a pharyngeal swallow. Kaatzke-McDonald et al. (1996) observed that using solutions of glucose, saline and distilled water did not produce a significant effect in triggering a pharyngeal swallow (p>0.05). However, Sciortino et al. (2003) observed a shorter duration of swallow when the anterior faucial pillars were stroked with a cold stimulus and a sour stimulus was presented (p=0.045).

Researchers were also interested in the physiological mechanism of thermal stimulation which can provide insight to which variables are necessary to trigger a swallow. Fujiu et al. (1994) conducted an experiment using healthy participants and looked at glossopharyngeal evoked potentials induced by mechanical stimulation (i.e. using a warm rod) to the anterior faucial pillars. It was observed that one third of the subjects reported "a desire to swallow" at least once during the experiment which was not influenced by the accumulation of saliva (Fujiu , Toleikis , Logemann & Larson , 1994). Therefore, these findings suggest that touch alone influenced the desire to swallow.

Chi-Fishman et al. (1994) reported similar results. Cats were used to determine if a cold mechanical stimulus presented to the anterior faucial pillars (i.e. stimulating the glossopharyngeal nerve) could modulate a swallow produced by electrical stimulation of the internal laryngeal nerve (ILN). The rational was that simultaneous electrical stimulation of the ILN and IX can increase the frequency of swallows; thus, a similar effect may be found if ILN was electrically stimulated while IX was stimulated mechanically (i.e. room temperature vs. cold temperature) (Chi-Fishman, Capra & McCall ,1994). It was reported that mechanical stimulation of the IX along with electrical stimulation of the ILN was capable of modifying the swallow response (p<0.01). However it made no difference whether the stimulus was room temperature or cold temperature.

Conclusions

According to the literature, in order to determine the effectiveness of thermal stimulation, one needs to look at a host of factors that is inherent in the stimulation technique.The overall protocol was similar in each experiment; a stimulus was presented to the faucial pillars and then a response was measured. However, the finer detail of the protocol varied from study to study. The areas that were not consistent were: the location on the faucial pillars being stimulated, the method of stimulation (e.g. stroke vs. touch), bilateral vs. unilateral stimulation and amount of time between trials. The temperature at the tip of the probe and the length of stimulation at the faucial pillars are also important factors to consider. Selinger et al. (1994) reported that by the time the probe had been removed from ice and reached the faucial pillars, the probe had reached minimal cold sensation levels. It was further observed that six seconds after the probe had been lifted from the ice, the temperature was perceived as warm. (Selinger, Prescott & Hoffman, 1994). Therefore, by constructing a special probe that specifies the temperature at its tip, more accurate results may be obtained.

Keeping these factors constant and only manipulating specific variables, it is possible to compare the results and determine what factors contribute to the triggering of the pharyngeal swallow. By not controlling these factors, it becomes quite difficult to determine the aspect of the procedure actually contributed to the triggering of the pharyngeal swallow.

Age and gender differences were found in the study conducted by Sciortino et al. (2003), therefore it is important to consider the age and gender when selecting subjects. This study was very well constructed and provided support to the effectiveness

of thermal stimulation. However, the results obtained came from healthy, normal volunteers. In order to determine if this technique is an effective therapeutic procedure in dysphagia management, this study needs to be replicated on individuals with dysphagia.

Finally, more research needs to be conducted on discovering the kinds of receptors located in the oral mucosa. Receptors in this area do not respond to every temperature. Some receptors may respond to negative degrees Celsius and others may respond to positive degrees Celsius. Therefore, it is important to discover what temperature causes the receptors to react. Furthermore, receptors in this area do not respond to the same stimuli. Some may respond to temperature, others may respond to mechanical stimulation, where as others may respond to taste. By looking at the physiology of the faucial pillars and its receptors, it can provide information as to how thermal stimulation can be improved.

Research in this area is very important because thermal stimulation can potentially improve the patient's ability to swallow safely. As well, it can improve the quality of life by allowing the patient to return to consuming foods that he or she enjoys. Thus, it is important to investigate the effectiveness of thermal-tactile stimulation as a treatment for individuals with dysphagia.

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Impact of animal assisted therapy on aggression in persons with dementia of the Alzheimer's type

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This critical review examines the effect of Animal Assisted therapy on patients with Dementia of the Alzheimer's type (DAT). DAT is defined as: a syndrome of acquired, progressive, persistent decline in memory, language and communication, personality, spatial ability, and cognition. Methodology used to study aggression and Alzheimer's Disease (AD): between subjects, within-subjects and mixed designs. Clinical Symptoms of DAT include: confusion, wandering, agitation, fear, and reduced ability to engage socially. Patients in the later stages do not follow conversations but instead rely on intonation and word stress patterns as clues to meaning (Hopper, 2003). Institutionalized persons with DAT may experience confusion, fear, depression, overload and social isolation, especially if they are verbally disruptive and aggressive. Patients with DAT benefit from structured behavioural treatments that reduce demands on their impaired cognitive abilities and capitalize on their spared abilities (Hopper, 2003). Dogs do not place high demands on their communication partners.

Introduction

Over the past decade, interest in animal therapy has been a growing topic for assisting treatment with the elderly. Especially of interest is the use of dog therapy for Alzheimer's patients to improve their social skills and reduce aggressive behaviours. The topic of the current paper is reducing aggression in patients with Dementia of the Alzheimer's type (DAT) and the question to be answered is: is animal therapy useful in reducing such aggression.

Dementia is defined as a syndrome of acquired, progressive, persistent decline in memory, language and communication, personality, spatial ability, and cognition (Hopper, 2003). The Early Clinical stage in DAT lasts from two to four years and involves some impairment in memory and communication. Social interaction remains relatively unaffected. In the Middle Clinical stage, severe language and vocabulary restrictions begin to surface. Patients become uninhibited in their conversation and have a tendency to ramble. The Late Clinical stage in DAT occurs in the last one to three years of the disease. In this stage, agitation, fear and wandering increase. Patients do not follow conversations but instead rely on intonation and word stress patterns as clues to meaning. In the late stages, individuals with DAT are able to follow one step commands and are usually institutionalized at this point. Institutionalized persons with DAT may experience confusion, fear, depression, overload and social isolation, especially if they are verbally disruptive and aggressive. Efforts are being made to better understand and minimize these negative effects of the condition.

It has been found that people with DAT benefit from structured behavioural treatments that reduce demands on their impaired cognitive abilities and capitalize on their spared abilities (Hopper, 2003). Dog therapy fits this treatment or care model very well. Dogs place low cognitive demands on people and can provide rewarding feedback to patients. Zisselmam, Rovner, Shmuely, and Ferrie (1996) examined the effects of pet therapy intervention with geriatric psychiatry inpatients. They assigned subjects to either an exercise control group or a pet therapy group. They reported a non-significant tendency for those who receive pet therapy to have less irritable behaviour.

In 1998, Forbes conducted a systematic overview of the literature on strategies to manage behavioural symptoms associated with Dementia of the Alzheimer type (DAT). Strategies such as planned walking, music therapy and visual barriers and of importance for this paper, pet therapy, were all found to: 1) foster improvements in reducing aggressive, agitated and disruptive behaviours, 2) to increase socialization, 3) to increase abilities in self-care, and 4) to reduce both wandering and day-night disturbances. The studies Forbes surveyed reported that although there was evidence to support the benefits for the use of these strategies, more research needed to be done to gather stronger evidence in order to draw valid conclusions on whether or which of these techniques worked.

A more recent study by McCabe, Baun, Speich and Agrawal (2002) observed the effect of a resident dog on problem behaviours of people with DAT in a special care unit. These researchers used the Nursing Home Behaviour Problem Scale to document the

behaviours of the residents. They compared the behaviours of the residents that had a dog present for the day shift versus the evening shift. The results of this study were that no significant improvements were found amongst the night shift residents. The day shift residents exhibited significantly fewer problem behaviours over the four weeks of the study. These results supported the idea that there would be long-term therapeutic effects for people with DAT using dogs.

Richeson (2003) examined the effects of animal-assisted therapy on agitated behaviours and social interaction of older adults with dementia. Richeson employed the Cohen-Mansfield Agitation Inventory and the Animal-Assisted Flow Sheet as measures . Fifteen participants from nursing homes participated in the study for three weeks. Pre- and post-test results showed significant decreases in agitated behaviours and significant increases in social interaction among those adults receiving the animal-assisted therapy.

Churchhill, Safaoui, McCabe and Baun (1999) also considered the effects of a therapy dog to alleviate agitation and desocialization for people with DAT. They looked at whether short-term exposure to a therapy dog as well as other calming interventions for persons with DAT. They found significant reductions in aggression and increased socialization behaviours.

Curtright and Turner (2000) examined the influence of stuffed toy animals and live animals on communication. They compared language output and animal based therapy. Surprisingly, they found similar results for both stuffed and live animals. This suggests that perhaps animal therapy may not need to be done with live animals, but that stuffed animals are also effective. This may have been due to poor controlling for the interaction that happened with the examiners.

Baun and McCabe (2003) also considered the effects of companion animals for persons with Dementia of the Alzheimer's Type. These two researchers found that companion animals have the potential to create new meaning and bring comfort to people with DAT. They observed that when caregivers plan activities with companion animals accounting for the functional abilities of people with DAT, agitation and aggression is reduced and social interaction may be increased. As a side benefit, they also discovered that there is a potential for reduced physiological stress on caregivers of DAT patients among those caregivers who are involved with and then become close to the therapy animals.

Although research in this area is relatively new, there is promising literature to suggest that animal therapy will benefit persons living with Dementia of the Alzheimer type (DAT).   Positive therapeutic

advantages may be experienced by the persons affected with DAT.

Methods

Search Strategy

Computerized databases, including CINAHL, PsycInfo, Medline, PubMed, and Cochrane Library, were searched using the following search strategy:
((Alzheimer's disease) OR (Dementia) OR (DAT)) AND ((Animal) OR (dog) OR (pet)) AND ((rehabilitation) OR (therapy) OR (treatment)).

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of any type of animal interaction on the behaviour of people living with DAT. No limits were set on the demographics of research participants or outcome measures.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: critical review (1), pre-post tests (4), parallel-group control treatment trial (1).

Defining the IV

The Delta Society defines Animal-Assisted Therapy (AAT) as "the use of animals in goal-directed interventions specifically designed to address the physical, social, emotional or cognitive needs of individuals or groups of individuals" (Delta Society, 2003). This definition is used to distinguish AAT from other services provided by animals, such as animal-assisted activity (AAA), pet visitation, animal facilitated therapy, pet therapy, weekly dog visitations, dog therapy (including touching, brushing and petting the dogs, as well as talking about animals), and the permanent placement of a dog in the resident care unit. Variable definitions of the therapy that was being conducted with animals were provided and most researchers used the above terms interchangeably.

