Sensory / Motor Therapy For The Treatment Of Oral Dyskinesia

A New Approach to the Treatment of Oromyofunctional Disorders With the Use of Tactile Cuing Handheld Exercisers

Jack Light D.D.S., M.S.D., M.P.H.

Maxillofacial Rehabilation Consultant at:

National Rehabilitation Hospital
Washington, DC

Kennedy-Kreiger Hospital,
The Johns Hopkins Medical Center
Baltimore, Maryland

The Hospital for Sick Children
Washington, DC

Persons with oral myofunctional disorders suffer from multiple risk factors for impairments. A craniofacial malformation may be responsible for both behavioral as well as structural modifications. This includes the effect of appearance on self concept and behavior (Case, 1988). Structural modifications as well as negative oral habits include: an open mouth resting posture; mouth breathing; low forward tongue carriage; forward articulatory tongue placement (linguadental/ lingua alveolar); abnormal lip, tongue and facial muscle movements during swallowing; reduced upper lip length and mobility; overcontraction of the mentalis muscle; negative habits such as nailbiting, thumb or finger-sucking, lip biting, and lip licking (Hale and Kellum, 1988). Clinical observations also include hypotonicity of the posterior oral musculature during swallowing activity.

The purpose of this article is to explore the etiology of oral myofunctional disorders and present a new approach to treatment using functional prosthetic therapy.

INFANT ORAL DEVELOPMENT

At birth, oral reflexes provide the foundation for all growth and development. Newborns are ready to suckle at birth. When the mouth of the normal infant is not participating in feeding or respiration maneuvers, the oral chamber is closed by active approximation of the tongue to the length of the hard and soft palate. The upper and lower lips are in apposition, and the tongue tip participates in labial closure when it is not pressed against the hard palate (Bosma, 1976).

The mouth, whether at rest or during feeding, is a sensory resource that contributes to the maintenance of the organism. It is generated by the infant's motion and a network of mucosal receptors. This sensory input is the key to the development of oral performance. Development of the central nervous system depends on this sensory input which in turn leads to motor competency of the oral mechanism (Bosma, 1976) The reflexive swallow in this early period is a suckle-swallow which consists of a forward and backward motion. At three months motor controls are improving. The reflexive suckle-swallow starts to shift to volitional patterns. At six months of development, babies are motorically and cognitively prepared to be more active participants in the feeding process (Morris, 1987). The anatomical relationship of the jaw and face begin to change between 4 and 6 months. As the lower jaw moves downward, the space within the mouth increases, providing a greater opportunity for the tongue to move in an up and down motion. The anatomic and neurological changes support a gradual shift from the immature suckling reflex pattern to a volitional sucking pattern. Both the suckle and sucking patterns will be present between six and twelve months until the suck beoomes dominant.

Lateralization movements of the tongue are beginning to occur between six to nine months of age, as teeth erupt and bolus formation and movement to the teeth are necessary. The world is discovered through

the mouth as the baby begins to learn about shape, texture, weight and taste. A tonic bite response emerges in response to the sensory input of objects and certain food substances. The movement patterns for chewing begin. Oral reflexes are now integrated as new voluntary skills are perfected for biting, chewing and preparation of the swallow bolus.

During the first 6-12 months of development, some infants have feeding difficulties due to a weak oral musculature. "Normal" muscle tone and general muscle integrity is critical to feeding and swallowing tasks. Oral motor dysfunctions common to all abnormalities of muscle tone include drooling, poor oral exploration and/or selective movement, the inability to initiate, grade, or sustain oral patterns, and potential impingement on breathing coordination. Children born preterm or with low birth weight may have a low tone which may affect the ability to initiate or sustain a suck-swallow and subsequent food manipulation (Kunos, 1995). Feeding skills appear to be critical to the infant's development for the capacity of self-regulation throughout the 1st year (Tuckman, 1994). It has been suggested that there is a "critical and/or sensitive period" for introduction of chewable textures in humans. The term "critical period" is applied to a fairly well delineated period in which specific stimuli must be applied in order to produce a particular action. After that critical time, the desired action can no longer be learned. The term "sensitive period" (directly relevant to most normal and handicapped children) is applied to an optimal time for the application of such stimuli, after which it is more difficult to learn a desired action or pattern of behavior.

