The Effect of Oral Sensorimotor Stimulations on Feeding Performance in Children with Spastic Cerebral Palsy

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Abstract- Oral feeding difficulties are common in children with cerebral palsy (CP). The effect of oral-motor dysfunction on feeding problems has been proved in several studies. The purpose of the present study was to evaluate the effect of oral sensorimotor stimulations on feeding performance in children with spastic cerebral palsy. A total of 12 children with spastic cerebral palsy underwent 24 sessions of oral-motor stimulations (3 days per week). The effect of the intervention was assessed after the 12 and 24 sessions. Feeding skills were assessed using Oral Motor Assessment Scale (OMAS). Data were analyzed using Friedman test and intra class correlation coefficient (ICC). The results of the study revealed a significant improvement in feeding skills including mouth closure, lip closure on the utensil, lip closure during deglutition, control of the food during swallowing, mastication, straw suction and control of liquid during deglutition. There were more improvement in mouth closure and less in straw suction. This study showed sensorimotor stimulation is useful for the treatment of the feeding problems, but the progress was not perfect. This could be due to the role of the position and cognitive skills in feeding functions. Thus, other strategies should be considered to achieve more improvement in feeding performance.

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Introduction

Cerebral palsy (CP) is a term that refers to a group of people with non-progressive disorders of the brain. Most of the time CP is known as a motor disorder. In addition to motor disorders, these patients may have other central nervous system problems such as feeding and communication disorders, mental retardation, epilepsy, sensory problems, learning disabilities and emotional problems (1). Feeding efficiency is one of the factors for children's health. Children with CP often suffer from feeding problems due to their disabilities, leading to inadequate caloric reception which eventually results in malnutrition (2). Feeding difficulties is a prevalent problem accompanied with weak feeding status and weak health in children with moderate to severe CP (3). Even children who suffer from mild feeding dysfunction and need mashed foods may be at risk of weak feeding status (3). Motion *et al*., also agreed with this notion and remarked that in CP children, primary, continuous and severe feeding problems are signs of latter weak growth, nutritional and developmental disorders (4).

In CP children usually feeding problems are resulted from multiple factors simultaneously (5). Gisel *et al*., declared CP children with severe oral-motor dysfunction swallow a standard amount of mashed food 2-12 times longer and chew solid food 1-15 times longer than their age peers, although, their feeding problems do not resolve even with long-time meals (6). Reilly *et al*., reported that feeding difficulties resulting from oral-motor dysfunction occur in over 90 percent of CP children (2). Oral-motor dysfunction results in the long-time feeding and poor quality of life for the children and their parents.

Many strategies for management of swallowing problems have been reported. These strategies include modification of behavioral problems during feeding, change in the sitting position, increasing frequency and duration of feeding meals, increasing diet calories, exercises for reinforcing and increasing the strength of swallowing muscles, and facilitating the oral-motor skills (7,8). Gisel provided oral sensorimotor treatment

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for improving feeding skills of CP children, his results indicated improvement in spoon feeding, biting and chewing but not improvement in drinking (9). Gisel *et al*., found that progress in oral-motor skills is an important factor for improving feeding skills (8, 10). The results indicated that more improvement is achieved after 20 weeks of treatment than 10 weeks including feeding time decreased a few amount and children maintained appropriate weight for their age. Therefore, they offered sensorimotor treatment may be sufficient throughout the childhood years but after that time, child development must be carefully controlled and oral calorie must be completed to supply the necessary energy for development. Haberfellner *et al*., treated the CP children for improving the feeding skills (11). The results indicated that feeding and chewing had significant improvement after the treatment. Therefore, they reported that jaw stabilization is an important factor for improving the feeding skills.

Several studies used sensorimotor strategies to improve the feeding performance, but these studies did not show their direct impact. On the other hand, in CP children the feeding problems are common and oral-motor skills are limited. Nutrition also plays an important role in myelination of nerves in the first three years of life. Because of the importance of feeding, we decided to study the effect of oral sensorimotor stimulations on feeding performance in 2-7 years old children with CP.