Results

The research question was addressed by evaluating the strengths of six articles, examining the methods used to test this hypothesis. In this paper the focus will now turn to evaluating the results reported by these studies in terms of the statistical analysis they used and their interpretations of the statistical results.

The systematic review by Forbes et al. (1998) narrowed down the selection of articles from 264 to 45 using a rating tool they created. The rating tool measured design intervention, inclusion, attrition, and control for confounders, method of data collection, and statistical analysis. Each category was divided into strong, moderate or weak based on a combination of these factors. They were attempting to determine the effectiveness of several therapies for DAT on several outcomes (i.e. aggression, self-care etc.). Their study reported p values but did not include any raw data, making it very difficult to compare with other studies. Because they reported what they believed to be significant findings, but with only the p values, and no mention of what sort of tests were done, what methods were used etc., it is difficult to assume clinical significance of any of the treatments reported.

Several other studies that were examined indicated use of two-way analysis of variance (ANOVA). These studies all reported significant increases in social interaction and/or reduction in aggressive behaviours. None of the studies reported control for investigator bias, drug interactions or observer effects. Drug interactions are especially important when studying a group of people that are known to be aggressive, because they most likely are restrained with sedatives. No studies controlled for time of medication taken, which could drastically affect results. Four studies did report the results of their statistical tests; one study did not. This study merely reported a main effect for presence of a therapy dog on the reduction of aggression by stating the statistics on increased socialization. Since this is not the reverse of aggression, results should also have been reported on the second hypothesis that animal therapy would reduce aggression.

Two of the six studies included testing to determine differences between groups (Mauchly's test of sphericity and a normality check). This allowed them to be confident that parametric tests could be used and that there were no great variations between groups that would affect the results.

One of the studies examined had such extreme flaws in the statistical analysis that this researcher discredits the results. This study reported to use a paired t-test and ANOVA as well as Chi-square for categorical variables. Since they did not have any categorical variables, they must have artificially categorized their subjects. Statistical significance was not found, but they continued to report a trend towards significance. Hence, this researcher conducted power analysis on the data to find that the actual chance that results were due to the manipulation was 0.178%, and assuming a power of 80% and an alpha of .05, they would need at least 617 subjects in order to show an effect. They then went on to discuss only women and found a significant decrease in agitation among women. However, since they were using a mean for gender rather than one for women only (and incidentally did not even get the percentage correct!), it must be concluded that this is a very weak interpretation.

In conclusion, only three of the six studies that were reviewed are considered to be strong. It is the opinion of this researcher that these three studies do measure what they claim to measure and are good papers on which to base the answer to the current research question. All three of these studies show significant decrease in aggression following some type of planned animal interaction and use appropriate measure to test this hypothesis.

Conclusion

Over the past decade interest in animal therapy has been a growing topic for assisting treatment with the elderly. Especially of interest is dog therapy for Alzheimer's patients to improve social skills and reduce aggressive behaviours. Although research in this area is relatively new, there is a strong body of evidence to support that animal therapy will benefit persons living with Dementia of the Alzheimer type (DAT). Positive therapeutic advantages occur for the persons affected with DAT as well as their caregivers.

Of 6 studies that were reviewed by this author, three were considered to be strong in term of statistical testing and methods used for analysis. It is the opinion of this researcher that these three studies do measure what they claim to measure and are good papers on which to base the answer to the current research question. All three of these studies show significant decrease in aggression following some type of planned animal interaction among residents of long term care facilities with Alzheimer's Disease. Thus, it is my opinion that there is a strong body of evidence to support clinical implementation of animal therapies.

One major factor that may have an impact on weakening my stance, is the fact that animal therapy has been so poorly defined. This problem occurred across all the studies and is relevant to my question in the way we define the independent variable. The Delta Society defines animal assisted therapy (AAT) as "the use of animals in goal-directed interventions specifically designed to address the physical, social, emotional or cognitive needs of individuals or groups of individuals (Delta Society, 2003.) This definition is used to distinguish AAT from other services provided by animals, such as animal-assisted activity (AAA), pet visitation, animal facilitated therapy, and

pet therapy. Unfortunately, there is no consistency throughout the literature to determine what term is being used to mean what type of intervention and most researchers seem to use the terms interchangeably. Over the course of my review, I found the terms: weekly dog visitations, dog therapy (cert. By Delta Society), Animal-assisted therapy (including touching, brushing and petting the dogs, as well as talking about animals), and the permanent placement of a dog in the resident care unit to be used interchangeably for the most part.

Despite this major problem with the definition of Animal Therapy, I support AAT as a valuable treatment for aggression in people with DAT. Although AAT was poorly defined, all studies found improvements in aggression levels of people who were exposed to dogs. However, these results are limited to long-term care facilities, and are only recommended as such. Since no difference was found based on the type of animal interaction, considerations such as funding may be important in choosing what sort of a program to implement in long term care facilities with people with Dementia of the Alzheimer's type. Finally, I suggest that further investigation be done to compare the types of animal therapies that were described to assess which types are the most effective.

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Evidence to support using parent-based intervention as a component of speech-language therapy for children

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This critical review investigates the impact of parent-based intervention as a component of speech-language therapy for children. Study designs include: multiple baseline design and experimental designs. Overall, the review of the research supports the use of parent-based intervention for children with speech-language delays or difficulties. More research needs to be done to examine the long-term effects of parent-based intervention, and to identify more specifically which children would benefit the most from this type of treatment.

Introduction

There are a number of treatment options for speech-language pathologists when treating children with speech and language difficulties. One of these options is using parent-based intervention (PBI). In this approach, parents are trained to provide speech-language support to their children using a variety of techniques.

There is some uncertainty regarding the benefits of PBI. On the one hand, it is suggested that parent-clinician partnerships are necessary to encourage children's development (Gibbard, Coglan, & MacDonald, 2004). It is also acknowledged that teaching parents to encourage their children's language skills is helpful in enhancing generalization of in-clinic therapy activities to the home environment (Iacono, Chan, & Waring, 1998). On the other hand, there are a few noted disadvantages to parent-based intervention. Hemmeter and Kaiser (as cited in Iacono et. al., 1998) reported that the parent is put in the role of the instructor to the child, and this will upset the parent-child relationship. Another concern is that some parents may not want to be involved in treatment of their child (Turnbull & Turnbull, 1982, as cited in Gibbard, 1994).

Objectives

Clinicians need to know that PBI is effective before implementing this type of approach. Many research studies have examined the effectiveness of PBI as a component of speech-language therapy for children. The objective of this article is to critically evaluate the literature concerning the evidence to support using PBI as a component of speech-language therapy for children.

Methods

Search Strategy

Computerized databases, including CINAHL, Psychinfo, PubMed, EBM, and Medline were searched using the following search strategy:

> ((parent training) OR (parent intervention) OR (parent education)) AND ((child) OR (pediatric)) AND ((speech-language) OR (speech) OR (language) OR (communication)) AND ((delay) OR (disorder) OR (impairment)) AND ((therapy) OR (treatment) OR (intervention)).

The search was limited to articles written in English between 1990 and 2004.

Selection Criteria

Only studies that examined the effectiveness of PBI on the speech-language abilities of children with speech-language delays or difficulties were selected for inclusion in this review.

Data Collection

Results from the literature search produced the following types of studies that met the selection criteria: multiple baseline design (1) and experimental design (4).

Results

Two of the reviewed studies compared PBI with a no-intervention control group. McDade and McCartan (1998) found that the PBI group made significant gains ($p < .01$) in expressive language in comparison with the control group. In all engagement states (interactive, unitary, and unengagement), there was not a statistically significant change in the control group, and there were significant treatment effects found for the PBI group ($p < .05$). The number of information-carrying words increased by

138% in the PBI group, and by 22% in the control group (McDade & McCartan, 1998).

In Phase 1 of a study by Gibbard (1994) comparing a PBI group with a no-intervention group, the results revealed that the PBI group made significantly greater gains in expressive language ($\underline{p}$ < .01) when compared to the control group.

Phase 2 of the study by Gibbard (1994) compared a PBI group, an individual therapy group, and a parental control group who received training on non-language related skills. Statistical analysis revealed that the differences between the PBI group and the individual group were not significant ($\underline{p}$ > .05) on expressive and receptive language variables, except for mean length of utterance (MLU). The PBI group made significantly greater gains in comparison with the parental control group ($\underline{p}$ < .05) on expressive and receptive language variables. The individual group made significantly greater gains ($\underline{p}$ < .05) than the parental control group on some measures (MLU, Derbyshire-total scores) (Gibbard, 1994).

Baxendale and Hesketh (2003) compared a PBI group (using the Hanen Parent Program (HPP)) with an individual therapy group. The study found that children in both groups improved their expressive and receptive skills by 73%. Comparison of language scores and MLU scores between the two groups revealed no significant differences. For parent interaction measures, and parent responses to child utterances, no significant differences were found between the two groups at any assessment point. The HPP was found to be more costly than the clinic-based therapy (Baxendale & Hesketh, 2003).

A similar study by Gibbard, Coglan, and MacDonald (2004) compared a PBI group with a standard care group (parent and child were seen on a three-month review and advice basis). Analysis of the results using the Mann-Whitney U Test revealed that the PBI group did significantly better than the standard care group ($\underline{p}$ < .05) on expressive and receptive variables. When the results were analyzed using ANCOVA, the PBI group did significantly better than the standard care group on expressive and receptive language variables, with the exception of the estimation of vocabulary. The cost-effectiveness of PBI was found to have no significant increase in cost per outcome gain over standard care (Gibbard et. al., 2004).

A study by Iacono, Chan, & Waring (1998), examined the effectiveness of PBI on a group of children using a multiple baseline design. A descriptive analysis was done on the results. In the study, three of the five subjects exhibited more frequent productions of linguistic units. For two of the subjects a post hoc decision was made to examine their vocalizations and gestures, and both subjects exhibited increases. When the parent strategies of each mother were examined it was found that only one mother reduced the number of child-directed utterances she produced; the other mothers showed increases. All mothers increased their use of models (i.e. reflection on child's activity), and overall use of specific teaching strategies (i.e. strategies used to extend child's utterance and elicit words) and reduced their use of directives (i.e. imperative or suggestion for child on what to do) (Iacono et. al., 1998).

A methodological strength of these studies was that they used appropriate research designs based on their research questions. All of the studies used the appropriate statistical tests to analyze their results based on the type of data, number of variables, and the type of research question. Another strength of these studies was in the interpretation of the results. All of the studies correctly interpreted p values and made conclusions regarding the results that seemed reasonable and justified.

