International Journal of Orofacial Myology and Myofunctional Therapy
Official Journal of the International Association of Orofacial Myology
50th ANNIVERSARY

Volume 23 | Number 1 | pp. 3-9 1997

Review Article

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Suggested Citation
Umberger, F. G., & Johnston, R. G. (1997). The efficacy of oral myofunctional and coarticulation therapy. *International Journal of Orofacial Myology, 23(1)*, 3-9.
DOI: https://doi.org/10.52010/ijom.1997.23.1.3

The Efficacy of Oral Myofunctional and Coarticulation Therapy

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There have been four decades of research concerning the relationships between orofacial myofunctional disorders and defective articulation. The issue of tongue force (Palmer and Osborn, 1940), resting tongue position (Mason and Profitt, 1974), related facial deformities (Francis, 1960) and articulation errors (Fletcher, Casteel, and Bradley, 1961) have provided mixed evidence of a relationship between biological and speech functions of the tongue. The results of these investigations called into question the role of the speech language pathologist (SLP) in the treatment of individuals with orofacial myofunctional disorders with and without concomitant articulation disorders.

In 1975, ASHA adopted a "Position Statement" questioning the validity of the diagnosis and treatment of orofacial myofunctional disorders and calling for more research in this area. For several decades, university training programs for SLPs did not include training for orofacial myology in their curricula. Fortunately, ASHA reversed its position in 1990 after studying the area in great detail. Both ASHA Position Statements can be found in the Appendix at the end of this article.

This paper will provide a brief summary of: (1) The role of intrinsic and extrinsic muscles during a "normal" and "tongue thrust swallow"; (2) Research supporting the belief that the muscles responsible for "tongue thrusting" are responsible for anterior speech sound distortions and substitutions; (3) The argument for treatment of the two phenomena as separate entities; (4) The argument for treatment of the two phenomena as related entities; (5) The models of treatment available for the SLP; and (6) The advantage of viewing both articulation and oral myofunctional problems as having a common learned neuromuscular relationship.

Muscle Activity in Deglutition

The tongue is the major organ involved in both swallowing and speech sound production. The tongue is divided into two muscle groups, the extrinsic and the intrinsic muscles. The extrinsic muscles move the tongue mass inside the oral/pharyngeal cavity. The articulation movements of the tongue are related to **place** of production. The intrinsic muscles shape the tongue mass. These muscles of articulation are associated with **manner** of production. The combined effect of these two muscle groups allow the tongue to accomplish rapidly and accurately a large number of shapes and movements necessary for both speech sound integrity and mastication/swallowing.

Because the same group of muscles is responsible for the biological functions of mastication, as well as swallowing and speech sound production, some clinicians evaluate the tongue's biological functions when assessing speech (articulation) functions. A logical argument evolved that the identical muscles that are responsible for anterior speech sound production are also responsible for oral myofunctional disorders including the tongue thrust swallow. The majority of speech sound errors are anterior distortions or substitutions and tongue thrust swallowing is an anterior thrusting of the tongue. Furthermore, if the tongue assumes an anterior position during functional rest (Hanson, 1994), the initial movements for either sound production or swallowing may exceed the phonemic boundaries established for many speech sounds and may result in a swallow that is begun too far anteriorly, resulting in an adapted thrust.

Additional theoretical evidence is suggested by the behavior of the intrinsic tongue muscles. The intrinsic muscles shape and tense the tongue. According to Zemlin (1998), tongue protrusion is accomplished by the tension of the transverse muscle. The tongue becomes longer and narrower, thus accommodating the genioglossus muscle in protrusion of the tongue. With the tongue in a tense posture, two potential problems are conjectured. First, ballistic movements to other surrounding sounds are compromised by inflicting a manner error on target phonemes and adjacent phonemes (co-articulation). Second, the swallow pattern requires considerable effort to overcome the tension present in the tongue.

Relationship of Muscle Activity in Swallowing and Speech Activities

A number of studies support the view that the same tongue muscles that produce anterior positioning of the tongue for speech production also produce an anterior resting and fronting of the tongue in a tongue thrust swallow.

Fletcher et al. (1961) studied 1,615 school-age children and reported that subjects with tongue thrust swallowing patterns were much more likely to have associated sibilant distortion than were subjects without this swallowing pattern. They established that 25-35% of tongue thrusters, versus 5-10% of non-tongue thrusters, exhibited sibilant distortion.