Materials and Methods

Participants

A total of 12 children aged 2-7 years (7 boys and 5 girls) participated in the present study. All children suffered from cerebral palsy with moderate-to-severe motor impairment. Eleven children used wheelchair for mobility, and one had ability to move by walker. All children had a range of hypertonicity in their extremities. Although all children had quadriplegia, the severities of spasticity differed between upper and lower extremities and between the right and left sides of the body. Children were selected who 1- scored at or below 10 scores on an initial assessment of OMAS (12), 2- did not have sensory impairments e.g. hearing loss & vision problems, 3- did not have structural abnormalities of the mouth e.g. cleft palate and pathological oral reflexes. Children had to understand therapist instructions and be able to control head and neck. Children were from two rehabilitation centers and one special school in the city of Isfahan. Institutional and parental consent were obtained before participating in the study.

Procedure

This study was an interventional and semi-empirical study. Children were selected to enter to the study in terms of inclusion criteria. The selected children received sensorimotor stimulations for eight weeks. On fourth and eight weeks, OMAS was used to assess the effects of oral sensorimotor stimulations on feeding performance as at the onset of the study. Two children did not receive stimulations three days a week regularly, therefore, were excluded.

In order to avoid bias in scoring after the treatment, Inter-rater reliability was examined. The assessment of oral motor performance was recorded by a video camera. Two speech therapists trained on OMAS including first author and a speech therapist that was blind to the study. The film played, and items of OMAS were scored.

Testing

Every child was seated on the floor or chair, and the back well supported by a back rest. If the child was unable to seat independently, he/she was seated in a corner site. Then the children were assessed for oral-motor skills using the OMAS (12).

OMAS is an accurate and reliable tool for assessment of oral-motor skills in children and adolescences with neurological damages. It is sensitive to changes and useful for interventional studies. There are seven items in this scale including mouth closure, lip closure on the utensil, lip closure during deglutition, control of the food during swallowing, mastication, straw suction, and control of liquid during deglutition.

The child's mother was asked to give the child one of the following foods normally: a soft food (yoghurt, was fed with a spoon), a solid food (wafers-type cookie) or a liquid food (using a glass, with and without a straw). The researchers did not interfere with the way the child intake the food but observed the child while chewing, sucking and swallowing and gave a score to each item of the OMAS. Each item was evaluated for 30 second. If the child manifested more than one oral motor skill for the same item, the most frequent skill was considered. If there was a relation between two scores, the highest score was recorded.

The rating system was passive (0), subfunctional (1), semi-functional (2) and functional (3). Each item has a numeric value as mentioned earlier. While the child was feeding, his/her oral-motor performances were recorded by a video camera (SONY; digital still camera, 14/1 mega pixels).

Sensorimotor stimulations

Stimulations were focused on three important areas of oral-motor performance: tongue lateralization, lip control, and vigor of chewing. Target movements were always extracted with food stimuli. This was preferred because it did not use manipulation by the therapist and foreign objects, such as plastic tubing or toothbrushes (8, 9). Treatment lasted 15 min daily and 3 days a week.

Tongue lateralization. The stimulations consisted of two parts:

1. A small amount of jam was placed on four corners of the lips alternately: left and right corner and middle of upper and lower lips so that the tongue had to remove the stimulus from outside the oral cavity.

2. For stimulating the tongue in the mouth, the stimulus was placed in the cheek pocket so that the tongue had to remove it from the cheek in order to swallow (8,9).

Lip control. The stimulations consisted of two parts:

1. Closing the lips around a pretzel (7 mm in diameter).

2. Holding a straw between the lips and blow into it for three seconds and the child was encouraged to repeat the function (8, 9).

Vigor of chewing. Small pieces of biscuits were placed on the molars to the right or left alternatively, and the child was encouraged to chew these (8, 9).

Results

Among 12 spastic cerebral palsy children who participated in the study, 5 were female (41/66%) 7 were male (58/33%). All children had feeding difficulties and gained at or below 10 scores in OMAS test. Children for daily living activity such as eating were dependent to parents. For all of the statistical tests, the significance level was ($P< 0.05$).

To evaluate the effect of treatment on feeding performance and oral-motor skills the Friedman test was carried out. There was a significant difference in oral-motor skills at the pre, mid, and post-treatment (Table 1).