These studies had some flaws in their methodology, research design, and interpretation of results. All of the studies failed to blind both the subjects and the experimenters. Also, all of the studies used convenience sampling in their selection of subjects, and a self-selection bias may have occurred. The lack of blinding and use of convenience sampling may have been unavoidable in the research design, and would not have skewed the results to a great degree. Lastly, none of the reviewed studies reported effect sizes which would have shown the magnitude of the difference between the groups that was found. Effect sizes may not have been reported because it was not a common procedure in the previous research.

Conclusions

Overall, these studies examining the effectiveness of PBI all reached similar conclusions and revealed that PBI was effective compared to no speech-language therapy, and equally as effective as individual therapy.

Based on the literature review and the strength of the research, there is evidence to support using PBI as a component of speech-language therapy for children. PBI is a practice that should be implemented as a component in the treatment of speech and language difficulties in children under certain conditions. In particular, the use of PBI should involve the setting of specific language objectives for families to have the most success (Gibbard, 1994). PBI also needs to be implemented with families where the parents need help on using

the appropriate language facilitation strategies (Baxendale & Hesketh, 2003). It should be noted that some children may require a more controlled and individualized approach to treatment, and PBI may not be appropriate for them (Baxendale & Hesketh, 2003). The results of the study by Baxendale and Hesketh (2003), suggested that PBI was not appropriate for children with moderate to severe language impairments. PBI has been found to be more costly than traditional clinic therapy in both of the reviewed studies that examined cost-effectiveness and families need to be chosen carefully to make sure that PBI is the best choice for them (Baxendale & Hesketh, 2003, Gibbard et. al., 2004).

More research needs to be done to examine the long-term effects of PBI. Research needs to compare the long-term effectiveness of PBI in comparison to other intervention approaches so that the most beneficial approach is chosen for use in clinical practice. Research regarding the use of PBI has proven the approach to be effective and this approach should be implemented into clinical practice. When clinicians are considering implementing PBI they need to consider the child's level of severity, the child's characteristics, the families' use of language facilitation strategies, and the cost of the program. Additional research should examine how to weight these factors when determining whether or not to use PBI. As a therapy approach, PBI has been shown to be very effective when chosen for the appropriate families. This approach needs to be implemented as a part of speech-language therapy for children because it is not only effective but will help to treat many more children who are in need of treatment.

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Clinical measurement of loudness discomfort levels

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This critical review examines the viability of directly measuring patients' loudness discomfort levels by examining the variables that may affect its measurement in given protocols. Furthermore, it investigates whether such measurements are necessary or whether alternative methods of obtaining these levels indirectly should be used. Overall research suggests that while an existing algorithm can satisfactorily predict optimum SSPL90 for a majority of patients, it will not do so for all patients. Thus, directly measuring LDLs in cases where it is possible may still be the best practice; however, a single best practice protocol has yet to be identified.

Introduction

The level of sound at which a patient experiences discomfort and will not accept listening to is commonly referred to as his/her *loudness discomfort level (LDL)*, also known as *uncomfortable loudness level (UCL or ULL)*, or *threshold of discomfort (TD)*. Clinical assessment measures commonly include procedures that measure a patient's LDLs for the purposes of selecting the saturation sound pressure level (SSPL90) of his/her hearing instrument (Hawkins et al., 1987, Dillon & Storey, 1998, Bentler & Cooley, 2001).

The rationale behind using a patient's LDLs to set the SSPL90 of the hearing instrument includes a need to maximize the patient's aided dynamic range to optimize audibility without compromising intelligibility (from saturation), to avoid rejection of the hearing aid because of discomfort to loud sounds (Hawkins et al., 1987) and to prevent further hearing loss (Dillon & Storey, 1998). For reasons such as these, there exists a need to obtain LDL measures that are both accurate and reliable (Bornstein & Musiek, 1993).

However, the task of obtaining such measures is difficult, and is largely influenced by several variables if measured directly. Such variables include psychophysical method, instruction set, signal type, signal duration, signal delivery, and auditory sensitivity (Beattie et al., 1980, Hawkins et al., 1987). In addition to this, measured LDLs should reflect real-life discomfort in order to be valid (Filion & Margolis, 1992, Munro & Patel, 1998).

An alternative method to directly measuring LDLs is proposed by Dillon & Storey (1998). Reasons for such an alternative include the difficult nature of obtaining reliable values directly, calibration issues when comparing LDL with SSPL90, limiting the measurement to one particular stimulus when setting the SSPL90 is to prevent discomfort to *all* sounds, and no evidence showing that the hearing instrument SSPL90 should *equal* a patient's LDLs.

While the reasons for obtaining or estimating LDLs are clear, it is less so as to which protocol would be the most clinically viable and it is even less evident if such measures should be obtained directly at all.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding measurement protocols for conducting LDLs. A secondary objective is to critically evaluate whether direct measurement is necessary, or whether an algorithm can be used to predict a patient's LDLs.

Methods

Search Strategy

Computerized databases, including MEDLINE-OVID and CINAHL, were searched using the following search strategy:

((loudness and discomfort and levels) OR (uncomfortable and loudness and level) OR (threshold and discomfort)).

No limitations were applied to these searches.

Selection Criteria

Studies included in this critical review paper had to examine any LDL measurement techniques and procedures, any variables related to its measurement, as well as alternatives to using this measurement in clinic for the purposes of fitting a hearing instrument. No limitations were placed on any factors that may affect LDL measurement, such as demographics of research participants.

Results of the literature search revealed two main types of research designs: repeated measures and crossover designs.

Results

Effect of Different Variables on LDL

Psychophysical Method

A single psychophysical method was not demonstrated to be superior, but significantly different LDLs were obtained between methods (Morgan et al., 1974, Hawkins et al., 1987, Bentler & Cooley, 2001). The method employed by Hawkins et al. (1987), yielded LDLs that were found to be more stable over time (4 dB shift over 4 days) when compared to a Bekesy procedure from Walker and colleagues (>20 dB shift over 4 days). In a previous study done by Morgan et al. (1974), a constant stimuli procedure was seen to produce more reliable LDLs than two other procedures (adjustment and tracking).

Instructional Set

Different instructional sets resulted in statistically significant LDL differences (Beattie et al., 1980, Hawkins et al., 1987). It was suggested that more stable and accurate LDLs would result when the instruction set included the following: specifying a time period and criterion for judging the loudness of the signal (Beattie et al. 1980), clearly defining the term "uncomfortable", giving a clear yet simple task to follow (where it is more concerned with making loudness judgements rather than button-pushing), providing printed material showing the different categories of loudness, and conveying the importance and use of the test to the patient (Hawkins et al., 1987).

The wording of the instructions should elicit loudness judgements rather than quality judgements, (i.e. "uncomfortable" should be used rather than "annoying") (Bornstein & Musiek, 1993). In addition, the clinician should be aware of stress and intonation verbal cues, as well as nonverbal cues, when instructing the patient on the task (Beattie et al., 1980).

Signal Type

Different frequency-specific stimuli (puretones, one-third octave band noise, one-third octave band filtered speech centered around 250, 500, 1k, 2k, and 4k Hz), did not result in statistically significant differences in LDLs. According to Dirks & Kamm, pulsed stimuli would prevent adaptation effects (as cited in Bornstein and Musiek, 1993). A general trend for LDLs to increase with higher frequencies

was noted (Beattie & Boyd, 1986, Hawkins, 1980, Morgan et al., 1974).

Similarly, different speech-like stimuli (wide-band noise, spondaic words, sentences) did not result in any statistically significant differences in LDLs (Hawkins, 1980). Findings were consistent when different recorded speech stimuli were used (Edgerton et al. 1980). No effect was found for different-gendered talkers (Bentler & Nelson 2001).

The predictive nature between puretone LDLs and speech LDLs was studied to determine if they would result in different values. When mean speech and puretone (500, 1k, 2k, 3k Hz) LDLs were compared, no statistically significant differences were found. Although very weak (p<.01), a statistically significant predictive relationship was observed between puretone and speech LDLs, but a large standard error (SE) shows that it does so inaccurately (SE ~9.5 dB) (Beattie & Boyd, 1986). A more recent study suggests that speech LDLs can be more accurately predicted from puretone LDLs if measured at 750, 1.5k, and 3k Hz (Bentler & Nelson, 2001).

Signal Delivery

No statistically significant differences were found when two different transducers (insert phones v.s. headphones) were used to obtain LDLs (Valente et al., 1997). It was shown that reliable LDLs can also be obtained in soundfield (Bornstein & Musiek, 1993). Significant differences in LDLs were found when speech stimuli were delivered via monitored-live voice across different clinicians (p<0.01) (Sammeth et al., 1989).

Signal Duration

An inverse relationship between signal duration and LDLs was revealed, showing that patients will tolerate louder sounds if they are shorter in duration (Fortune & Scheller, 2000). A statistically significant correlation was found between clinically measured LDLs and discomfort ratings for longer duration sounds (such as traffic), but could not be found for shorter duration sounds (Munro & Patel, 1998).

Auditory Sensitivity

Greater LDL values were observed for increasing hearing losses (thresholds) across several studies (Edgerton et al., 1980, Valente et al. 1997, Bentler & Cooley, 2001). Furthermore, it was revealed that ears with flat losses have a greater correlation between thresholds and loudness (p<0.001) than those with sharply sloping losses (Sammeth et al., 1989). A general trend for LDL values to remain fairly constant for hearing thresholds up to 45 dB HL, and gradually increase

with increasing puretone thresholds was noticed (Edgerton et al., 1980).

Contrary to this common trend, a more recent study revealed that normal hearing individuals demonstrated significantly higher LDLs than those with hearing impairments. This contradiction may be explained by the fact that hearing impaired ears are thought to experience greater loudness summation (due to increased critical bandwidth), and previous studies used puretone stimuli rather than complex stimuli, which may result in lower LDL measures (Bentler & Nelson, 2001).

Age & Gender Effects

No statistically significant differences were found between LDLs obtained from males and females. Similarly, no significant differences were shown to exist between LDLs obtained from adults and children (7-14 yrs.) (Kawell et al., 1988).

Alternative Method to Direct Measurement

In a study that compared outcomes from clinically measured LDLs to those predicted by an algorithm using patient hearing thresholds, it was seen that although the measured LDLs improved accuracy of predicting the optimum SSPL over the algorithm, they did not do so significantly. In fact, SSPL was demonstrated to be almost as well predicted from 3FA thresholds (500, 1k, 2k Hz), and is easier to measure (Storey et al., 1998). The predicted SSPL was deemed acceptable by 86% of the subjects (n=29) in a laboratory evaluation, and 63% of the subjects (n=32) in a field experiment.

