

## **Critical Review: Is oral sensorimotor treatment an effective technique to improve feeding skills and promote growth in children with cerebral palsy?**

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This critical review examines the effectiveness of oral sensorimotor treatment in improving feeding skills and promoting growth in children with cerebral palsy. A literature search was completed, and yielded the following types of study: three randomized controlled trials and one cohort study. Overall, the literature provided weak to moderate evidence to support the effectiveness of oral sensorimotor stimulation in improving feeding skills and maintaining growth; however, there was no evidence to support its effectiveness in promoting catch-up growth in this population. This intervention requires further research involving larger samples, double blinding, and more standardized assessment measures to ensure validity and reliability of results.

### ***Introduction***

Children with mild to moderate cerebral palsy (CP) exhibit characteristic, stereotyped motor movements, and those with severe CP demonstrate severe postural dysfunction in addition to a stereotyped motor repertoire (Gisel, 2008). In association with this altered motor behavior, children with CP often have difficulty with feeding and swallowing. These difficulties can include impairments in lip closure, tongue coordination, biting, chewing, drinking, spoon feeding, and all phases of swallowing (Logemann, 1998). Because of these feeding difficulties, children with CP often have difficulty ingesting food and consuming enough calories to meet growth demands (Reilly & Skuse, 1992), and this reduced caloric intake can lead to under-nutrition and difficulty maintaining appropriate body weight (Stallings et al., 1993). Other consequences of feeding impairments include increased feeding time and caregiver stress (Edebol-Tysk, 1989).

There are various options for treating dysphagia in children with CP, such as postural changes, diet modification, oral sensorimotor treatment, and enteral or “tube” feeding in some cases (Gisel, 2008). At this point in time, it is not clear which treatment approach is optimal. One treatment option that is often used is oral sensorimotor stimulation, which aims to develop oral-motor skills through the use of sensorimotor exercises or stimulation, or intra-oral appliances. The goal of this type of treatment is to increase the efficiency of food intake, as well as to improve nutritional status and maximize weight gain (Gisel, 2008).

Since feeding and swallowing impairments can have such detrimental effects on the growth and development of these children, it is crucial that clinicians and experts in the field of swallowing

management have an understanding of the best approach for managing this issue. However, it is not only important for speech-language pathologists and medical professionals to be aware of the optimal treatment options for dysphagia in this population. Parents and caregivers, who are desperate to help a child with CP, often look for strategies they can implement to help improve the child’s feeding skills. Speech-language pathologists must be able to provide parents and caregivers with evidence-based recommendations for the effective management of dysphagia for this population.

### ***Objectives***

The primary objective of this paper is to critically evaluate existing literature regarding the effectiveness of oral sensorimotor stimulation in improving feeding skills and promoting growth among children with CP. The secondary objective is to propose evidence-based practice recommendations for future practice and research regarding dysphagia management in children who have CP.

### ***Methods***

#### **Search Strategy**

Computerized databases, including CINAHL, PubMed, and SCOPUS were searched using the following search criteria:

((dysphagia) OR (swallow\*) OR (deglutition)) AND (child\*) AND (cerebral palsy) AND (sensorimotor)

Relevant literature cited within selected articles was sought.

#### **Selection Criteria**

Studies selected for inclusion in this critical review paper were required to examine the impact of

sensorimotor stimulation on feeding skills and growth measures among children with CP. All articles were required to cite feeding or oral-motor skills or eating efficiency, as well as anthropometric or growth measures, as dependent variables. Studies were not included in this review if the participants were simultaneously receiving other types of treatment for dysphagia.

### **Data Collection**

Results of the literature search yielded the following types of articles compatible with the aforementioned selection criteria: randomized controlled trial (RCT) (3) and cohort study (1).