Even with developmentally delayed children, there is evidence that solid foods need to be introduced at appropriate times, or those milestones of development will be missed. This may lead to rejection of solids (food refusal and vomiting) when they are introduced in a later period (Arvedson and Brodsky, 1993). The longer the delay, the more difficult it is for many children to accept textural changes. This was noted during observational visits to the feeding program at Kennedy-Krieger Institute, in Baltimore, Md., where children ages 2-4 with poor feeding and swallowing skills are being treated by occupational therapists as well as behavioral psychologists. Feeding skills and behavioral difficulties dominate the treatment regimen.

THE PATIENT WITH AN ORAL MYOFUNCTIONAL DISORDER

At age one, the child should have transferred from a reflexive suckle-swallow to a volitional suck-swallow with lips approximating and the beginning of an adult oral transit phase of swallowing. Instead, the child with an orofacial myology disorder presents a mixed pattern, with a volitional suckle-swallow. The child may function with incompetent lip closure, incompetent tongue range of motion for oral transit phase of swallowing as well as risk of an articulation disorder and craniofacial malformations.

TREATMENT TIMING FOR THE PATIENT WITH A MYOFUNCTIONAL DISORDER

There has been controversy regarding the earliest age at which a patient should be enrolled in orofacial myofunctional therapy (Pierce, 1988). Issues discussed include the risk of unnecessary treatment due to self correction of the disorder with maturation; motivational problems of younger children in carrying out practice assignments; and skepticism towards changing habits deeply ingrained.

Recently, there has been an increased interest by speech-language pathologists (SLPs) in oral motor disorders for the treatment of dysphagia and specifically pediatric dysphagia. A recent survey (ASHA, 1994) states that the % caseload of SLPs for dysphagia treatment is 32.6% up from 11.3% in 1992. SLPs are presently providing interventions for impaired feeding skills (nutritive suck) as early as six months of age to promote normal oral motor development. This should be a signal to therapists involved with orofacial myology; all clinical research and observations indicates that, as abnormal development is delayed in treatment, increased behavioral as well as decreased oral motor skills occur. In the opinion of the author, clinical experience has proven that as early as the dysfunction is noted, treatment should be considered.

USE OF THE INTRAORAL PROSTHESES AS A SENSORY/MOTOR TREATMENT TOOL

Treatment must include retraining oral musculature to adopt patterns that improve functional competence. Oral motor exercises are both fundamental and critical to treatment because they enable the patient to carry out consistent and repetitive exercises at the clinical treatment sessions as well at home. If the patient can be sent home with intraoral tools with a specifically designed oral exercise instructional program, treatment can be facilitated and stabilized more quickly and efficiently. Maxillofacial prosthetic management has traditionally been used to replace oral structures congenitally missing, (cleft palate prosthesis), or a head and neck surgical resection due to cancer. Palatal augmentation prostheses have been used to compensate for imadaquate tongue elevation movements for a hemiglossectomy (Wheeler et.al.,1980). There has been no previous treatment using

prosthetic devices with an exercise program to reshape muscle movement patterns.

A new approach to treatment includes a prosthetic treatment system that will address the oral motor exercisers and instructional program.

Research was conducted to test and evaluate the affects of interfacing prosthetic forms and shapes with the tongue and lips to change movement patterns. An exercise program was introduced into the training and treatment time sequences were additionally tested.

PREVIOUS RESEARCH

First Research Study

A study was conducted to test the use of a palatal prosthesis to "shape" accurate tongue-palate placement for ten esophageal speakers who were rated as poor speakers. (Light, 1976). The hypothesis was, if intraoral palatal prostheses can be augmented (thickened) in portions of the palate that are shown to be defective for phonemes essential to the glossal press-air injection technique, improvement would result for esophageal speech.

Results of Palatographic Recordings

A palatogram is the recording of contacts made by the tongue on an artificial palate that has been dusted with talcum powder during the production of phonemes such as /t/,/s/, or /k/. The palatograms are photographed and compared to palatograms taken one week later after wearing a restructured, augmented palate. For every subject, for each of the three phonemes, total area covered by the palatal wipes increased. The average percentage increases for /t/,/s/,and /k/ were 40%, 46% and 57% respectively. The contacts now resembled "good" esophageal speakers or a normal laryngeal speaker.