Reliability and Validity

Test-Retest Reliability

Consistent with other findings, within session and between session variability using speech stimuli was found to be relatively low (Sammeth et al., 1989), showing that LDLs can be measured quite reliably. Test-retest levels were found to be within 5-10 dB in almost 95% of the subjects (Edgerton et al., 1980, Beattie & Boyd, 1986).

However, it has been demonstrated that intra- and intersubject variability is another matter, and can vary as a function of procedure employed, instruction set, signal type and frequency (Hawkins, 1980, Hawkins et al., 1987, Bornstein & Musiek, 1993, Valente et al., 1997). Edgerton et al. (1980), showed that a large degree of intersubject variability in LDLs for a given threshold can be found, and that prediction from thresholds alone could not be accurate. Reported results from Sammeth et al. (1989), support such findings.

External Validity

Filion & Margolis (1992), found clinical LDL judgements to be poor predictors of real-life impressions of discomfort. On the contrary, Munro & Patel (1998), showed that when the SSPL90 was set to levels determined by clinically measured LDLs, subjects did not express real-world auditory discomfort, and were more likely to experience discomfort to environmental sounds of longer durations when the output exceeded these levels. Clinically measured LDLs predict real-life auditory discomfort, at least for longer duration sounds such as wind or traffic noise (p<0.01).

Predictive Validity

When incorporated into the fitting, clinically measured LDLs only slightly improved the accuracy of predicting optimum SSPL; rms error was 5.9 dB. The theoretical formula from Dillon & Storey, (1998) was found to be almost as good a predictor of acceptable SSPL, with an rms error of 6.3 dB (Storey et al., 1998).

Conclusions

While research has consistently demonstrated the importance of obtaining accurate, reliable, and valid measures of LDL for the purposes of selecting the hearing instrument's SSPL90, no specific "best practice protocol" has been identified. Given the evidence described in the preceding paragraphs, the following is an attempt to describe which variables should be included in such a protocol.

The psychophysical method and instruction set suggested by Hawkins et al. (1987), may provide a good means of obtaining reliable LDLs because of its clear instructions, simple-to-follow task, it gives the listener the purpose of the task and loudness criterion for judging, provides categories above and below the target category (uncomfortable), and is more conducive to judging loudness than quality. Furthermore, the listener can read the instructions from a paper, along with the examiner, and the examiner provides no further interpretations.

While evidence may seem to support the use of speech-like (complex) stimuli (i.e. close correlation between longer duration sounds and LDLs, and use of meaningful stimuli), it may be more useful to determine frequency-specific LDLs simply because of the way a hearing instrument is fit (frequency-by-frequency, or by channels). If speech-like stimuli *is* to be used, its presentation should be standardized and recorded, not monitored-live voice. Either gendered talkers should result in similar LDLs.

LDLs obtained using frequency-specific stimuli centered at 750, 1.5k, 3k Hz may actually be good

predictors of real-life situations (complex stimuli) if all frequencies cannot be obtained. As well, it can be completed in less time and be less fatiguing to the patient. Although puretone stimuli may be too short in duration if pulsed (which may reveal elevated LDLs), it may avoid adaptation effects.

Depending on the protocol of any given clinic, measurement of LDLs using insert phones or headphones should not result in significant differences. Given what the field has come to realize about the advantages of testing with insert phones, its use may be considered first, but will not result in inappropriate levels if headphones must be used for one reason or another. Soundfield testing may also be used if necessary.

Although there is some evidence to suggest that it would not be worth measuring LDLs for the purposes of selecting the SSPL of a hearing instrument, and can be almost as well predicted using 3FA hearing threshold data, the authors have recognized that because there will be patients that do differ with respect to the predicted SSPL, evaluation and fine-tuning is still absolutely essential (Storey et al., 1998). Given this and the high intersubject variability identified by many authors, it would be in the best interest of the patient if LDLs can be obtained via direct measurement. Because concern should be about the individual patient, such variability is alarming; for the same hearing thresholds a wide range of LDLs can be possible.

However, if accurate measures are not possible to obtain (such as with very young children, or difficult-to-test patients), an alternative method may be used to predict a patient's LDLs. It has been demonstrated that such a method will predict an acceptable SSPL setting for a majority of patients, and does not require age or gender considerations.

In the words of Valente et al. (1997), "The available technology does not appear to provide clinicians with any justifiable reason to simply complete an audiogram and allow software to predict the LDL using algorithms based on average group data" (pg.66). Until evidence can demonstrate greater strength of using predicted LDLs to select the SSPL90, clinicians should be aware that directly measuring LDLs is advisable, but should be conducted in a standardized manner based on the evidence.

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The Desired Sensation Level (DSL) method in 2004:
DSL m[i/o] version 5.0

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The Desired Sensation Level (DSL) Method for the electroacoustic selection and fitting of hearing instruments for infants, children and adults has been revised on several occasions to keep pace with changing technology. The computer-assisted implementation of the DSL method was first released in 1993 (DSL 3.1) and was updated to DSL[i/o] for wide-dynamic range compression in 1996. Version 5, the most recent version, has been enhanced for multi-channel, multi-slope digital devices and to address new verification protocols in hearing instrument fitting. The poster will describe these enhancements, which include 1) a multi-channel, multi-slope input/output strategy for use with newer technology, 2) a technique for hearing instrument fitting utilizing ABR data, 3) new RECD data, and 4) 'range' of targets for adult fittings.

Do audiologic rehabilitation efforts have a positive impact on coping and communication?

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This critical review examines the effects of audiologic rehabilitation efforts on coping and communication of older adults with hearing loss. Study designs include: randomized controlled trials, quasi-experimental designs, and group experimental designs. Overall, research supports the positive impact of audiologic rehabilitation efforts on coping and communication of older adults; however, issues in research design as well as the clinicians' own views impact the acceptance and the use of audiologic rehabilitation efforts in the clinical environment and as such, must be addressed.

Introduction

Audiologic rehabilitation (A/R), which was once considered at the center of the field of audiology, has gone through many changes in the recent past. As a result, the provision of A/R in the clinical environment has been challenged and A/R has moved into the periphery of many audiological practices.

During the past decade, A/R in general and the use of hearing aids in particular, has been the subject of growing interest and activity. One reason for this is the realization that for many hearing-impaired individuals, the fitting of hearing aids is not a simple and straightforward road to improving communication problems caused by the hearing loss (Arlinger, 2000). In this respect, the current focus on hearing aids as the predominant form of intervention is inadequate for the majority of older people with hearing impairment (Hickson et al, 2003). Kochkin (1996) reported that 18% of people who own aids do not wear them, 17% of aids are returned for credit, and only 53% of hearing aid users expressed satisfaction with their hearing aids. A/R beyond that of hearing aid provision alone is clearly warranted (Kochkin, 1996).

Personal perception of handicap is reduced after a short-term A/R program, or after being fit with hearing aids (Weinstein, 1996). However, economical constraints have become evident in many health-care systems, increasing the demands for providers of A/R to show what benefits the patients obtain after various kinds of intervention and at what cost, i.e., cost-benefit analysis (Abrams et al., 2002). As well, the application of new technology to A/R has also brought about a need to evaluate the impact of intervention strategies on the services provided to participants in A/R programs.

To justify A/R as a clinical procedure, as well as part of audiological curricula, A/R must be proven to have a positive impact on coping and communication on individuals with hearing loss. This would facilitate acceptance of A/R services by third-party insurers and health care administrators.

Objectives

The primary objective of this paper is to critically evaluate existing literature regarding the impact of A/R efforts on coping and communication by adults with acquired hearing loss.

Methods

Search Strategy

Computerized databases, including CINAHL, PubMed, and Cochrane Library, were searched using the following search strategy:

> ((audiologic rehabilitation) AND ((aural rehabilitation) OR (aural rehab) OR (communication courses).

The search was limited to articles written in English between 1985 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper investigated the impact of any type of A/R efforts on coping and communication of individuals with hearing loss. No limits were set on the demographics of research participants or outcome measures.

Data Collection

Results of the literature search yielded the following types of articles congruent with the aforementioned selection criteria: randomized controlled trial (RCT) (2), experimental group designs (2) and quasi-experimental design (1).

Results

With respect to the literature reviewed, most studies showed that A/R efforts did have a positive impact on individuals.

Randomized Controlled Trials

Beynon and colleagues (1997) evaluated the benefits of a communication course for first time hearing aid users. Individuals fitted with hearing aids for the first time were randomized into two groups, a treatment group and a control group. After the initial fitting, patients first wore the hearing aid for six weeks. Those individuals assigned to the treatment group then entered a four-week communication course. Hearing handicap was measured by means of a self-rated questionnaire (Quantified Denver Scale of Communication (QDS)) at the time of hearing aid fitting and 13 weeks later. Reduction in handicap, as measured by the change in QDS, was significantly greater for the treatment group than for the controls.

Abrams et al's (1992) randomized controlled study found similar results. The effect of a group counseling-based communication course in addition to amplification (group 1) was compared to patients receiving hearing aid only (group 2) and those with neither hearing aids nor A/R. The effect on self-perceived handicap was measured by the change in HHIE pre- and post-intervention. For both experimental groups, hearing handicap was reduced as a function of intervention whereas there was no change in hearing handicap for the controls.

A limitation of these studies is the use of self-assessment scales as outcome measures. Although these inventories may represent the best estimates of the clients' performance, reactions, and feeling, in day-to-day communication, the inventories are far from perfect. For example, their content does not tap many aspects of interactive communication, they are based on no accepted model of communication breakdown, and they are not designed to assess change per se and may do it ineffectively (Montgomery, 1994). Also, the use of inventories assumes literacy and motivation on the part of the client, which is not always the case.

Experimental Group Designs

Kricos et al (1992) examined the efficacy of a communication-training program for elderly adults with hearing impairment. An experimental group received a 4-week communication-training program whereas the control group received no training. Results revealed significant reduction in self-perceived hearing handicap and slight but significant improvement in speech recognition ability for all subjects.

Kricos et al (1996) examined a controlled trial of active listening training to determine the efficacy of A/R using measures of speech recognition, self-perceived hearing handicap, and psychosocial status. Two intervention procedures were evaluated. Pre- and post-treatment speech recognition measures, psychosocial assessments, and hearing handicap scales systematically evaluated the effectiveness of the procedures. Active listening training was found to be an effective rehabilitation procedure improving both speech recognition and psychosocial functioning.

A limitation of these studies is that they are based on group means. They tend to ignore individual differences, which are readily apparent from variability among subjects within groups. Concluding that a treatment is effective pertains to the group mean and does not imply that every individual within a group responded in the same manner.

Quasi-Experimental Design

Hickson and colleagues' (2003) study, looked at the benefits of communication education programs. The experimental group attended a communication education program whereas the control group received a communication assessment but no intervention. Significant improvements were found in the experimental group in terms of knowledge about communication changes with age and about strategies to maintain communication skills compared to the control groups. Ten years later, the experimental group was still found to be coping and managing well relative to the controls.