### **Results**

Gisel (1994) investigated the effect of oral sensorimotor intervention on feeding skills and anthropometric measures in 35 moderately eating impaired children with CP using a randomized controlled trial. The children studied ranged in age from 4.3 to 13.3 years and all had moderate to severe motor impairments as a result of CP. Children were randomly assigned to three treatment groups: group A received sensorimotor treatment for 20 weeks, group B received chewing-only treatment for 20 weeks, and group C (control) followed the "school routine" for 10 weeks, then received 10 weeks of sensorimotor treatment. Treatment lasted 5-7 minutes a day, five days a week. Sensorimotor treatment focused on tongue lateralization, lip control, and vigor of chewing. In the chewing-only treatment (group B), children were offered small pieces of fruit gelatin to chew. In the "school routine" (group C), children brought their lunches from home, food textures were examined, and plans were made for children to increase texture in at least one item of food. Weight and skinfold measures, as well as observations of children's feeding skills, were taken at weeks 0, 10, and 20. Feeding skills were observed and divided into six domains: biting, chewing, spoon feeding, cup drinking, straw drinking, and swallowing/drooling. Researchers observing the children at lunch time administered the Functional Feeding Assessment (FFA) subtest (Gisel & Alphonse, 1995) of the Multidisciplinary Feeding Profile (Kenny et al., 1989), rating feeding behaviours on a scale of one to five. A t-test of differences was conducted, and limited improvements were seen in domains of spoon feeding, biting, and chewing after 10 weeks of treatment. When analyzing weight gain, statistical analyses were not performed due to the large variation in each group. The author determined without statistical analysis that limited weight gain was observed among all children over the first 10 weeks of treatment, with children

receiving sensorimotor treatment gaining more than those in the control group. Although all children maintained their weight-age percentile ranking, none demonstrated catch-up growth. Overall, this study was successful in supporting its hypothesis, namely to determine the effect of oral sensorimotor intervention on feeding skills and anthropometric measures in eating impaired children with CP. The findings of this study suggest that oral sensorimotor treatment is effective in improving feeding skills in the areas of biting, chewing, and spoon feeding, but not drinking. Findings also suggest that this type of treatment is ineffective in promoting growth among children with cerebral palsy.

Gisel (1996) examined the effect of oral sensorimotor treatment on eating efficiency and anthropometric measures of 35 children with CP and moderate eating and motor impairments using a randomized controlled trial design. The participants and methodology were the same as those in the study described above, but outcome measures in the present study examined eating efficiency according to three domains: eating time for three standard food textures, after-swallow clearing time for three standard food textures, and duration of meal time. Skinfold measures were not taken in addition to weight in this study. Children were videotaped during lunch time to obtain a semi-profile view of the face and neck. Children were offered 10 trials of three food textures: puree, viscous, and solid. Chewing duration was measured as the time between placement of food in the mouth and completion of the first swallow. Since most children swallowed more than once, time between the first and final swallow or termination of mandibular movement for two seconds was measured (clearing time). These times were measured at 0, 10, and 20 weeks. A t-test of differences was conducted and it was found that, although there were no significant differences between groups for eating time after 10 and 20 weeks of treatment, groups A and B showed decreased eating times after treatment. Eating time for the control group tended to increase after the control period and treatment period. A t-test of differences showed no significant differences in clearing time at weeks 0, 10, and 20 in any groups or textures. The method of statistical analysis used to analyze children's weight gain was not included; however, it was reported that children across all groups essentially only maintained their weight-for-age percentile line, and did not show any catch-up growth. This study was successful in examining the effect of oral sensorimotor treatment on eating efficiency and growth measures in children with CP and moderate dysphagia. It was found that oral sensorimotor treatment was neither effective in increasing eating efficiency, nor in promoting catch-up growth.

