
An Effective Oral Motor Intervention Protocol for Infants and Toddlers with Low Muscle Tone

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There is a lack of information regarding effective oral motor treatment methods that can be used with infants and toddlers who exhibit low muscle tone. This article describes an oral motor treatment protocol that can be used for a home intervention program. Parents were trained in one 2-hour session and additional consultations upon request to use oral motor techniques appropriate to the child's individual needs. A videotape was sent home with the parents to provide models of the techniques demonstrated in the training sessions. Four case studies were completed. All four children had low muscle tone secondary to Down syndrome. The four infants were pretested with the Developmental Pre-Feeding Checklist (Morris & Klein, 2000) and posttested with the Battery for Oral-Motor Behavior in Children (Long, Bahr, & Kumin, 1998). The parents completed a questionnaire at the time of the posttest documenting which techniques they had used and the frequency and consistency with which they had used the techniques. The findings of the case studies suggested that young children with low muscle tone who consistently received the oral motor home treatment program demonstrated improved oral motor function for eating, drinking, and speaking.

Many infants and toddlers with low muscle tone, including those with Down syndrome, are at high risk for oral motor difficulties, which directly impact eating, drinking, and speaking. Although speech-language patholo-

gists and/or occupational therapists cannot directly address speech in young infants, treatment initially focusing on the development of feeding skills can provide the foundation for later developing speech. A program consist-

ing of oral massage, oral activities/exercise, and therapeutic feeding techniques can help the child develop adequate oral movement for eating and drinking. The muscles of the oral area must work well for eating, drinking, and speaking.

Speech is the most refined fine motor function in the body (Bahr, 2001). Speech as a motor output system is based on the integrity of the sensory systems and the integration of these in the brain. "More sensory nerve fibers are present in the mouth than in any other part of the human body, and evolution of mouth function supports organization of the entire body" (Nelson & DeBenebib, 1991, p. 131). Therefore, it is important to focus on sensory input to the oral area as well as motor output. Moore has suggested that there are many more sensory fibers than motor fibers in the central nervous system and that (Moore, 1999) the sensory fibers do the learning. Sensory systems have been estimated to learn 100 times faster than motor fibers.

The foundation for oral movement involves both sensory and motor processes including the intention to act, sensory intake, sensory integration, motor planning, motor command from the motor cortex, muscle contraction via neuronal input, culminating in the oral movements required for eating, drinking, and speaking (Bahr, 2001; Fisher, 1991). A variety of feedback mechanisms work along with these processes to help the individual determine the correctness of the movement. The mouth is a sensory environment, which can be affected by treatment. According to Nelson and De Benebib (1991):

The various parts of the mouth need to relate to one another at a sensory level to coordinate their function, so the clinical objective becomes one of introducing more normal movement sensations and establishing the orientation of each segment of the whole to encourage more normal function. (p. 137)

Although, current research supports the idea that speech and nonspeech tasks appear to be controlled by different cortical areas of the brain (Moore & Ruark, 1996; Moore, Smith, & Ringel, 1988; Ruark & Moore, 1997), the same mechanism is used for the processes of eating, drinking, and speaking (i.e., the bones and muscles that comprise the oral area). In recognition of this relationship, many sensory and motor treatment techniques are beginning to be incorporated into early intervention therapy sessions to address oral motor concerns related to eating, drinking, and speaking. Some of the techniques include oral massage, other "hands-on" facilitation techniques, feeding therapy, and oral exercise programs. However, there is a lack of information regarding the effectiveness of appropriate treatment protocols to address difficulties in eating, drinking, and speaking experienced by children with low muscle tone.

This article presents a comprehensive home treatment protocol for addressing oral motor issues in infants and toddlers who exhibit low muscle tone. Case studies will illustrate the effectiveness of consistent and frequent use of this oral motor home treatment protocol. Children with low muscle tone typically receive physical and/or occupational therapy at an early age to help them accomplish many gross and fine motor developmental milestones. In fact, Kozma (1995) reports that muscle tone can be improved via physical therapy. According to Bobath (1971, p. 528), "postural tone and motor patterns can be changed" through treatment. However, children with low muscle tone often do not receive early oral motor intervention from a speech-language pathologist to improve the fine motor function of the oral mechanism for eating and drinking and to help them accomplish developmental speech milestones.