A limitation of this study is the sample population was restricted to those individuals who read newspapers and/or read notice boards in senior's centers. A second limitation is the subjective manner in which individual were assigned into control and treatment groups skewing the results in favor of individuals interested in the communication program and aware of the study.

Conclusions

General consensus appears to be that A/R efforts have a positive impact (Abrams et al, 1992; Beynon et al, 1997; Hickson et al, 2003; Kricos et al, 1996). The following recommendations may help move A/R back to the center of the profession as it once was.

One recommendation is methodological flaws that exist in research designs be addressed. For instance, the development and agreement of outcome measures that reflect communication performance in everyday listening and speaking situations is essential.

A second recommendation is aimed at clinicians. To maintain A/R as an integral part of the profession, it is just as important for clinicians to implement A/R into their clinics as it is for research to show the positive results of A/R efforts.

A third recommendation is for educational institutions to continue to teach future audiologists the importance of A/R and provide training in A/R.

These recommendations may help to ensure that A/R remains a vital and integral part of the field of audiology as it was once, and as it should be.

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Identification of discourse comprehension impairments

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Two new measures of language comprehension, the **Joint Story Retell (JSR)** and the **Expectancy Violation Detection Task** (**EVDT)** designed for preschoolers were evaluated in this investigation for the purpose of identification of language comprehension impairments in young children. Results demonstrated that children previously identified with language impairments performed significantly more poorly on these two measures than children in the same age range who were developing language normally. Additionally, taken together the JSR and EVDT correctly classified 85% of the study's participants according to their original group assignment, language impaired or normally developing. Thus, these measures are sensitive to language comprehension impairments in young children and may be used with confidence in the early identification of children with language comprehension impairments.

Cochlear implants and optimizing speech perception

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This critical review examines which preoperative measures dictate which individuals will adapt most quickly and optimally to their implants. Study designs include: quasi-experimental designs, case control, and cohort study. Duration of deafness and speech performance pre-implant appear to be the most influential candidacy criteria in terms of postoperative speech performance and the adaptation process required for postlingually deaf adults to adjust maximally has been recognized to be between 12 and 24 months however, the collective interaction between multiple variables affecting post-implant success has yet to be investigated.

Introduction

A number of factors must be addressed when cochlear implantation is being considered as a treatment option for adults with severe to profound sensorineural hearing losses (acquired postlingually) who do not benefit from standard amplification. Unlike other clinical interventions, such as getting prescription glasses to correct near-sightedness, getting a cochlear implant (CI) typically requires substantial learning and adaptation before the user can obtain maximum perceptual benefit (Svirsky, et al., 2004). It cannot be predicted how much benefit, in terms of speech recognition, a person will receive from a CI. Nevertheless, several factors appear to be significant contributors. Thus, assessing candidacy is of utmost importance in determining which individuals would be more likely to utilize their implants optimally.

Candidacy criteria for CI-ation have evolved in synchrony with speech processing technology (David et al., 2003). The current criteria differ from earlier guidelines that required both higher pure tone thresholds and poorer aided speech discrimination scores for candidacy (David et al., 2003). For postlingually deafened adults, the current criteria for implantation require speech reception to be less than 40% of words in the best aided condition (Copeland & Pillsbury, 2004). This often translates into 10% correct responses in open-set (no contextual or visual cues) single-word testing (Copeland & Pillsbury, 2004).

Whatever the limitations that may hinder speech perception upon initial stimulation with a CI, it appears that perceptual adaptation does take place and is largely successful, with no significant evidence of enduring preconceptions. However, this adaptation process can take several months or even years. Duration of deafness and speech performance pre-implant appear to be the most influential candidacy criteria in terms of postoperative speech

performance. Potential rehabilitative measures to facilitate pre-implant speech performance may contribute to post-implant success. The development of alternative signal processing and rehabilitation procedures to facilitate and increase the speed of the adaptation process may result in important increases in the quality of life of some CI recipients over the first few months or years after CI-ation (Svirsky et al, 2004). Further research is needed with respect to candidacy issues governing successful post-implantation speech performance.

Objectives

The purpose of this paper is to address the question: which pre-implantation criteria are the best predictors of successful post-implantation speech performance. In other words, what preoperative measures dictate which individuals will adapt most quickly and optimally to their implants?

Methods

Search Strategy

Computerized databases, including PsychInfo, PubMed, and Cochrane Library, were searched using the following search strategy:

> ((cochlear implant) OR (cochlear implantation)) AND ((speech perception) OR (speech recognition) OR (speech comprehension)) AND ((adults) OR (postlingual adults)).

The search was limited to articles written in English between 1990 and 2004.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the candidacy criteria or technological variables which best predict the postoperative speech recognition abilities of postlingually deafened adults who have

received CIs. Limits were set on the age of research participants as well as communication preference, but not for other demographic variables or outcome measures.

Preoperative measures, the number of participants, the time interval over which subjects are evaluated, the stimuli used and the tests employed were all methodological considerations in examining the predictors of optimal speech perception in CI users.

Data Collection

Results of the literature search yielded the following types of articles fitting with the aforementioned selection criteria: quasi-experimental design (8), case control (2), and cohort study (2).

Results

Preoperative candidacy criteria

In a quasi-experimental comparison of published and composite data sets including 808 CI users, Blamey et al. (1996) found that duration of deafness had a strong negative impact on the auditory performance of postlingually deafened adult implant users. Age at onset of deafness had little effect on performance up to age 60, while age at implantation had a slight negative effect (Blamey et al., 1996). Duration of implant had a positive impact on performance and etiology had a weak effect on performance (Blamey et al., 1996).

Rubenstein et al. (1999) aimed to determine the effects of preoperative speech reception on postoperative speech recognition with a CI. They found that duration of deafness and preoperative sentence recognition are both significant predictors of word recognition with a CI and can account for 80% of the variance in word recognition.

In the study by David et al. (2003), which examined the impact of speech coding strategy on the speech perception performance in severe and profound postlingually deafened adults, open-set speech recognition sequences revealed significant improvements in word and sentence scores as innovative technology applied new speech coding strategies. Analysis of covariance was performed to determine whether duration of deafness and preoperative aided sentence recognition, in addition to pure tone averages, could alter the differences in speech perception scores measured between speech coding groups. Analysis of covariance confirmed that these selection variables did not change the relationship of the differences observed between speech coding strategies. Subgroup analysis of profoundly deafened patients supported this. Thus, while duration of deafness and preoperative sentence

recognition were shown to have an impact on speech perception skills, the particular speech coding strategy did not seem to have a significant effect on adult CI users.

Duration of Adaptation

Oh et al. (2003) evaluated the long-term speech perception of cochlear implantees and compared the developing auditory performance patterns of prelingual children and postlingual deaf adults. In the postlingual adults, the average results did not improve further after 2 years. The data for the postlingual adults were subgrouped according to the duration of deafness (short-term, < 5y, long term, ≥5y). In the short-term group, the speech perception performances recovered at a faster rate and showed greater improvements within 1 year after implantation (71% performance level at 12 months) than the long-term group. The long-term group showed smaller improvements in K-CID (Korean version of Central Institute of the Deaf test) score and a plateau of a 27% performance level was only achieved after 2 years.

In one case control design, Gomaa et al. (2003) evaluated the validity of the previously reported predictive index for postoperative CI performance, based on preoperative duration of deafness, and speech recognition. They found that postoperative performance as measured by consonant-nucleus-consonant word scores had an inverse relationship with the duration of deafness, and a direct relationship with the preoperative performance on CID sentence recognition tests.

Svirsky et al. (2004) evaluated CI users in a quasi-experimental design. This showed that although implant users performend more poorly than normal-hearing listeners, they also showed significant learning and adaptation over time and achieved nearly normal performance after some experience with the CI.

In a 10 year longitudinal study, Hildesheimer et al., (2001) studied 27 adults and 35 children who each completed 4 speech perception tests. They compared long-term speech perception improvements experienced after cochlear implantation. Results show that average open-set score results of adults were similar to those of children (Hildesheimer et al., 2001). Those adults with 6 months to 1 year of device use reached their maximum performance on open-set tests (Hildesheimer et al., 2001).

Difficulties in Research Designs

The research design and outcome measures used determine their generalizability to the greater population of adult CI users. Randomly controlled trials (RCTs) using a large, uniform sample population, tested both preoperatively and

postoperatively with outcome measures reflective of real world speech recognition are ideal, but may not be possible. In the methodological review of the above mentioned studies, it was suggested that double-blind randomized trials be employed. However, the double blind RCTs in this particular area of interest is difficulty. While clinicians may be blinded , it is not possible to blind the subjects because any changes made to the mapping of the electrodes would be immediately perceivable to the subject. Also, one of the principles of RCTs is the assumption that subjects are randomly selected from a larger population of cochlear implanted adults. However, given the already small population size of cochlear implanted adults, random selection of subjects from within this population could amount to a very small sample size The statistical power and generalizability of a research design is increased by a greater number of participants in the study. For this reason, many studies use convenience samples in order to evaluate as many patients as possible.

Conclusions

We now have high levels of control over response patterns in the auditory nerve, which in turn offers the potential to reproduce normal auditory processing more closely than was previously possible (Wilson et al., 2003). Despite this, many researchers have documented that there is an initial discrepancy between the stimulation patterns provided by a CI and the listeners' expectations of how speech should sound, which, in the case of postlingually deafened CI users, would be expected to be stored in the patients' long-term memory (Svirsky et al., 2004). There are many factors contributing to this, and recommendations to resolve these issues are the focus of this paper.

Svirsky et al. (2004) illustrate that unlike other clinical interventions, such as getting prescription glasses to correct near-sightedness (which, more often than not, results in immediate benefit), getting a CI typically requires substantial learning and adaptation before the user can obtain maximum perceptual benefit.

Despite the early difficulties that may limit speech perception upon initial stimulation with a CI, studies suggest that perceptual adaptation does take place and is, for the most part, successful, with no substantial indication of residual biases (such as a basalward shift or other types of frequency shifts) once the adaptation process is over (Svirsky et al., 2004). However, this adaptation process can take several months or even years.

The adaptation process required for postlingually deaf adults to adjust maximally to a CI has been accredited to be between 12 and 24 months (Hildesheimer et al., 2003; Svirsky et al., 2003). It has also been suggested that at least part of this post-implantation adaptation is related to changes in speech sound labeling, a process whereby the listener modifies his/her expectations concerning the perceptual patterns associated with different speech sounds (Svirsky et al., 2003). This process may be further may be facilitated if comprehensive rehabilitative training programs are made available postoperatively.