Gisel, Applegate-Ferrante, Benson, and Bosma (1996) evaluated the effect of oral sensorimotor treatment on anthropometric measures and oral-motor skills in 27 moderately eating impaired children with cerebral palsy using a cohort design. Based on results from initial tests and videofluoroscopy, children were assigned to group A (aspiration) or NA (non-aspiration). Children ranged in age from 2.5 to 10.0 years. Both groups followed the school routine (described above) for feeding for 10 weeks (control) and then underwent 10 weeks of oral sensorimotor treatment. Weight and skinfold measures, as well as observations of children's feeding skills, were taken at the onset of treatment, and again at 10 and 20 weeks. Feeding skills were divided similarly as in Gisel's (1994) study, but with drooling being a separate, seventh domain. All methodology was the same as Gisel's (1994) study, with the exception of the chewing-only group, which was not included in the present study. A two-way mixed analysis of variance (ANOVA) was conducted, with group and time as a repeated factor. This analysis revealed significant differences in oral-motor competence between the two groups, with poorer oral-motor skills in children who aspirated. All feeding domains were weaker among children who aspirated, except cup drinking, clearing, and drooling. Among both groups, significant improvements were found in spoon feeding, chewing, and swallowing following oral sensorimotor treatment. There were no significant changes in drinking skills. In order to analyze weight gain over the course of the treatment period, a two-way mixed ANOVA was employed, with time (week 10 vs. week 20) as a repeated factor and group (NA vs. A) as a between-subjects factor. Children among both groups maintained pretreatment weight-age percentile but did not demonstrate catch-up growth. This study was successful in investigating the effect of oral sensorimotor treatment on growth measures and oral-motor skills among children with CP who were stratified according to aspiration and non-aspiration. Oral sensorimotor treatment was found to significantly improve oral-motor skills, specifically spoon feeding, chewing, and swallowing, among both groups of children. This treatment was not, however, successful in improving growth measures, as seen by the lack of catch-up growth observed among both groups of children.

In a randomized controlled trial study, Haberfellner, Schwartz, and Gisel (2001) examined the effects of one year of intraoral appliance intervention on functional feeding skills and anthropometric measures in 20 children with CP, ranging in age from 4.2 to 13.1 years. All children had tetraparesis (weakness of all four limbs) and moderately impaired motor ability. Children were

randomly assigned to immediate intraoral appliance treatment or a control period of six months prior to receiving the same treatment as those receiving the appliance immediately. Once tolerance for wearing the appliance was reached, children wore it on a nightly basis. The first treatment phase (6 months) focused on stabilizing the mandible. The second phase (6 months) aimed to facilitate ingestive skills. This was achieved by mobilizing the tongue through the addition of small beads to the appliance in order to elicit tongue lateralization, lifting, or tipping. Goals also included lip pursing and retraction. Weight, arm and leg lengths, and skinfold measures, as well as observations of functional feeding were taken at the start of the pre-treatment period, and at 0, 6, and 12 months. The FFA (Gisel & Alphonse, 1995) was used to rate functional feeding behaviours, which were divided into seven domains: biting, chewing, spoon feeding, cup drinking, straw drinking, clearing, and swallowing. A paired t-test of differences was conducted, and significant improvements in spoon feeding, biting, and cup drinking were found during Phase 1 of treatment. Results also indicated significant gains in chewing and swallowing during Phase 2 of treatment. There were no changes in straw drinking competence. Raw anthropometric measurements were converted to z scores in order to make comparisons between children of different ages and sex. Changes in z scores for children's weight over time were not significant during the control period or during both phases of treatment, indicating that children maintained growth trajectories. There was a slightly significant catch-up in length during the second phase of treatment. Gains in oral-motor skills were found to be roughly 15% above effects related to maturation, mediated by mandibular stabilization, facilitation of cup drinking, chewing, and biting. Overall, this study was successful in examining the effects of one year of intraoral appliance intervention on functional feeding skills and anthropometric measures in children with CP. This type of intervention was found to be effective in significantly improving feeding skills across five of the seven domains, and was also found to result in slightly significant catch-up growth during the second treatment phase.

## *Discussion*

### **Subject Selection and Characteristics**

Disease characteristics of participants were generally homogeneous – children across all studies had a diagnosis of CP with moderate to severe motor impairment. All children's weight was at or above the 5<sup>th</sup> percentile for their age, and skinfold measures were at or below the 35<sup>th</sup> percentile. All children required some level of assistance with activities of

daily living. Children across all studies ranged in age from 2.5 to 13.3 years. One advantage to having homogeneous disease characteristics is that any changes observed would likely be due to treatment and not to group differences, thus increasing the power of the study. There was no mention of the presence of additional disorders in any of the articles, which could affect the generalizability of results to children who have CP only. Sample sizes were small, varying from 20 to 35 children. Although no sample size calculations were included in the articles, it is evident that larger sample sizes are required in order to generalize results to the population of children with CP.