Review of the Literature

Low muscle tone (hypotonia) has been defined as "the degree of stiffness" in the muscles "to stabilize and move the skeleton" in the presence of gravity (Boehme, 1990b, p. 210) and as "a limpness or a feeling of heaviness when a limb is moved passively" (Boehme, 1990a, p. 1). According to Bahr (2001):

Individuals with hypotonia demonstrate postural instability resulting in insufficient head, neck, and trunk control. Many individuals with oral motor concerns exhibit low muscle tone proximally (e.g., in the trunk of the body) and hyperextension or fixing patterns in the more distal areas of the body (e.g., in the shoulder girdle, neck, jaw, upper extremities, and lower extremities). (p. 46)

Some of the ways in which hypotonicity can directly affect eating, drinking, and speaking are:

- Sternal depression during inhalation, flared ribs (Redstone, 1991), and insufficient movement of the respiratory musculature (Rosenfeld-Johnson, 1999) resulting in inefficient respiratory support for speech production;
- Difficulty with dynamic jaw and tongue stability as well as graded jaw, lip, and tongue movements (Bahr, 2001; Kumin & Bahr, 1999; Morris, 1989), which impact eating, drinking, speaking;
- Open mouth posture (Desai, 1997; Frazier & Friedman, 1996);
- Difficulty with jaw closure and subsequent lip closure (Bahr, 2001; Kumin & Bahr, 1999; Rosenfeld-Johnson, 1999);
- Difficulty forming a tight oral seal for suckling or sucking (Frazier & Friedman,

- man, 1996; Rogers & Coleman, 1992; Rynders & Horrobin, 1996);
- Difficulty with initiation of suckling and swallowing response (Rogers & Coleman, 1992; Frazier & Friedman, 1996);
- Incoordination of the suck-swallow-breathe sequence (Frazier & Friedman, 1996; Lau & Schanler, 1996; Oetter, Richter, & Frick, 1995);
- Difficulty with precise tongue movement (Kumin & Bahr, 1999; Rogers & Coleman, 1992) and poor bolus control (Frazier & Friedman, 1996; Kumin & Bahr, 1999; Spender et al., 1995; Spender et al., 1996);
- Tongue thrust or reverse swallow pattern (Bahr, 2001; Desai, 1997);
- Drooling (Desai, 1997; Frazier & Friedman, 1996; Kavanagh, 1995; Kumin & Bahr, 1999; Morris & Klein, 2000);
- Limited oral play experiences which may lead to difficulties with oral sensory discrimination, oral hyposensitivity, or oral hypersensitivity (Bahr, 2001; Frazier & Friedman, 1996);
- Difficulties with speech development (Bahr, 2001; Kumin, 1994; Morris & Klein, 2000);
- Difficulty with velo-pharyngeal closure (Desai, 1997);
- Difficulties with adequate intraoral pressure for speech production (Swift, Rosin, Khidr, & Bless, 1992); and
- Reduced speech intelligibility (Kumin, 1994; Miller & Leddy, 1998; Miller, Leddy, & Leavitt, 1999).

The incidence of hypotonia in children with Down syndrome is estimated to be over 95% (Share & French, 1993). This is, therefore, an ideal population in which to examine treatment.

Method and Procedure

A comprehensive oral motor home treatment protocol including oral massage, oral facilitation techniques, therapeutic feeding techniques, and nonspeech oral exercise was used with four young children who had low muscle tone secondary to Down syndrome. Parents were trained to use oral massage; oral facilitation techniques; therapeutic feeding techniques; jaw exercises; and exercise regimens using bubbles, straws, and horns as appropriate. Pre- and posttesting were completed as a means of observing changes in the four subjects' oral motor function over time.

Parents were instructed in oral motor techniques to be completed as part of the home program. The same speech-language pathologist provided an initial 2-hour individual evaluation and training session as well as requested follow-up training sessions for all of the parents. The parents were provided with a videotape containing explanation as well as demonstration of all the techniques suggested. They were also given written information regarding techniques discussed. A full written report was provided. Additional consultations were provided for the families as requested between pre- and posttesting. Three of the four families requested additional consultation. All of the children received additional speech and language services between pre- and posttesting. In fact, Subjects 1, 2, and 4 received at least 4 months of weekly speech-language treatment that included the use of oral motor techniques. This treatment was implemented by trained graduate student clinicians.