Ward, Malone, Jann and Jann (1961) determined that approximately 75% of early-elementary-age school

children exhibited "abnormal swallowing". They observed a high coincidence of tongue thrust swallowing and phonemic variations. These early studies seemed to explain the frequently reported clinical observation of "speech correction teachers" concerning the concurrence of tongue thrust and articulation disorders found in the children in their caseloads.

Hale, Kellum, Nason and Johnson (1988) began a longitudinal study of 137 kindergarten children. They reported that 74% of their subjects dentalized articulation of one or more phonemes; 65% used a forward resting posture of the tongue; and 27% manifested both dentalized resting postures and tongue thrusting.

Two years later, they re-examined 133 of the original group of 137, now as second-graders (Hale, Kellum, Richardson, Messer, Gross and Sisakun, 1992) and found that 84.2% were dentalizing the lingua-alveolar sounds. They summarized that "except for sibilant sounds, this dentalization rarely results in speech that *sounds* different". This appears to be consistent with what Pierce (1996) refers to as "acoustically correct but cosmetically incorrect".

Hanson (1994) reported that "in this writer's private practice, 30% of 320 children referred for therapy for tongue thrust were found to have a frontal lisp". He summarized that "studies by Shelton, Haskins, and Bosma (1959), Ronson (1965), Jann, Ward, and Jann (1964), Bell and Hale (1963), and Subtelny, Mestre, and Subtelny (1964) found that children with abnormal swallowing patterns are much more likely to have lisps than those without a tongue thrust".

Pierce (1978) stated that "many speech pathologists, like dental specialists, have become interested in tongue thrust as a result of failure - the failure of traditional articulation therapy techniques to bring about permanent changes in articulation skills. Many a child glides easily through auditory training, placement techniques, correct production of the sounds in the initial, medial, and final positions, even flawless recitation of structured sentences, poems, etc. ad infinitum and stubbornly stalls at carry-over." She suggests that treating the articulation errors without recognizing and treating the biological functions of the tongue - resting posture and swallowing - may frustrate the clinician and the patient.

Goldberger (1975) states that 60% of tongue thrusters have a lisp which cannot be eliminated unless the child receives therapy for the tongue thrust condition. This estimate is considerably higher than published research data; however, there is both clinical and experimental evidence supporting the relationship between tongue thrust resting posture/swallowing and speech.

Swallowing and Speech Articulation as Separate Acts

The argument for treating oral myofunctional disorders and articulation production as unrelated behaviors is summarized in the concept that even though they both involve the use of the tongue, this does not infer a cause-effect relationship. The learning of the motor acts of the tongue for biological and speech acts occur under separate conditions. The human species is ill-suited to talk and swallow at the same time. Since the two behaviors occur under different circumstances, there is little evidence that a paired stimulus learning process is present. Most incidence studies report that the tongue thrust swallow pattern decreases progressively through the mixed dentition stage, at which point it levels off and remains fairly stable through adolescence and adulthood (Barrett and Hanson, 1978). Developmental norms also indicate patterns of "maturation" for articulatory skills.

Swallowing and Speech Articulation as Related Acts

The two acts of swallowing and speech sound acquisition occur early in life. Normal swallowing and speech production involve both anterior and posterior placement and varied tongue positions. Developmentally, front sounds are learned first. Maturation for both speech and swallowing involve skills in front-to-back tongue movement. It is possible that successful therapy for retraining tongue position for speech sound production may have positive effects on the training of tongue positioning for biological purposes. There is certainly evidence that the opposite is true: that training for correcting the resting posture of the tongue and the swallowing pattern will have a positive effect on speech articulation.

Barrett and Hanson (1978) recommend beginning to work on dentalized speech sounds after the seventh or eighth week of tongue thrust therapy. They conclude that "the proper lingual resting postures are fairly strongly habituated, and it is relatively easy to teach the feature of lingua-alveolar contact."

Mason and Profitt (1974) suggest initiating speech therapy if lisping and tongue thrusting or malocclusion coexist before puberty, in spite of concurrent problems. "Adaptive articulation therapy techniques emphasizing phonetic placements are especially recommended as a means of correcting speech errors and modifying resting tongue position in prepubertal children."

Straub (1962), one of the first orthodontists to "preach" and publish the possible detrimental effects of tongue pressures on the teeth during swallowing, turned to speech pathologists to help him with these tongue problems. With the assistance of speech pathologists, he developed an exercise program which included speech, oral muscle, swallowing, and habituation exercises.