In terms of inclusion and exclusion criteria, children were only selected if they could eat a standard solid texture within 1 SD and a puree within 2 SD of established time norms (Gisel, 1988; Gisel, 1991). These criteria further increase the homogeneity of participant characteristics, thus, changes observed over the course of treatment would likely be a result of intervention, rather than group differences.

Gisel et al. (1996) recruited children from schools of the United Cerebral Palsy Association of Central Maryland and the Division of Special Education of Baltimore County. Children in the three other studies were recruited from “special schools” in Montreal, but no details were provided regarding the actual recruitment process, such as whether selection was random. It is possible that selection bias could have occurred in these studies, thus potentially affecting the generalizability of results. Also, there was no mention of children’s receptive language ability or cognitive level in the studies. While Haberfellner et al. (2001) did note that children’s communicative development was based on their ability to respond to yes/no questions related to personal needs, this information is not a standardized way of assessing receptive language. Information regarding children’s receptive language and cognitive ability is crucial, as many of these studies involve encouraging the child to perform or imitate an action, such as chewing. There was no mention of sensory impairments in any of the studies. If a child is expected to imitate an action, it must be known whether that child has any sensory impairments that could affect his or her ability to follow instructions. In terms of exclusion criteria, children with mild motor impairments were excluded from the studies. This could lead to false conclusions about treatment of feeding impairments in children with CP with mild motor impairments.

All studies, with the exception of Gisel et al.’s (1996) cohort study, randomly assigned participants to treatment or control groups. This decreases the possibility of bias, thus increasing the generalizability of the results and overall power of the studies.

## **Method**

Many of the studies lacked detail regarding the procedures used therein. For instance, Gisel (1996) was not forthcoming with important methodological information, such as the type of statistical analysis used to examine weight gain data. In Gisel’s (1994) study, there was no explanation of the “standard fashion” for taking weight and skinfold measures, nor any mention of who took these measures. In order to replicate the study, these details are necessary. The FFA should have been included with the articles in order to provide readers with the exact details of the assessment tool. Studies using the FFA run the risk of introducing experimenter bias since eating domains were rated based on researchers’ observations. Not only is there room for bias, but also inaccuracy, since observations were made with the naked eye and not more stringent measures, such as the use of equipment. Although the FFA relies on visual observation, which may be weaker than radiological examination procedures, the FFA is appropriate for the purposes of these studies. There are several advantages to the FFA, such as its ease of use, cost effectiveness, and non-invasiveness to participants. Also, the FFA provides a lot of information related to swallowing that can be seen outwardly, such as lip closure, and control of lips, tongue, and cheeks to channel food in the right direction.

Treatment was administered by assistants who were instructed by authors on how to carry out the therapy procedures. There was no mention of whether those administering the treatment were blinded to the expected outcomes of the study. Again, this has the potential to introduce experimenter bias. Also, there was no mention of whether participants or their caregivers were blinded to possible treatment outcomes, which could lead to performance bias, thus skewing the results and affecting their generalizability. Blinding would have led to stronger and more reliable results in these studies.

Haberfellner et al. (2001) failed to control for the possibility of children receiving oral sensorimotor intervention from other therapists during the time of the study. This introduces the possibility that gains in feeding skills and growth measures may not be solely the result of the intraoral appliance intervention. Thus, results from this study may not be generalizable.

## **Statistical Analysis**

In both Gisel’s (1994) and Haberfellner et al.’s (2001) studies, a t-test of differences, which is a parametric test, was used to compare interval data (ratings of functional feeding skills), which is nonparametric. The Mann Whitney U should have been employed instead of the t-test of differences to analyze this data. Gisel (1994) also failed to conduct a