The comprehensive oral motor home intervention program included (a) oral massage, (b) Beckman Facilitation Techniques (Beckman, 1997), (c) therapeutic feeding techniques, (d) Jaw/Bubble/Horn/Straw exercises (Bahr, 2001; Rosenfeld-Johnson, 1999), and/or (e) other oral motor techniques as appropriate.

The oral massage was used to bring greater sensory awareness to the child's oral mecha-

nism as well as to improve responses in the oral area (i.e., decrease hypersensitivity or tactile defensiveness) so that more specific oral motor techniques could be applied (Bahr, 2001). This sequence generally involved manual massage of the facial musculature and massage inside the mouth with an implement such as the NUK oral massage brush.

Beckman Facilitation Techniques (Beckman, 1997) are techniques that can be used in conjunction with oral massage. These facilitation techniques consist of approximately 25 manipulations of the oral and facial surface tissue as well as the underlying oral and facial musculature to improve muscle function (Bahr, 2001). The parents were instructed in the use of particular Beckman Facilitation Techniques that the speech-language pathologist believed to be appropriate for each child at the time.

Therapeutic feeding techniques were taught to the families as the children were ready for these. They included appropriate positioning; biting and chewing activities; and bottle, spoon, and cup use to encourage graded movement of the oral mechanism for eating and drinking.

A variety of oral exercises were prescribed to improve graded respiration as well as graded jaw, lip, and tongue movement. Jaw exercises (Bahr, 2001; Rosenfeld-Johnson, 1999) designed to improve jaw alignment, strength, stability, and grading of jaw and tongue movement were introduced as appropriate. The Bubble Blowing, Horn Blowing, and Straw Drinking Hierarchies (Rosenfeld-Johnson, 1999) were also introduced as appropriate.

The Bubble Blowing Hierarchy (Rosenfeld-Johnson, 1999) is a set of oral motor and respiration exercises. It is designed to improve abdominal grading, graded jaw movement, lip rounding and protrusion, jaw and lip dissociation, jaw and tongue dissociation, tongue retraction, back of tongue side spread, and motor planning.

The Horn Blowing Hierarchy (Rosenfeld-Johnson, 1999) uses a series of 14 horns designed for home practice ordered by level of difficulty. The hierarchy addresses abdominal grading, "jaw grading, jaw-lip dissociation, jaw-tongue dissociation, lip closure for saliva control, lip rounding, tongue retraction, back of tongue side spread, and motor planning" (Rosenfeld-Johnson, 1999, p. 47).

The Straw Drinking Hierarchy (Rosenfeld-Johnson, 1999) targets lip strength, lip protrusion and rounding, tongue retraction, back of tongue side spread, and jaw-lip-tongue dissociation. Eight specific straws are provided with the program ordered by level of difficulty for home practice.

The complete treatment protocol taught to the families in this study can be found in Table 1. Portions of the protocol were taught to the families based on the demonstrated needs of each child.

Four families were taught techniques included in the comprehensive oral motor home treatment protocol based on the individual needs of each child. All were asked to use the protocol as least once daily. The amount of time varied according to each child's needs and the specific activities recommended. For example, oral massage was recommended three times per day before the child used his or her mouth in some manner. Therapeutic feeding techniques were recommended for use at each meal. Beckman Facilitation Techniques were recommended once daily. Other oral activities/exercises were recommended at least three to five times per week following the specifications of each program.