Goda (1968) devised a ten to twelve week program in which the speech sounds /t/, /d/ and /l/ were used to provide a reference for habitual rest posture.

Overstake (1975) studied the possible relationship between tongue thrust swallowing, openbite and overjet malocclusions, and interdental /s/ speech problems in two

groups of children who had this triad of problems. One group received swallowing therapy and speech therapy for the /s/ sound, while the other group received swallow therapy only. Both groups corrected the swallowing pattern and BOTH groups improved speech production. He concluded that "deviant swallowers with interdental /s/ speech defects tend to correct such speech defects automatically, as their swallowing behavior changes toward swallowing considered to be normal, without any intervening speech therapy."

After repeated observations of children resistant to articulation therapy who also had reverse swallowing patterns, Baskervill (1976) achieved success by using a speech improvement program (S.I.S.) and myofunctional therapy (M.F.T.), separately and in combination.

Christensen and Hanson (1981) studied ten six-year-old children all with frontal lisps and tongue thrust swallowing patterns. Five received speech therapy plus tongue thrust therapy and five received speech articulation therapy only. Hanson (1988) reports that "children in both groups made equal progress on /s/ remediation. Those who received tongue thrust therapy also corrected the tongue thrust. Tongue thrust persisted in children who did not receive oral myofunctional therapy."

Pierce (1996) reported on 100 patients who were referred to her by dentists or orthodontists for "tongue thrust therapy". At the time of the initial evaluation, 49% had no speech articulation problems, although three of these patients reported having had speech therapy in the past. 19% were using incorrect placement of the tongue either for /t,d,l,n,s,z,sh, and ch/ (11%) or /s,z,sh, and ch/ (8%). This group did not distort the production of these phonemes; they just "looked funny". They would probably not be identified by the general population as having "speech problems". The third group of thirty-two patients (32%) had very noticeable articulation errors. Their errors were not only cosmetically incorrect but also acoustically incorrect.

She reported that "all 100 patients included in this survey were enrolled in a traditional tongue thrust therapy program: ***Swallow Right*** (Pierce, 1993) with emphasis on rest posture and swallowing pattern. Only those patients in Group 3 'Articulation Errors' received instruction and exercises to improve their speech. These articulation activities were superimposed on the standard treatment program for rest posture and swallowing and did not require additional lessons, with the exception of one frontal lisp and three of the four distorted /r/s. These four patients needed to be seen for up to four 'articulation therapy' sessions." Pierce (1996) summarized that "all of the patients were successful in correcting the resting posture of the tongue and lips and in correcting the swallowing pattern within ten to twelve treatment sessions. This survey confirms that MANY 'speech problems' self-correct as a direct result of 'tongue thrust therapy'; SOMETIMES it is helpful to include articulation exercises in the treatment regimen; and RARELY it will be necessary to schedule additional sessions to work on articulation. In particular, those patients whose speech is 'acoustically correct but cosmetically incorrect' will improve significantly just by changing the rest posture and the swallowing pattern."

Landis (1994) designed a therapy protocol that emphasized work on modifying tongue rest position, increasing sensory awareness and specific speech sound practice.

Hanson (1994) summarized the interrelationship between the biological and the articulatory functions of the tongue as follows: "A number of orofacial muscle activities may accompany improper production of articulated sounds. Foremost among these is the behavioral pattern traditionally referred to as 'tongue thrust', which consists of resting and pushing the tongue against or between the anterior teeth. Other accompanying oral-motor activities include thumb or finger sucking, lip licking, lip or cheek biting, leaning the hand against the chin or cheek, tongue sucking, and excessive breathing through the mouth. Of these, the most detrimental to speech is probably resting the tongue abnormally low and forward in the mouth. In many children, the tongue remains in that position during speech, possibly resulting in the anteriorization of lingua-alveolar consonants."

An alternative to retraining the tongue for a single change in phoneme production is the concept of working on all speech sound production from a more retracted functional tongue rest position as well as during connected utterances.

In summary, several authors (Ingram, 1976; Weiss and Lillywhite, 1991; and Olmsted, 1971) have indicated that there is a common anterior to posterior development for both normal swallowing and phonetic development. The process of swallowing and articulation development share a physiological sequence.

Models of Treatment for the Speech-Language Pathologist (SLP)

Several models of intervention are available to the SLP for those clients that present evidence of misarticulation and an oral myofunctional disorder.