It has been demonstrated that two significant predictors of speech perception ability with implants are preoperative sentence recognition and duration of deafness (David et al., 2003). It has been suggested that preoperative residual speech recognition acts as a "trophic factor" that protects the spiral ganglion and/or the central auditory pathways from degeneration (Gomaa et al., 2003). Taken together, these two variables account for approximately 80% of speech recognition scores postoperatively (Rubenstein et al., 1999). Thus, predictability of CI outcome is possible depending on the preoperative duration of deafness and speech recognition abilities (Gomaa et al., 2003). Nonetheless, these variables cannot entirely explain the differences in speech perception scores measured between speech coding groups (David et al., 2003).

It is highly recommended that other variables be taken into consideration to generate a more accurate prediction of postoperative speech recognition performance. It is thus necessary to understand other possible predictors of outcome, such as lip-reading ability, nature of and age at onset of deafness, use of a hearing instruments, cognitive skills and rehabilitative training post-implantation (Oh et al., 2003).

There are many areas of cochlear implantation that, with further investigation, may provide parallel improvements in speech recognition abilities for implant users. Stimulation with bilateral implants has provided important advantages for many patients, including head shadow benefits, and binaural summation and binaural squelch or both for some patients (Wilson et al., 2003). Further investigative efforts in this area may indicate better ways to gain benefits from binaural implants. Another area that should be the focus of some future studies is to find predictors of the rate and speech coding strategy will provide the individual with maximal perceptual benefit (Skinner, 2003). Wilson et al., suggest that future research efforts may also bring about applications of intramodiolar implants, with the accompanying possible advantages of reduced stimulus levels (and power consumption), increased spatial specificity of neural excitation, and a larger number of stimulus sites. It is essential that attention

is directed to discovering how a combination of behavioral responses in addition to analysis of intracochlear responses to stimulation on the electrodes might make clinical fitting more constructive than using behavioural responses alone (Skinner, 2003). These future research efforts are expected to bring with them an improvement in the speech perception ability of future implant users.

With the recent advances in speech processing strategies and the anticipated improvements in implant technology as well as clinical fittings, more rigorous speech recognition test batteries may be required to quantify these advantages. Skinner (2003) makes the insightful recommendation that the relation of speech recognition to the combined effects of electrode position, intracochlear neural responses, processor fitting parameters, cognitive and verbal skills, cause of hearing loss, and biographical factors may present important goals on how to provide patients with maximal speech perception benefit from their cochlear implants.

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Oropharyngeal stimulation with air-pulse trains increases swallowing frequency

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While previous research has suggested that sensory stimulation applied to the faucial pillars can facilitate swallowing, the range of stimuli that is effective in facilitating swallowing remains unclear. We sought to determine whether oropharyngeal air-pulse stimulation would facilitate swallowing in healthy subjects. Preliminary results from four subjects showed that oropharyngeal air-pulse stimulation evoked an irrepressible urge to swallow, followed by an overt swallow as verified by laryngeal and respiratory movements. Moreover, air-pulse stimulation was associated with a significant increase in swallowing frequency. These findings in healthy adults suggest the possibility that oropharyngeal air-pulse stimulation may have clinical utility in dysphagia individuals who experience delayed triggering of the swallow reflex.

Is there evidence to support using parent report as a screening tool for identifying children with speech and language delay?

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This critical review examined four articles for evidence concerning the using of parent report as a screening tool for identifying children with speech and language delay (SLD). Overall, research supports the use of parent report for identifying children with SLD; however, systematic review of said literature revealed liabilities deficiencies in methodology and interpretation of results, potentially affecting outcomes. These concerns are discussed and recommendations for practice are presented.

Introduction

With the movement towards evidence-based practice in health professions, there is increased pressure on speech-language pathologists (SLPs) to make clinical decisions that comply with current research findings. Identifying children with speech and/or language delay (SLD) and then prioritizing those who require treatment is a daily task required of clinicians. The use of screening tools, such as parent report measures, can theoretically help in this decision making; these tools could save time, money and resources (materials and people) allowing for more efficient service because SLPs would not be required to spend time on a full speech-language assessment where unnecessary (i.e. those children who passed a screening). However, before we replace the traditional clinical evaluation with such parent screenings we must examine the specificity and sensitivity of screenings tools; using screenings simply because they can be implemented quickly does not ensure they will produce valid and reliable results. The clinical significance of low specificity of a test includes potentially misidentifying normally developing children as below age-appropriate expectation; the clinical significance of low sensitivity values includes potentially missing the children who should be appropriately identified as delayed. Each of these situations has serious social (peer relationships, acceptance, etc.), financial (misuse of resources, long term costs of delayed developmental skills such as education or employment opportunities, personal independence, etc.), and psychological (stigma of therapy, diagnostic labeling, or lack thereof; self-esteem; etc.) implications. Therefore, it is necessary to ensure professional confidence in these measures before we can implement them in our practices. This paper reviewed current research in order to resolve if evidence exists to support the use parent report as a screening tool for identifying and prioritizing children with SLD.

Objectives

The objectives of this paper were to critically evaluate existing literature regarding parent report as a screening tool for identifying children with SLD and propose evidence-based practice recommendations based on findings.

Methods

Search Strategy

Computerized databases, including PsychInfo, CINAHL, EBM Reviews, and PubMed, were searched using the following search strategy:

> parents and speech disorders OR parents and language disorders OR screening and development OR parent report and language OR parent report and speech OR parent concern and language OR parent concern and speech OR parent screening and language OR parent screening and speech.

The search was limited to articles written in English between 1990 and 2004.

Selection Criteria

Studies were selected for this critical analysis based on the following criteria: they discussed parent report as a measure of speech and/or language delay and compared it to another form of clinical evaluation. Studies that examined parent report with respect to specific speech and/or language related disorders, such as autism and ADHD, were excluded.

Results

Three of the articles reviewed supported the use of parent report as a method for identifying children with SLD. The fourth article reported the neither

parent screening or structured screening against which it was compared resulted in high enough specificity or sensitivity values to warrant clinical significance. However, critical analysis revealed that these findings may not be as rigourous as suggested. The results of the critical analysis will now be discussed.

Analysis of Methodology

On the whole, the methodology of each study was poor. The primary problem concerned the measures against which parent report was compared: psychometrics and norming of the outcomes measures were poor and/or lacked standardization themselves. For example, one author employed a test normed on a very different population from that which was investigated. Additionally, if we are not confident that the outcome measures actually measured what they were intended to measure, we do not know how to interpret the results of comparisons between them and parent screening tools. While many of the outcome measures were and continue to be considered standard clinical practice, making the studies very practical from a clinical perspective, they were not and continue not to be standardized measures; many leave much to be desired from a statistical viewpoint. Measures against which the parent screening tools are compared need to be more rigourous in their psychometric qualities to ensure that we are validating the screeners against measures known to be valid and reliable themselves.

Other common flaws in methodology included vague procedures and sampling issues, specifically small or homogenous sample populations. For example, one study only examined 64 children from Wyoming while another only included children from a research subject pool from the University of Washington. Replicating such studies would prove difficult given unclear procedures and without replication, we cannot validate findings. Further, weak sampling precludes the ability to generalize findings to other populations, inhibiting the implementation of evidence-based practice because any findings are evidence only for that specific group of people. This, therefore, prevents any potential contribution the study might make to the evidence base of research.

The Ideal Design

Comparing parent screening results to standard clinical practice outcomes seems to be an appropriate way to determine validity of parent report as a means for identifying children with speech and language delay. However, future studies need to examine larger numbers of more representative samples. Research done on small samples in Wyoming or

England cannot be generalized to the common population of North America; more systematic and larger-scale investigations need to be conducted. Furthermore, measures against which the parent screenings are compared need to be more rigourous in their psychometric qualities. We need to ensure that we are validating the parent report against measures that are valid and reliable themselves. Without this, no parallel between standard screening tools/assessment measures and parent report can be made. Lastly, the ideal design should include procedures that are more clearly delineated than those in the current review. This would ensure replication of research is possible and that the evidence base could be furthered more confidently.

Analysis of Results and Interpretations

While most of the researchers employed appropriate statistical analyses (e.g. they used discriminant analysis for associational questions), their interpretations were often vague or incorrectly presented. For example, one author presented numerical data but failed to clarify what variables had been analyzed to produce such results. Another author incorrectly stated that results were significant when in fact the reported p value was above the value typically associated with significant. Results presented in manners such as these examples, leave readers with little confidence in the data reported. The implication of flawed results and interpretation is twofold: (1) readers are likely to disregard any findings; and (2) potentially valuable findings will not be incorporated into practice, thus impeding evidence-based practice. Thus, on this basis, it is difficult to accept the current research on parent report as a screener for identifying children with SLD.

Recommendations

Based on critical analyses of each study's methods, results, and findings, it is recommended that due to the inconclusive evidence and shortcomings in research, traditional clinical evaluations should remain standard clinical practice; such evaluations may incorporate parent report, but should not be replaced by parent screenings.

Of the studies reviewed, only one reported clear statistical significance and discussed the clinical significance; two others were vague in their results and one presented potentially misleading findings as some values were inappropriately interpreted. The fourth study reported that neither the parent-led screening tool nor the structured screener against which it was compared resulted in specificity and sensitivity values high enough to warrant clinical

significance. Generally, more rigourous analyses are needed in order to have confidence in results and to practically apply findings. Furthermore, all four studies suggest further research be completed and that future investigations might examine larger and more diverse samples. Also, one study went so far as to suggest the field of study might benefit from government involvement in order to systematically track and screen all children, a system comparable to Ontario's Infant Hearing Program where all infants are screened for audiological problems soon after birth. It is clear then, that current evidence itself is inconclusive; therefore, traditional clinical evaluation should remain standard clinical practice. Such practice may incorporate parent report, but should not be replaced by parent screenings.

In summary, it is my recommendation that the currently available literature is not strong enough with respect to methodology and analyses, to provide evidence for using parent report as a screening tool for identifying children with SLD. At this time, more research is needed. Such research should, as suggested by the reviewed literature, include larger and more diverse samples, use stronger outcome measures, and more thorough interpretation of results. However, there are limitations to the above recommendations that include the potentially incomplete selection of research articles for review. As such, the recommendations presented in this paper might be considered in light of this limitation. Future investigation of the validity and reliability of parent report should help clarify if parent report can stand alone as a screening tool for the identification of children with SLD; whether it is best used in conjunction with other measures, or whether it is not appropriate for screening at all.

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The impact of oral language delays on literacy development

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This critical review addresses whether or not children with specific oral language delays are at risk for later literacy problems and if so, whether these children should receive priority speech and language services to prevent this future impairment. The research studies include prospective, longitudinal and retrospective-prospective, longitudinal, correlational designs. Based on the critical review, there is strong evidence to suggest that overall, children with oral language delays are at risk for later literacy problems. However, further research needs to be conducted in order to identify the specific oral language delay for which priority speech and language services is merited.