Each child received at least two assessments, a pretest assessment before the treatment protocol was begun and a posttest assessment after 20–24 months of treatment. A questionnaire was completed by the parents at the time of the posttest assessment (see the Appendix). On the questionnaire, the parents reported how consistently they had used the

oral motor techniques and which techniques they had used in the home program. The following areas were addressed in the questionnaire: (a) oral motor techniques used, (b) specific Beckman Facilitation Techniques used (Beckman, 1997), (c) frequency of Beckman Facilitation Techniques used, (d) frequency of oral massage application, (e) frequency of Jaw/Bubble/Horn/Straw exercise use (Bahr, 2001; Rosenfeld-Johnson, 1999), (f) age the child began participating in oral massage/motor techniques, and (g) other oral motor techniques used. All parents had received the same initial training and completed the same questionnaire. Three out of the four families requested additional training between pre- and posttesting. All of the children received additional speech and language services once per week. Based on the results of the questionnaire, it was determined which children had received consistent and frequent oral motor intervention at home and which had not received consistent and frequent oral motor intervention. Consistent and frequent oral motor intervention was defined as the use of the treatment protocol at least once daily. The questionnaire can be found in the Appendix.

All of the children were evaluated at two points in time (i.e., pretest and posttest). The Developmental Pre-Feeding Checklist (Morris & Klein, 2000), which was used as the pretest, measures eating and drinking skills in children birth to 24 months. This checklist assesses the areas of feeding position, food types, food quantity, coordination of sucking, swallowing, and breathing, as well as jaw, lip, and tongue movements (Morris & Klein, 2000).

The Battery for Oral-Motor Behavior in Children (Long et al., 1998) was used as the posttest. It could not be used as a pretest, because the infants were 3–4 months of age at the time of initial testing and could not complete the required tasks. The Battery for Oral-

Table 1. Comprehensive Oral Motor Home Protocol for Infants and Toddlers with Hypotonia

A. Oral massage with or without the NUK oral massage brush (Bahr, 2001)

B. Beckman Facilitation Techniques (Beckman, 1997)

- | | |
|--|--|
| 1. Upper lip stretch | 14. Upper cheek stretch |
| 2. Side-to-side upper lip stretch | 15. Upper posterior cheek stretch |
| 3. Lower lip stretch | 16. Lower cheek stretch |
| 4. Side-to-side lower lip stretch | 17. Lower posterior cheek stretch |
| 5. Corner lip stretch | 18. Masseter cheek stretch |
| 6. Horizontal lip stretch | 18a. Probe for posterior cheek strength |
| 7. Lip curl and stretch | 19. Resistive chewing |
| 8. Resistive lip stretch | 20. Lateral pressure to the tongue |
| 8a. Probe for strength | 21. Pressure to inner upper gum |
| 9. Diagonal nasal bridge stretch | 22. Pressure to inner lower gum |
| 10. Z-stretch for the nasal bridge | 23. Stimulation to midblade of the tongue |
| 11. Mini "C" stretch | 24. Palate and tongue blade sweep |
| 12. Pressure to the base of the tongue | 25. Stirrup for midblade elevation |
| 13. Gum massage | 26. Inner lower gum sweep for tongue tip elevation |

C. Therapeutic Feeding Techniques

1. Positioning
2. Bottle/breast-feeding
3. Spoon feeding
4. Biting and chewing
5. Cup/straw drinking

D. Sara Rosenfeld-Johnson Programs and Other Jaw Exercises (Bahr, 2001; Rosenfeld-Johnson, 1999)

1. Jaw exercises
 2. Horn Blowing Hierarchy
 3. Bubble Blowing Hierarchy
 4. Straw Drinking Hierarchy
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Motor Behavior in Children (Long et al., 1998) is an organized observational tool that measures muscle function and motor planning. The child's posture and oral structures are assessed at rest. Muscle function of the jaw, lips, and tongue is assessed during spoon-feeding, while taking bites of food and chewing, during bolus formation, and while drinking. Motor planning is assessed via a list of 21 yes/no questions generally asked of the parents. These questions reflect characteristics common in children with dyspraxia.