The results of speech scoring after wearing a prosthetic palate for one week, that had been augmented for defective phoneme placement sections of the palate (the prosthesis was not worn for the recordings pre-and post-testing): intelligibility improved for 8 out of 10 subjects; phonation improved for 7 out of 10 subjects; articulation improved for 9 out of 10 subjects; stomal noise decreased for 5 out of 10 subjects; and struggle to speak decreased for 5 out of 10 subjects.

Second Research Study

A study was conducted for a set of newly designed, handheld intraoral tactile cuing devices (Light, 1991). In addition to the concepts of palatal reshaping to retrain tongue movements used in the first research study, the set of five exercise devices also retrained lip movement patterns, A 40 minute exercise protocol was used with the devices for the treatment of incompetent lip and tongue movements. The design was a case/control comparison, where the cases had to serve as their own controls. Twenty research cases were enrolled for the study. Two subjects became ill and left the study leaving 18 in the study. Subjects enrolled for the study were patients with dysarthria due to a stroke or traumatic brain injury, and laryngectomies with poor esophageal speech. The treatment consisted of 20 training sessions provided in a period of four weeks, during which the handheld devices were used with an exercise protocol. It provided tongue and lip exercises for the production of consonants /p/,/t/, and /k/, and the vowels / /,/o/,/u/ and /i/.

Results of Tests

An array of tests and measurements were administered to permit assessing improvement at baseline and endpoint of treatment. These included the 25-word list of the Phonetically Balance Word List (Resnick, 1962), oscillography (for laryngectomees) voice onset, loudness, syllable air charges, and duration of phonation (LaBorwit, 1983). Ultrasound imaging and evaluation were also done by the speech-language pathologist treating the subjects. When verbal, these tests and measures were tape recorded in random sequence so that the SLPs who served as independent scorers could not identify the tests as to baseline and post treatment status.

In addition to the formal tests, the subjects, their primary caretaker or closest family member were interviewed to solicit comments, criticisms, problems encountered, suggestions, etc. The SLP's evaluated the qualitative outcomes for their individual patients, in addition to the evaluation of the protocol, the exercisers, problems encountered, etc.

Sixteen subjects out of eighteen subjects showed improvement for a variety of measures tested. Observed improvement varied from patient to patient. This was based on the qualitative reports (clinical record notations) written by the speech-language pathologists treating the patients as well as on reports from patient and family. Some of these tests were backed by the quantitative measures. Measures tested included: intelligibility, tongue and lip movements (including rate and speed), swallowing, decrease of excessive salivation, chewing, improved buccinator movement, and breath support.

The comments by subjects and family members touched on "quality of life" parameters such as; "I can drink without a straw", "I can use my lips and tongue more completely to eat", "I can kiss my wife without drooling", and "I can teach again without spraying my students with saliva".

As a result of this preliminary study of the handheld intraoral exercisers:

1. Tests and instrumentation were recommended to

specifically measure improvement of tongue and lip competency rather than intelligibility. For example, nonspeech motor movements of strength, speed, endurance, range of movement and accuracy of placement can be tested by the Iowa Oral Performance Instrument (IOPI) for tongue-palate pressure and endurance (Luschei, 1991), diadochokinetic rates, lip scales etc. 2.The protocol was shortened to 15 minutes that will fit into treatment time usually given the patient with oral motor exercises. 3. Modification of the design of the exercisers was noted and accomplished. 4.The exercisers and exercise program were accepted by the range of subjects and SLP's.

RELATED SIGNIFICANT RESEARCH

In 1992, there was new clinical information about the reaction of tongue musculature to a prosthetic surface. A 37 year old, male physician with a diagnosis of degenerative neurologic disorder (possible ALS), was referred by the National Institutes of Health (NIH). He was treated by the author in collaboration with his speech-language pathologist. A combination of a palatal lift and augmentation prosthesis was designed to improve a soft palate and tongue range of motion and competency. Hypernasality was reduced and articulatory contacts as well as tongue-palate contacts for the oral transit phase of swallowing, were improved, but oral function intermittently reverted to incompetency. Diagnosed with a spastic-flaccid dysarthria, the patient was recommended for ultrasound imaging at NIH, Department of Rehabilitation Medicine. Swallowing speed and tongue movements were evaluated with and without the prosthesis.