Introduction

Over the past decade, the health care system has been re-structured and is now working from a preventative framework. The goal is to identify which individuals are at risk for a specific impairment and to treat them before the problem escalates. A specific issue that has arisen in the field of speech-language pathology is the relationship between oral language delays and literacy impairments.

An oral language delay may be defined as an impairment in the comprehension and/or production of a spoken, written and/or other symbol system. This disorder can effect the form, content and/or function of language (ASHA cited in Paul, 2001). Adequate language skills may be seen as the foundation for later literacy achievement. The comprehension of written text is dependent upon the development of linguistic knowledge used to understand speech (Paul, 2001). Thus, current research is concerned with the negative effects that language impairments may have on later linguistic development.

Along with oral language delays, literacy difficulties can also have both immediate and long-term effects on the individual. In particular, the inability to effectively receive and process printed text could have a disabling impact on the individual's academic, social and emotional success. Therefore, the relationship between these two variables is an important issue to address because early detection and intervention of children with oral language delays may prevent future literacy impairments from occurring.

Objectives

The primary aim of this paper is to critically evaluate the existing literature addressing the impact of oral language delays on literacy development. The secondary aim is determine whether or not a specific type of oral language delay should be given priority speech and language services to prevent this future impairment.

Methods

Search Strategy

The research articles were found using a computerized database search, including PubMed, Medline and Cochrane Library. The following key terms were used:

((Language delay) OR (language disorder) OR (speech delay) OR (speech disorder) AND ((literacy delay) OR (reading disability) OR (writing disability)).

The search was limited to articles published in English between 1990 and 2004.

Selection Criteria

Studies that were selected for inclusion in this critical review paper examined the relationship between any oral language delay and later literacy development. The selected articles were not limited according to the demographics of the research subjects or the outcome measures of the studies.

Data Collection

The literature search yielded studies that employed prospective, longitudinal, correlational designs (3) and one that employed a combined retrospective-prospective, longitudinal correlational design (1).

Results

Impact of Oral Language Delays on Literacy Development

Bird *et al* (1995) were concerned with whether or not persistent literacy problems were found only in children with widespread language deficits. The researchers found that subjects who presented with expressive phonological impairments had more difficulty performing phonological awareness and literacy tasks ($p < .001$) than subjects with no history of phonological impairments. In addition, subgroup analyses comparing the literacy skills of subjects with pure phonological disorders to subjects with phonological disorders plus additional language impairments did not reach significance. Therefore, both the subgroups displayed equally poor performance on the literacy tasks.

The study conducted by Catts (1993) addressed whether or not children with speech-language impairments were at a higher risk of reading disabilities than were children with no history of speech-language impairments. The researcher reported that children with language impairments were at an increased risk for reading disabilities ($p < .01$) when compared to non-impaired subjects. In contrast, the relationship between speech impairments and literacy abilities was found to be non-significant ($p > .05$).

Catts (1993) also hypothesized that the standardized and nonstandardized language measures administered in kindergarten would be related to first and second grade reading achievement. It was reported that when reading was assessed in terms of word recognition, phonological awareness and rapid automatized naming were the best predictors of reading outcomes. This conclusion was supported by moderate correlations between these two measures and reading outcomes.

Felsenfeld *et al* (1994) examined the correlational relationship between performance on selected cognitive-linguistic variables measured in childhood and adult educational and occupational outcomes for individuals with and without a history of moderate phonological/language disorders. It was reported that subjects with moderate phonological disorders performed significantly more poorly than the control subjects on tests of cognitive-linguistic abilities. Also, the strength of association between early articulation skills and adult language measures was moderate to good (r values between .50 - .75).

Felsenfeld *et al* (1994) also analyzed if the present educational and occupation status of adults who had a moderate phonological/language disorder in childhood was different from that of adults who did not have this impairment. The statistical analysis showed significant Chi-Square ($X2 > 3.84$) and Pearson correlation ($r = .60$) results. Therefore, subjects with speech delays in childhood were more likely to experience poor educational and occupational outcomes than subjects with no history of speech impairments.

Leitao and Fletcher (2004) proposed that subjects who presented with non-developmental speech errors would continue to perform more poorly than subjects with developmental speech errors in terms of their literacy skills. The researchers found that when compared to subjects with developmental speech impairments, the subjects with non-developmental speech impairments were significantly more likely to have weak phonological awareness skills ($p = 0.04$) and reading comprehension abilities ($p = 0.037$).

Overall, these research findings are supported by rigorous studies. First, all of the researchers employed appropriate methodologies. For instance, a longitudinal research design was suitable because in order to answer the research question the researchers were required to measure changes over an extended period of time. Also, all of the studies used a control and experimental group. This lends further support to the findings because the researchers were able to determine that the results were actually due to the variable in question and not due to some external factor. Next, a majority of the studies administered standardized measurement tools and outcome measures that were valid and reliable. This practice supports the research findings in that the tests measured what they claimed to measure and that the tests would yield similar results if repeated on the same subjects regardless of the number of examiners or the timing of administration.

The research findings are further justified by the suitability of the statistical analyses. First, all of the studies employed the appropriate statistical tests given the research question and the number and type of variables involved. For instance, if the researchers posed an association question they used an associational statistical test. In contrast, if the researchers asked a difference question they used a difference statistical test. Next, the researchers' conclusions are supported by significant statistical results. For instance, when analyzing the relationship between speech and/or language impairments and later literacy achievements all of the studies reported p values of $< .05$. This further supports the researchers' conclusions because it reveals that the relationship between oral language delays and literacy impairments is not likely due to chance. Lastly, the researchers' interpretations of the statistical tests were appropriate. For instance, all of the researchers discussed the issue that association

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not does translate to causation. The researchers communicated that an oral language delay is only one of many conditions or risk factors that shape an individual's future achievements. Therefore, given the appropriateness of the methodological practices and the suitability of the statistical tests there is reason to accept the conclusion that an oral language delay is a risk factor for later literacy problems.

Prioritizing Speech and Language Services

Although there is a consensus amongst the researchers that there is a link between oral language impairments and literacy problems a debate still exists regarding what specific component of the language disorder or which subject-specific factors are the best predictors of future literacy delays.

This debate is evident in the various research findings. For instance, while one study concluded that subjects with non-developmental phonological processes were more likely to experience literacy problems than subjects with developmental phonological processes, another study argued that language impairments were a risk factor for literacy problems, whereas speech impairments were not.

Therefore, even though the researchers agree that in general, an oral language delay is a risk factor for future literacy problems, the use of varying cohort groups makes it difficult to conclude which specific language impairment is most in need of priority speech and language services.

Conclusions

A critical review of the available literature has demonstrated that there is strong evidence to suggest that an oral language delay is a risk factor for future literacy impairments. However, there is not sufficient consensus and evidence in the research to recommend that children with a specific oral language delay should receive priority speech and language services.

In order to determine who should receive priority treatment, future research should focus more closely on several variables. First, researchers should question whether or not the nature of the language disorder (e.g., non-specific language impairment vs. specific language impairment) is a predictor of later literacy problems. Also, researchers should address whether or not the severity of the oral language delay predicts who is more at risk for literacy problems. Lastly, researchers should consider whether or not the environment of a child with an oral language delay affects his/her probability of developing literacy deficits. By including these variables into their studies, researchers can determine which children are most at risk of developing future literacy

delays and thus, should be prioritized for speech and language services.

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The effectiveness of tinnitus retraining therapy

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This critical review examines the effectiveness of tinnitus retraining therapy (TRT) for patients who suffer from chronic tinnitus. Study designs include: cross-sectional study, retrospective, case study, observational, prospective, and case control study. Overall, research concludes that TRT is an effective treatment; however, flaws in these studies' methodologies make it difficult to draw any strong conclusions of its efficacy at this stage.

Introduction

Tinnitus is a perception of sound without external auditory stimulation. It is a symptom that can be related to a wide variety of physical disturbances. More than 360,000 Canadians have tinnitus in an annoying form and about 150,000 find that these noises seriously impair the quality of their lives (Tinnitus Association of Canada). Patients with debilitating tinnitus experience great psychological distress in that their tinnitus may disrupt their sleep, break their concentration, cause them to withdraw from social interactions and may lead to depression.

Therefore, careful review of current treatments and attempts to formulate new ones are valid and necessary undertakings for audiologists. We must be knowledgeable and skilled with regards to the current treatment options available in order to help these patients improve their quality of life.

Due to the variety of possible causes of tinnitus, it has been difficult to find a single effective treatment. Some of the existing treatment options include: behavioural and dietary modifications, electrical stimulation, masking instruments, drugs, cognitive therapy, biofeedback, chiropractic manipulation, and gingko biloba. There is currently no widely accepted treatment for tinnitus.

The purpose of this critical review is to evaluate the effectiveness of tinnitus retraining therapy (TRT). TRT is one of the newest treatments and it has gained international popularity and attention. Developed by Dr. Jastreboff in the late 1980s, it is based on a neurophysiological and psychological model of tinnitus.

TRT aims to allow a patient to habituate to the tinnitus signal by modifying the neural connections linking the auditory with the limbic (emotions) and autonomic nervous systems. There is often no difference in the psycho acoustic properties of the tinnitus sound "perceived by people who suffer because of it and those who are not bothered by it" (OHSU Tinnitus Clinic). Therefore, it is the reaction to the tinnitus, not the tinnitus itself, that determines if it becomes a debilitating problem.

The goal of TRT is to retrain the brain to respond to tinnitus as a neutral sound. This is accomplished through intensive directive counseling sessions and the use of masking.

The recommended duration of treatment is between 12 and 24 months. TRT is currently offered in at least two centers in Ontario: the Canadian Hearing Society's Toronto Audiology Clinic and the Tinnitus and Hyperacusis Assessment center located in Whitby. The fees for therapy are approximately $1000 to $3000. TRT is not covered by the Ontario Health Insurance Plan (OHIP) and the noise generators are not covered under the Assistive Devices Program (ADP) in Ontario (www.canadiantinn.com). Once tinnitus habituation is achieved, there is no need for continuing the treatment.

This thesis is being adopted and referenced by growing numbers of researchers and clinicians around the world. Lockwood and Salvi (1998) have identified specific neurophysiological mechanisms responsible for tinnitus by measuring neural activity after tinnitus was induced. They found activity in the limbic system when tinnitus was present in subjects. TRT is directed at physiologically altering the bond between the limbic system and tinnitus. This is the first hard evidence that the theory may be valid.