Setting and Materials

Evaluation and parent training sessions were conducted in an individual treatment room with the parents present. All assessment and training sessions were completed by the same clinician, who is a certified speech-language pathologist and an oral motor clinical specialist. Trained graduate students observed and took data on the oral motor behaviors observed at each session. Treatment techniques were demonstrated as an ongoing part of the sessions. A NUK oral massage brush was used during the completion of general oral massage and some of the Beckman Facilitation Techniques. This brush is a toothbrush-like instrument with soft rubber protuberances on one end. It is used to facilitate increased oral awareness in the mouth and to apply some of the Beckman Facilitation Techniques. Various food and liquid textures were presented as part of the assessment and training process. Therapeutic feeding techniques were taught as appropriate with the use of spoons, cups, straws, bottles, and so forth. Jaw exercises were completed with chewy foods wrapped in cheesecloth, various sizes of plumbing tubing, Chewy Tubes, or bite blocks. As previously mentioned, bubble, horn, and straw programs (Rosenfeld-Johnson, 1999) were introduced

to the children at an appropriate point in time. At times, puppets that swallow (Hanson, 1998) were used to demonstrate oral massage and other oral motor techniques. A freestanding mirror was frequently used to provide the child with visual feedback. All sessions were videotaped with the permission of the parents. The videotapes were given immediately to the parents at the conclusion of the assessment and training sessions so that the parents could apply the techniques demonstrated during the sessions. Appropriate techniques were taught to the parents based on each child's oral motor needs.

Case Studies: Use of Comprehensive Oral Motor Home Treatment Protocol

Families of four young children with hypotonia were trained to use the comprehensive oral motor treatment protocol. All four children had a diagnosis of Down syndrome with the etiology Trisomy 21. According to the parent questionnaire, two of the subjects (one male and one female) received consistent oral motor treatment as part of their home programs (at least one time daily), whereas two of the subjects (one male and one female) received inconsistent oral motor treatment as part of their home programs. These case studies compare pretest and posttest results of each individual child to document the effectiveness of consistently applied oral motor treatment as part of a home program for four young children with hypotonia (see Table 2).

Subject 1

Subject 1, a male with Down syndrome, has received consistent and frequent oral motor treatment as part of his home program.

Table 2. Questionnaire Results

Oral Motor Techniques Used	Subject 1 (male, consistent treatment)	Subject 2 (male, inconsistent treatment)	Subject 3 (female, consistent treatment)	Subject 4 (female, inconsistent treatment)
Oral Massage Frequency (Bahr, 2001)	Seven times per week	Currently not doing this	Three times daily	Currently not doing this
Beckman Facilitation Techniques Frequency (Beckman, 1997)	One time daily	Currently not doing these exercises. The ones listed below have reportedly been done in the past.	Three times daily	Currently not doing these exercises. The ones listed below have reportedly been done in the past.
Upper lip stretch	✓	✓	✓	
Side-to-side upper lip stretch	✓		✓	
Lower lip stretch	✓	✓	✓	
Side-to-side lower lip stretch	✓		✓	
Corner lip stretch			✓	
Horizontal lip stretch	✓	✓	✓	
Lip Curl and stretch			✓	
Resistive lip stretch			✓	
Probe for strength				
Diagonal nasal bridge stretch	✓		✓	
Z-stretch for the nasal bridge	✓	✓	✓	
Mini "C" stretch		✓	✓	

Table 2. (continued)

Oral Motor Techniques Used	Subject 1 (male, consistent treatment)	Subject 2 (male, inconsistent treatment)	Subject 3 (female, consistent treatment)	Subject 4 (female, inconsistent treatment)
Pressure to the base of the tongue	✓			✓
Stirrup for midblade elevation				
Gum massage			✓	✓
Upper cheek stretch	✓		✓	
Upper posterior cheek stretch	✓		✓	
Lower cheek stretch	✓		✓	
Lower posterior cheek stretch	✓		✓	
Masseter cheek stretch	✓		✓	
Probe for posterior cheek strength				
Resistive chewing				
Lateral pressure to the tongue	✓		✓	✓
Pressure to inner-upper gum	✓			
Pressure to inner-lower gum	✓			

(continued)

Table 2. (continued)

Oral Motor Techniques Used	Subject 1 (male, consistent treatment)	Subject 2 (male, inconsistent treatment)	Subject 3 (female, consistent treatment)	Subject 4 (female, inconsistent treatment)
Stimulation to midblade of tongue	✓			✓
Palate and tongue blade sweep				✓
Inner lower gum sweep for tongue tip elevation				✓
Recommended Use of Therapeutic Feeding Techniques	✓	Some	✓	Some
Sara Rosenfeld-Johnson Programs and Other Jaw Exercises (Bahr, 2001; Rosenfeld-Johnson, 1999)				
Jaw Exercises			✓	
Bubble Blowing Hierarchy			✓	Beginning
Horn Blowing Hierarchy	✓			
Straw Drinking Hierarchy			✓	Beginning
Age Began Oral Motor Treatment	3 months	4 months	1 month	4 months
Other Oral Motor Techniques	None	None	Tongue walking, vibrating massager, signing, and cueing are done daily.	Electric toothbrush and brushing teeth