The imaging showed important new evidence. The tongue, without the prosthesis in place, moved in large segments, but with the prosthesis in position it moved in small segments as a normal tongue would move. Dr. Maureen Stone has conducted research (Stone, 1995) to show that the normal tongue does not move in large segments. The literature always refers to the tongue in terms of "tip"," dorsum", "blade" and" back". In reality according to this research the tongue segments into 25 parts (5 front to back and 5 from right to left). According to the research, the more shapes the tongue can create by the complexity of tongue-palate contact, the richer the phonology of the language. One part of the tongue may push against the palate to help position or shape another part. In other words, local tongue-palate "bracing" enables the entire tongue to make shapes it otherwise could not make. Yet another facet to the use of the palate by the tongue during speech is that the tongue uses the stability and tactile feedback provided by palatal contacts to coordinate its movements with the jaw.

The ultrasound imaging evaluation indicated that an augmented surface of the artificial palate can facilitate a sensory stimulation to the tongue similar to normal tongue-palate stabilizing contacts.

IMPLICATIONS OF RESEARCH

Based on the research described above, it was determined that prosthetic devices can be designed with shapes and surfaces that will improve sensory stimulation to the central nervous system. An exercise protocol used in conjunction with handheld devices will stimulate a maximum sensory response in the lips and tongue with the goal of improving muscle strength, range of motion, and accuracy of placement, and generalizing the accurate motor pattern.

The research showed that resistence and pressure exercises improve muscle strength. The resistance pulling and pushing of the tongue and lips against the solid,stippled surface of the devices in the pathway of a desired movement pattern will increase muscle strength as well as teach a new motor task. Exaggerating movement increases range of motion using a variety of vowel/consonant/vowel configurations in the exercise protocol encourages exagerated movements and lets the patient hear and feel the full range and accuracy of these movements. New motor tasks for speech and swallowing skills can be learned. The goal of learning a new motor skill is reached by providing tasks that are repetitious in the correct pattern and ultimately become automatic. Practice and appropriate feedback during the learning process are needed to produce movement skills that will generalize.

THE HANDHELD INTRAORAL EXERCISERS

Description of the Exercisers

The training devices are a set of 5 handheld tactile aids in child and adult sizes developed to assist with "resisted-movement" as well as with "successive approximation" training exercises. They are handheld with the handle protruding from the lips and the palatal portion loosely fitting against the hard palate.

The devices have variations in the palatal base portion or in the handle. These variations, called "activators" are designed to help the tongue and lips in the movements and placements needed for articulating the consonants /p/,/t/,/k/, all of which require either strong lip closure or tongue-palate contact. Additionally, improved elevation of the tongue to the palate results in an improved oral transit for swallowing. A protocol for the exercise sessions is incorporated into 15 minute sessions which includes resisted movement techniques as well a variety of vowel-consonant-vowel movements.

ADVANTAGES OF THE EXERCISERS

• They are standardized for size, shape and placement; non-invasive and non-toxic • Devices help achieve the muscle movement patterns utilized in "resisted movement" and "successive approximation" techniques used by SLP's • Patient's reduced motor control and cognitive skill are not barriers to their use • Patients can use devices accurately on their own, speeding up their rehabilitation • No new concepts of speech rehabilitation are involved • Only a simple, relatively brief explanation of the devices and protocols are needed for the SLP's to master their use • Patients show no reluctance to use the devices • SLP's have easily incorporated them into their current practice • Each set has been sterilized for single patient use.