Methods

The goals of the studies in this review were to quantify the impact of tinnitus, investigate the effects of habituation, and address self-perceived disability in patients undergoing TRT.

The number of patients that were included in the studies generally ranged from 32 to 1000 patients. Only one study explicitly stated the subject inclusion and exclusion factors. The studies usually included patients being treated at a specific center over a period of time. Convenience sampling was

employed, whereby the cases were self-selected by their presence in a particular program or clinic.

The designs used in these studies differed in their methodological rigour. These included: cross-sectional study, retrospective designs, case studies, prospective cohort studies, and observational study. Other studies, usually randomly assigned the subjects to groups comparing full treatment TRT to treatments that were composed of only one or two of the components of treatment or used a waiting list control group for treatment/ no treatment comparisons.

Prospective studies generally followed the same steps: 1) medical evaluation to rule out retrocochlear disease, 2) case history, and 3) audiological evaluation. If receiving TRT then also 4) diagnosis and selection for the treatment category, 5) directive counseling, 6) selection and fitting of hearing aids or noise generators, and 7) follow-up counseling according to the individual needs of the patient and established timetable.

The subjects were either fit with no instrument, monaurally, binaural fitting of both wide band noise generators or hearing aids.

All subjects were evaluated at the beginning of the treatment, six months later and 12 months later as a minimum. The various measurements sought to assess the percentage of time spent awake during which the subjects were aware of tinnitus, the percentage of the time it caused distress or annoyance, the strength of the reaction and the impact of tinnitus on various life factors.

Results

All of the results were presented as a proportion of people experiencing improvement after treatment.

TRT involves placing the patient into a treatment category depending on the presence of hearing loss or hyperacusis in addition to chronic tinnitus. Most studies did not give separate results for each category of treatment, and instead reported the overall percentage of patients who showed improvement. One study examined the effects of habituation taking the category of treatment into account. Bartnik et al. (2001) evaluated patients with tinnitus and subjective hearing loss and compared them to the results of patients with tinnitus only after one year of treatment. Their results indicated improvement in about 70% of patients with tinnitus only and in about 90% of patients with tinnitus and subjective hearing loss after one year of therapy, however this difference between groups was not significant. Their results supported Jastreboff's previous claims that the type of devices used for sound therapy has no significant impact on the treatment outcome (Jastreboff, 1996).

Berry et al. (2001) used the Tinnitus Handicap Inventory (THI) in their nonrandomized, prospective analysis of patients undergoing TRT. THI scores correlated with subjective perception of overall tinnitus effect (p<.001). Following 6 months of TRT, the total, emotional, functional, and catastrophic THI scores significantly improved (p<.001). Although the sample size was small, every patient was followed up, and changes in the THI total score were significant. However, this study did not incorporate control groups.

Four studies examined the effectiveness of TRT by dividing the patients into different treatment groups and/or control groups. One found that 64.5% of their patients improved significantly after the initial group therapy, whereas the patients of the waiting list control group showed no significant improvement (Delb, 2002). McKinney was involved in two studies: the first one found that the effectiveness of the treatment varied from 64% to 84%. In contrast, improvement in tinnitus relief was observed in only 6% of the non-treated group (Jastreboff & Jastreboff, 2004). The second study showed a 78% positive change in all variables in the TRT group and only 18.8% improvement in the control group (Jastreboff & Jastreboff, 2004). The selection procedures in the studies diminish the validity of these results. The patients in the treatment groups were referred to the clinic, whereas the control group participants were recruited by advertisements in a journal. A study done by Jastreboff showed 83% significant improvement in patients after TRT and an 18% improvement in patients who received counseling only (Jastreboff, 1996). However, these latter patients were not randomly assigned to the counseling only group. They could not continue with the intervention predominantly due to financial constraints. Their lower response rate may be due to extraneous factors associated with lower socioeconomic status. The fact that Jastreboff is the developer of TRT may also make his results more prone to bias.

Case series of patients that attended specific clinics were reported. Sheldrake et al. (1999) reported that there was improvement in 96% of the patients seen in one retrospective study. In another, observational study he reported that after treatment with TRT, 83.9% of their patients achieved a successful outcome on completing treatment. However, there are no details provided on the criteria to define 'improvement'. At another location, 129 patients received full treatment and 105 of these patients showed significant improvement (Wang, G, 2004). Other clinics from around the world have claimed to experience success rates of 80-88% (Jastreboff & Jastreboff, 2004).

Caution must be used in interpreting these results. Aside from Berry et al. who used the THI, these studies lack a standardized, described outcome measurement. The two main methods used for obtaining results were the personal interview, which is subject to interviewer and social desirability bias, and questionnaires. There was often little information on the precise nature of the measurement procedure used to obtain awareness indices. The exact questions asked and the rating scales used were not usually included or described. These articles also lack the inclusion of raw data and statistical analyses.

The criterion for success also differs among studies. Successful treatment is usually defined as a specific percentage improvement in annoyance or awareness, plus an improvement of one life factor. These studies used 20%, 30% or 40% improvement criterion. However, there is no indication of how these percentages were calculated from the outcome measures used. The questionnaire developed by Jastreboff, for example, is composed of a variety of questions whose answers are not all numerical and the calculation of a percentage improvement from the responses was not described. Without proper definition, 'improvement' may mean anything from a slight reduction in tinnitus-related distress to the elimination of tinnitus altogether.

In all studies, the results were collected at multiple times, which is appropriate because TRT results in progressive improvements over time. The greatest improvement occurs after 3-6 months (Jastreboff & Jastreboff, 2004). It has been argued that patients who are recorded as having unsuccessfully improved do not represent failure. It may only mean that they did not achieve the criterion by the time stated. Some patients may have received benefit, but they may take longer to achieve habituation.

Due to the lack of information regarding the outcome measures used in the studies, it is difficult to ascertain the validity and reliability of the results. Aside from the THI, the questionnaires have not undergone psychometric testing. It can also not be determined whether appropriate methodological and statistical techniques were applied. They were adequately described in only two studies (Bartnik, et al, 2001;Berry, et al, 2002).

Recommendations

Results from all of the studies included in this review conclude that TRT is shown to be an effective treatment. The success rates usually cluster around 80% of the patients showing improvement and reduction of annoyance to their tinnitus. However, flaws in their methodologies make it difficult to draw

any strong conclusions about the efficacy of TRT at this stage (Wilson et al, 1998). TRT cannot be demonstrated to be superior to other treatments due to the lack of comparative studies.

At the same time, there is no evidence in this literature to the contrary. That is, none of the studies reported zero, low or even moderate success rates.

Following this review, the recommendation is to provide information regarding TRT to chronic tinnitus sufferers as one option, among others. This investigation has shown that TRT has helped some patients and it has the potential to help others in the future. However, the literature does not satisfactorily describe the criteria for patient selection so the studies do not suggest a patient subgroup most likely to respond to TRT.

As clinicians, we must demand evidence of its efficacy through strong studies presented in peer review journals. An ideal research design would be a prospective control group design that randomly assigns patients to different treatment groups and includes a waiting list control group. There must be published protocols and structured assessment methods to ensure consistency with TRT implementation and evaluation across studies. The use of the Tinnitus Handicap Inventory (THI) is also highly recommended. It is desirable for its ease of administration, incorporation of functional as well as emotional constructs, good construct validity, and strong internal consistency and test-retest reliabilities. It can also provide a comparison point against which 1) samples can be compared for initial severity and 2) treatments can be judged in terms of the size of their effects (Berry et al, p 1153).

Until research that is more rigorous has been undertaken, we must be certain to tell our patients that TRT is promising, but currently controversial and investigative.

If the patient has already tried numerous other approaches, is experiencing a reduced quality of life because of their tinnitus, and they are willing to spend the money then I feel that it is alright to encourage them to try this treatment. For one, this review did not find any literature that suggests that this treatment creates any harm for the patient nor has any negative side effects. Secondly, there is currently no widely accepted treatment for tinnitus. If they are interested, the clinician should recommend attending a general information session at one of these centers before they commit to the therapy to decide if they want to pursue TRT further. We must aid them in finding a proper person who is qualified to carry out this treatment. It has been suggested that some people claim to offer TRT without possessing sufficient knowledge of the method (Kroener-Herwig et al, 2000).

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The information that is beginning to emerge about this treatment looks promising. Moreover, the connections found between the limbic system and tinnitus is an extremely interesting development, especially in regards to this neurophysiological theory. More research and clinical studies are in progress in a number of centers to validate the effectiveness of TRT in a formal manner (Jastreboff, 2001). In conclusion, this review agrees with the statement that while there "are no grounds for discrediting TRT, neither is there reason to claim its superior efficacy" (Kroener-Herwig et al, p 77, 2000).

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Improving the oral language foundation for reading:
Phonological awareness and narrative skills

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The phonological awareness (**PA**) skills of a large sample of senior kindergarten students were examined prior to and following a broad range of programming. Positive outcomes were found with varied patterns of change for different types PA skills. Continued work to include other oral language skills foundational to reading, namely narrative skills, is underway. Story retelling (**SR**) as a tool for assessing and guiding programming of narrative skills is currently being explored.

Voluntary swallowing in people who stutter

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People who stutter not only have difficulty with the organization and initiation of speech movements but also of sequential finger movements and bilaterally coordinated hand movements. It is hypothesized that this reflects disfunction of the the supplementary motor area (SMA). The current study was designed to assess whether similar behavioural anomalies are evident with voluntary swallowing, a motor response that is thought to involve the SMA. If there are anomalies in swallowing in adults who stutter, it opens the possibility of using voluntary swallowing to track changes in SMA function in children that may accompany recovery from stuttering.

Adults who stutter and age and sex matched control participants were compared on three tasks requiring voluntary swallowing: 1) choice response task in which subjects had to either swallow or touch the tongue to the upper lip or press a button with the thumb when one or another stimulus cue was presented; 2) a go-no go task in which subjects had to swallow when one cue was presented but do nothing when either of the two other cues used in condition 1 was presented; and 3) a repetitive swallowing task in which subjects were asked to swallow repeatedly for 30 seconds after the presentation of the cue. Swallowing was recorded using a pressure transducer placed next to the larynx and respiration was monitored with a respiratory belt placed around the chest. Dependent measures of swallowing included swallow onset time, duration of swallows, duration of respiration interruption during swallowing and, in the case of condition 3, number of swallows performed in the 30 second period. Although there were some minor differences between the groups, our conclusion is that in contrast to the case of performance of oral movements associated with speech and the performance of sequential finger movements, people who stutter show no anomalies in swallowing. This may reflect the highly automatic nature of swallowing once initiated, and/or that the organization and initiation of this response may involve different brain mechanisms than those associated with speech and manual responses. Either way, it does not seem as if this will be a useful approach for the study of brain organization in young children.