statistical analysis in order to examine weight gain. One must question the validity of results when correct methods of data evaluation are not used. When comparing weight over the course of treatment, a suitable parametric test is the paired t-test, which should have been employed in this study, since weight is considered to be ratio (parametric) data. Haberfellner et al. (2001) converted raw growth measurements into z scores in order to analyze children's weight over time. Again, a more appropriate method of analysis would have been a paired t-test, which is suitable for analyzing weight changes over time. Gisel (1996) employed a paired t-test of differences to analyze differences between groups for eating time, clearing time, and duration of meal time. This was an appropriate statistical test since time is considered to be parametric data and the paired t-test is a parametric test. Gisel (1996) did not include the method of analysis used to analyze children's weight gain. When comparing weight over the course of treatment, a suitable parametric test is the paired t-test, which should have been used in this study, since weight is parametric data. Gisel et al. (1996) used a two-way mixed ANOVA to compare differences in oral-motor competence between the aspiration and non-aspiration groups. This test was appropriate given that this was a cohort study, and that the two-way ANOVA is used to examine the influence and interaction of two different covariates. Overall, most of the studies used appropriate statistical tests for the purposes of maximizing the data; however, there were some instances of inappropriate selection of statistical tests. None of the studies included power analysis, which should be included in order to determine the power of the study, that is, the probability that the test will reject the null hypothesis.

### **Levels of Evidence**

Given the numerous methodological weaknesses seen across all four studies, the findings of each can be considered weak to moderate evidence. Gisel's (1994) study had some strong components, such as randomized assignment and homogeneous disease characteristics; however, there were limitations in sample size, statistical analyses, and methodology. Thus, the findings of this study can be considered weak to moderate evidence. Gisel's (1996) study was strong with regards to its randomized controlled trial design and inclusion criteria, but contained limitations in methodology (bias, lacking detail). This study can be considered weak evidence. Gisel et al.'s (1996) cohort study used appropriate statistical analysis and clearly stated from where participants were recruited, though did not discuss blinding. Overall, this study provided a moderate level of evidence. Haberfellner et al.'s (2001) study had a strong design – a randomized

controlled trial – and more detail regarding overall procedures; however, it contained limitations with respect to methodology and statistical analysis. Therefore, this study can be considered weak evidence.

### **Conclusion**

Despite the varying quality of the literature reviewed, this research provides some evidence that oral sensorimotor stimulation is effective in improving feeding skills and maintaining growth among children with CP. However, there was no evidence to support the effectiveness of this treatment in promoting catch-up growth in such children. The information reviewed is important for guiding future clinical practice, as well as identifying areas warranting further research.

### **Recommendations**

#### **Clinical Implications**

Regardless of some methodological and statistical issues in the reviewed literature, there is evidence to suggest that oral sensorimotor stimulation is effective in improving feeding skills and maintaining growth among children with CP. Given that it is cost and time efficient and easily administered, oral sensorimotor stimulation is recommended for use by parents and caregivers, as well as clinicians. This form of therapy is relatively non-invasive to the child, depending on level of tolerance, and could lead to stronger bonds between the parent or caregiver and child. Despite the demonstrated improvements in feeding skills and maintenance of growth trajectories, there was no evidence supporting the effectiveness of this intervention in promoting catch-up growth. While longer meal times and oral sensorimotor treatments may be appropriate for a younger child, as growth demands increase, necessary calories must be supplemented in some way. One possible method is oral caloric supplements. These are relatively inexpensive, can be easily administered by parents and caregivers, and are non-invasive to the child. Another possibility, though more invasive, costly, and time consuming, is tube feeding. This should be considered for more severe cases of CP. This literature review confirms the need for critical evaluation of materials prior to clinical implementation such that the safety of clients is ensured through evidence-based practice.

#### **Further Research**

Future research related to dysphagia among children with moderate CP should consider larger sample sizes to provide greater generalizability and

power. Further research should also involve multi-site trials, double blinding to reduce bias, and the development of more instrumental, standardized assessment measures to ensure valid and reliable results. A more in-depth examination of the FFA is recommended in order to increase its validity and reliability in assessing feeding skills. Considering the fact that all articles reviewed were authored by the same individual, an occupational therapist, it is crucial that future research be conducted by a broader range of professionals, particularly speech-language pathologists. Subsequent research should focus specifically on catch-up weight gain, since this was an area showing no improvement in any of the studies. In order to thoroughly and accurately investigate the effectiveness of this treatment, a randomized controlled trial with double blinding should be conducted, comparing oral sensorimotor treatment to no treatment whatsoever. This does, however, raise ethical questions surrounding treatment time lost for children in the control group.

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