EXERCISE PROTOCOL

Illustrated is the use of the handheld "spoons" during the exercises. (Fig. 1)

SUGGESTED SUBSTITUTIONS FOR SOME OROFACIAL MYOLOGY TREATMENT EXERCISES

• Lip Exercise: Spoons #1 and #2 in sequence can substitute for: "Grin and Pucker", "Air in the Cheek", "Button pull", "Lips Together" • Front Tongue Exercise: Spoons #3 and #2 in sequence can substitute for: "Tongue Curls", "Push-Ups", "Tongue on the Spot", with or without orthodontic rubber bands placed on the tongue. • Back Tongue Exercise: Spoons #4 and #5 in exercise sequence can substitute for orthodontic rubber bands placed on the middle and back of the tongue to middle and back hard palate.

SUMMARY

A new prosthetic procedure that uses a sensory/motor treatment approach to retrain musculature to adapt patterns that improve oral functional competence has been proposed and reviewed. The goal is to provide as much repitition of the correct pattern as possible and achieve automatic execution of the skilled task. By using learning through massed trials and variable training procedures, so that there are fewer errors on tasks being performed, one hopes that the skill will generalize (Beukelman and Yorkston, 1991). The proposed prosthetic treatment and management approach allows the training procedure to continue on a daily basis, between clinical sessions, so that the skills will generalize more rapidly.

Address correspondence to:
Dr. Jack Light
104 New Mark Esplanade
Rockville, Maryland 20850

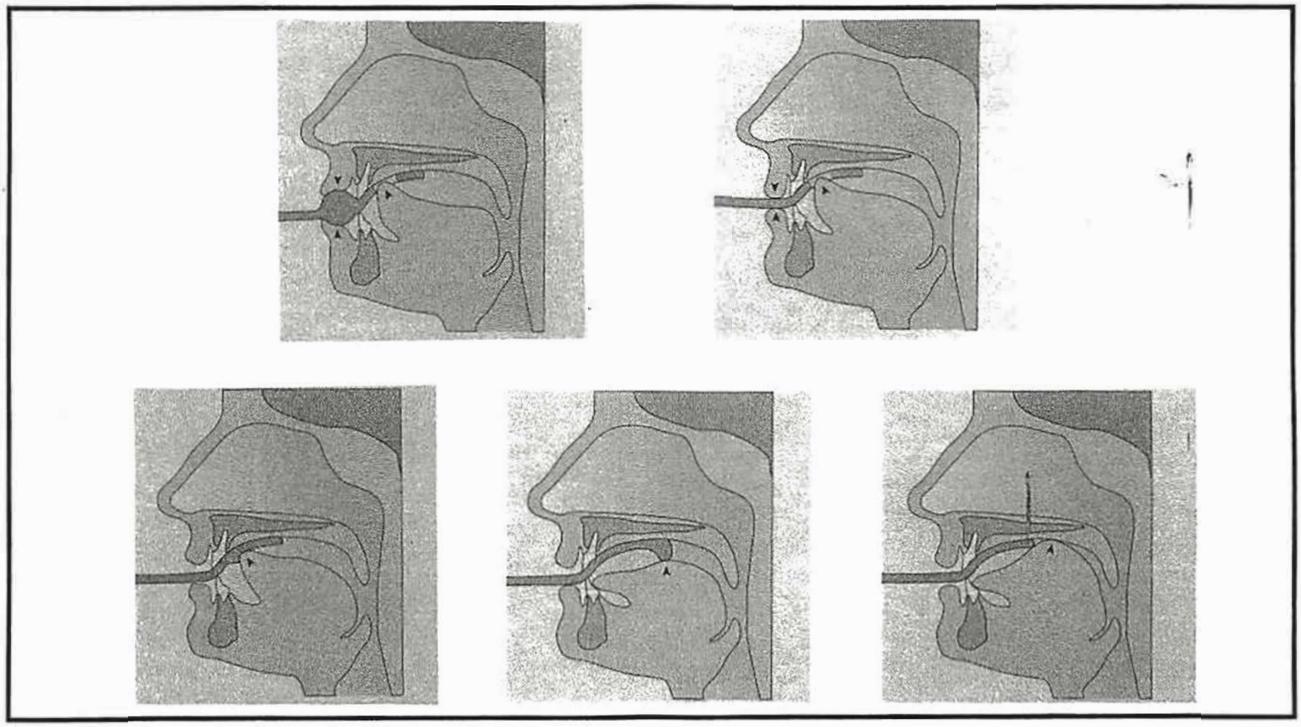


Figure 1

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