Table 1. The effect of oral sensorimotor stimulations on oral-motor skills in children with spastic cp

Oral-motor skills	Assessment stage	Mean(SD)	Mean rank	Friedman *P*-value	Bonferroni comparisons	Bonferroni *P*-value
Mouth closure	**I**	1.08±1.08	1.50		I-II	0.125
	II	1.75±1.21	1.96	< 0.001	II-III	0.062
	III	2.41±0.51	2.54		I-III	0.008
Lip closure onto the utensil	**I**	1.08±0.79	1.58		I-II	0.125
	II	1.50±0.79	2.08	0.008	II-III	0.500
	III	1.75±0.62	2.33		I-III	0.031
Lip closure during deglutition	**I**	1.16±0.71	1.62		I-II	0.125
	II	1.58±0.51	2.12	0.025	II-III	1
	III	1.66±0.49	2.25		I-III	0.062
Control of food during deglutition	**I**	0.91±0.79	1.33		I-II	0.016
	II	1.50±0.52	2.08	< 0.001	II-III	0/062
	III	1.91±0.28	2.58		I-III	0.004
Straw suction	**I**	0.41±0.66	1.67		I-II	0.250
	II	0.66±0.88	2.04	0.025	II-III	0.500
	III	0.83±0.93	2.29		I-III	0.062
Control of liquid during deglutition	**I**	0.75±0.75	1.33		I-II	0.016
	II	1.33±0.49	2.21	< 0.001	II-III	0.500
	III	1.50±0.52	2.46		I-III	0.004
Mastication	**I**	0.91±0.79	1.33		I-II	0.008
	II	1.83±0.39	2.29	< 0.001	II-III	1
	III	1.91±0.28	2.38		I-III	0.008
Final score	**I**	6.33±3.33	1.00		I-II	< 0.001
	II	10.16±2.12	2.04	< 0.001	II-III	0.001
	III	12.00±1.59	2.96		I-III	< 0.001

I represent pre-treatment assessment stage, II represent mid-treatment assessment stage, and III represent post-treatment assessment stage

Also, the willcoxon signed rank test (Bonferroni comparisons) was used to check out the effect of a number of treatment sessions on oral-motor skills. It revealed significant differences only after 24 treatment sessions in many oral-motor skills and significant differences in first and last phases of assessment in chewing (Table 1).

In order to compare the effect of treatment on each oral-motor skill, at the first, differences of scores in pre-treatment and post-treatment was obtained for each performance and then these differences were compared together using Friedman test. More improvement was in mouth closure and less in straw suction. However, these differences were not statistically significant (*P*=0/190) (Table 2).

Table 2. Comparing oral-motor skills following oral sensorimotor stimulations

Oral-motor skills	Mean(SD)	Mean rank	*P*-value
Mouth closure	1.33 ± 1.15	4.92	
Lip closure onto the utensil	0.66 ± 0.77	3.62	
Lip closure during deglutition	0.50 ± 0.67	3.38	
Control of food during deglutition	1.00 ± 0.73	4.46	0.190
Straw suction	0.41 ± 0.51	3.17	
Control of liquid during deglutition	0.75 ± 0.45	4.00	
Mastication	1.00 ± 0.85	4.46	

In order to check the validity, one independent speech therapist except the first author scored the oral-motor skills at pre, mid, and post-treatment by observing the videotapes. Data were analyzed using the Intra-class Correlation Coefficient (ICC). ICC was higher than 60 in all skills except control of food during swallowing and lip closure during deglutition, indicating substantial agreement between the two observers (Table 3).

Table 3. Correlation of scores between two independent speech therapists

Oral-motor skills	Pretreatment assessment	Mid-treatment assessment	Post-treatment assessment
Mouth closure	0.804(0.452-0.939)	0.887(0.657-0.966)	0.615(0.095-0.872)
Lip closure onto the utensil	0.895(0.676-0.969)	0.894(0.673-0.968)	1.00(1.00-1.00)
Lip closure during deglutition	0.471(-0.111-0.812)	0.884(0.648-0.965)	0.727(0.292-0.913)
Control of food during deglutition	0.859(0.583-0.957)	0.333(-0.269-0.748)	0.372(-0.228-0.767)
Straw suction	0.767(0.373-0.927)	0.885(0.649-0.965)	0.949(0.833-0.985)
Control of liquid during deglutition	0.709(0.257-0.907)	0.814(0.474-0.943)	0.706(0.251-0.905)
Mastication	0.927(0.768-0.978)	0.766(0.370-0.926)	0.645(0.143-0.883)
Final score	0.915(0.933-0.975)	0.847(0.554-0.954)	0.850(0.561-0.954)

Data represent ICC with confidence intervals.