He received oral massage (Bahr, 2001) 7 times per week and Beckman Facilitation Techniques (Beckman, 1997) once daily from the age of 3 months. The following Beckman Facilitation Techniques (Beckman, 1997) were used: upper lip stretch, side-to-side upper lip stretch, lower lip stretch, side-to-side lower lip stretch, horizontal lip stretch, diagonal nasal bridge stretch, Z-stretch for the nasal bridge, pressure to the base of the tongue, upper cheek stretch, upper posterior cheek stretch, lower cheek stretch, lower posterior cheek stretch, masseter cheek stretch, lateral pressure to the tongue, pressure to inner-upper gum, pressure to inner-lower gum, and stimulation to midblade of tongue. His family consistently used the recommended therapeutic feeding techniques. The Sara Rosenfeld-Johnson Horn Blowing Hierarchy (Rosenfeld-Johnson, 1999) was also used with Subject 1.

Subject 1 was first seen for oral motor assessment at 3 months of age (pretest). On the Pre-Feeding Skills Checklist (Morris & Klein, 2000), he attained four out of the six feeding skills assessed at the 3-month level. He was fed in a semisitting position, took 7 or 8 ounces of liquid per feeding at four to six feedings per day, sequenced 20 or more sucks from the bottle, and used a suckling pattern. He was not yet spoon fed, so he did not suck semisolids from a spoon or use a suckle-swallow to move semisolid food to the pharynx as there was no opportunity for this. The Battery for Oral-Motor Behavior in Children (Long et al., 1998) was used for the posttest. Subject 1 was 27 months of age at the time of the posttest. He exhibited generally normal muscle function in jaw, lip, and tongue movement on the Assessment of Oral Movements During Feeding/Eating and Drinking subtest. His total score on this subtest also reflected generally normal muscle function. On the Apraxia Inventory, he exhibited mild motor planning dysfunction.

An informal speech sample was attained. At 27 months of age, Subject 1 produced 10

individual phonemes as part of his babbling. These included six consonants and four vowels: /m, b, p, d, t, k, æ, a, ou, and ʌ/. He produced one word approximation (i.e., /dʌ/ for the word, *door*). He also produced three true words (i.e., *poppop*, *Abby*, and *nitenite*).

Subject 2

Subject 2, a male with Down syndrome, has not received consistent or frequent oral motor treatment as part of his home program. He began oral motor treatment at 4 months of age. His oral motor treatment plan consisted of oral massage (Bahr, 2001) and Beckman Facilitation Techniques (Beckman, 1997). According to the parent questionnaire, the oral massage (Bahr, 2001) and the Beckman Facilitation Techniques (Beckman, 1997) are no longer being used. The following Beckman Facilitation Techniques (Beckman, 1997) were reportedly used with the subject at some point in time: upper lip stretch, lower lip stretch, horizontal upper lip stretch, Z-stretch for the nasal bridge, and mini "C" stretch. Some of the demonstrated therapeutic feeding techniques were used with Subject 2.

Subject 2 was first seen for oral motor assessment at 4 months of age (pretest). On the Pre-Feeding Skills Checklist (Morris & Klein, 2000), he attained four out of the seven feeding skills assessed at the 3–4 month level. He was fed in a semisitting position, took 7 or 8 ounces of liquid per feeding at four to six feedings per day, sequenced 20 or more sucks from the bottle, and used a suckling pattern. He was not yet spoon fed or given opportunities to take sips from a cup, so he did not suck semisolids from a spoon, use a suckle-swallow to move semisolid food to the pharynx, or drink from a cup.

The Battery for Oral-Motor Behavior in Children (Long et al., 1998) was used as the posttest. Subject 2 was 21 months of age at the time of the posttest. He exhibited moderate muscle dysfunction in jaw, lip, and tongue