Discussion

Oral-motor dysfunction in CP children has been proved. In several literatures, many strategies were used to treat the feeding problems. Hou *et al*., reported most of the CP children have oral-motor and feeding problems in early years of their life interfering with their growth and eating (13). The purpose of the present study was to examine the effect of oral sensorimotor stimulation on feeding function.

Scoring the OMAS items at different phases of treatment by two different speech therapists showed that the raters rated the items in a consistent manner. Therefore, the positive effect of oral sensorimotor stimulation on feeding performance is reliable, and the bias of the researcher did not affect the results.

When authors surveyed the effect of oral sensorimotor stimulations on any oral-motor performances, all of the feeding skills such as mouth closure, lip closure on utensil, lip closure during deglutition, control of food during deglutition, straw suction, control of liquid during deglutition and mastication improved significantly. More improvement was in mouth closure and less in straw suction in comparing with other performances, but this outcome was not significant. This result is consistent with the following studies.

Gisel report about the effect of oral sensorimotor practices for 20 weeks (5 days in a week) in CP children showed that spoon feeding, biting and chewing

significantly improves but the practices did not affect the straw sucking (9). Liu *et al*., suggested primary oral practices had a positive effect on feeding function in premature children so that weight gain was significantly improved in these children (14). In addition, Fucile *et al*., found that oral stimulation causes faster transition from tube feeding to oral feeding in premature children and after the treatment the children received the more milk more quickly (15). Rocha *et al*., also showed that oral sensorimotor stimulation with nonnutritive sucking in very low-birth-weight children causes' faster achievement to oral feeding and more stable clinical status (16). Gisel showed that 10 weeks of sensorimotor treatment improve oral-motor skills in CP children with feeding problems (8).

The results of the present study are in contrast with the results of Ernst *et al*., (17). They found that nonnutritive sucking did not have any effect on feeding outcomes in premature children. It seems to be due to the type of intervention, duration of intervention and, the population was studied.

According to significant role of the tongue in the feeding, mandible movement in chewing and the role of orbicularisoris muscle in lip closure for continuing the preparatory phase, it is clear that strengthening these muscles improve feeding function (18). Current findings suggest that using oral sensorimotor stimulations applying lip, tongue, and jaw movement, indirectly improves feeding function.

By continuing the treatment to 24 sessions, improvements do not increase significantly but all of the oral-motor skills improve to a higher level after 24 (8 weeks) than 12 (4 weeks) treatment sessions. Mouth closure, control of food during deglutition, control of liquid during deglutition, and chewing were only significant. This could be due to the impact of jaw, lip and tongue movements on these performances and more focused treatment in these organs. In addition, chewing was improved significantly after 12 and 24 treatment sessions. It seems to be due to the direct focus of treatment on the chewing. Gisel reported significant differences obtained after 10 weeks of treatment and he disagreed with longer treatment for feeding skills (9). It seems that other factors such as posture play an important role in feeding problems of CP children following brain injury and motor problems in their trunk, head and neck.

Children with CP often have reduced control of posture resulting to the deterioration of their swallowing and feeding disorders (19). Larnet *et al*., found that following the correction of neck position, aspiration in all five children and oral leak in two children were decreased, and retention of food was improved in one child (20).

On the other hand, improvement of cognitive skills may cause improvement of feeding functions in these children. Therefore it seems that lack of significant progress with continuing treatment sessions may be due to interference of the cognitive skills in learning motor skills, so that if sensorimotor stimulations are combined with strengthening cognition, the more improvement is achieved.

It is noteworthy to treat the feeding problems in children with CP. Although oral sensorimotor stimulations are one of the treatment strategies, we should also consider other strategies to achieve more improvement in feeding performance of children with CP.

Specific components of feeding behaviors improved by continuing intervention. To obtain maximum performances in feeding skills, we should consider other strategies along with the oral sensorimotor stimulations as well.

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