- The SLP can ignore the problem(s). There is evidence that improvement in speech sound articulation might occur without intervention. A tongue thrust swallow is a viable method of deglutition. An early position by Mason and Proffit (1974) indicated that even in the presence of a malocclusion, therapeutic intervention for swallowing variations is not indicated prior to puberty.
- The SLP can elect to treat the articulation errors and refer the client to an orofacial myologist for oral myofunctional therapy. The SLP would be free to use therapy techniques that meet the needs of the client's articulation production. Such a decision would ignore the potential interactive effects of the two therapies.

- The SLP who is trained in orofacial myology can elect to focus on the oral myofunctional disorder and "ignore" the articulation errors. This decision would acknowledge the etiology of the articulation errors as secondary to a tongue thrust resting posture and swallowing pattern. This approach would modify the swallow pattern with the anticipation that the speech errors would "self correct" without formal treatment.
- The SLP who is trained in orofacial myology can elect to treat the articulation errors and the oral myofunctional disorder/tongue thrust swallow as concomitant problems. The therapy would use interventions that would systematically retract the tongue. Then both correct swallowing behavior and articulation behaviors would be used to reinforce the overall goal of achieving tongue retraction and adjusting tongue tension. Theoretically the general concepts of coarticulation therapy, rather than a phonemically based regime, would have the greatest effect on the generalized training approach.

Coarticulation in the Treatment of Articulation and Oral Myofunctional Disorders

Speech sound distortions/substitutions and tongue thrust swallowing share a common relationship, the anterior resting posture of the tongue. The "fronting of the tongue" results in both articulation and swallowing beginning from a position that can compromise the performance of both activities. Several studies referenced in this article (Overstake, 1975; Baskervill, 1976; Christensen and Hanson, 1981; and Pierce, 1996) reported that programs to retrain the muscles involved in swallowing resulted in improvement in articulation.

We propose that articulation therapy based on coarticulation, combined with oral myofunctional training, can contribute to a general repositioning of the tongue both at rest and in function, improving articulation, swallowing and resting posture of the tongue. The goal of such therapy is to use the known interrelationships of speech sound interactions to help the client "feel" and habituate a more posterior positioning of the tongue.

Nicolosi, Harryman, and Kresheck (1989) define coarticulation as "articulatory movements for one phone which are carried over into the production of previous or subsequent phones, but which do not affect the primary place of articulation, as occurs when assimilation affects the place of articulations." The authors describe forward and backward coarticulation as being analogous to carryover and anticipatory coarticulation. The implication of both the definition and the reality of coarticulation is that each sound has phonemic boundaries rather than a "place" for each sound's production, and that smooth dynamic speech is accomplished by the sharing of space (and features). For example, the tugging action of a front sound combined with the addition of the tugging action of a back sound results in the front sound being made more posteriorly and the back sound more anteriorly. Often such "sharing" of place of production results in assimilation of both sounds into each other. The effects of coarticulation have been reported as far as four phonemes before and four phonemes after an imbedded phone (Daniloff and Moll, 1968).

Operational Definition of Coarticulation Therapy: Articulation therapy can make use of the known effects sounds have upon each other. McDonald (1964) provided the first attempt to assess these effects in his "Deep Test: A Sensory-Motor Approach." By combining sound elements, McDonald encouraged clinicians to listen and record variations in a targeted phoneme. Such variations provided phonetic environments in which the sound perceptually improved and environments in which the sound perceptually worsened. These environments were then used to construct logical therapy to alter the client's learned sensory-motor patterns (repositioning) of the tongue. Expanding on McDonald's concept of testing and therapy, we will operationally define coarticulation therapy as: the process of assessing and using the interactions of phoneme production to teach new generalized tongue postures and movements, which result in improved speech sound production and speech intelligibility.

Assessing Context: Sibilant sounds have often been reported as those most affected by an anterior resting posture of the tongue. These sounds are made anteriorly, and therefore have little tolerance for additional anterior phonemic space or place of production. To assess a sibilant (such as the /s/) using the principles of coarticulation, the following general model is suggested.

Select ten vowel sounds that represent the vowel quadrilateral (V1-10). Have the client produce the /s/ phoneme in the following VC sequence: V1/s/ through V10/s/. Then have the client produce the following CV sequence: /s/V1 through /s/V10. Now select four consonants such as C1=/t/, C2=/k/, C3=/n/ and C4=/b/ and insert each of the consonants before and after the VC and CV sequences as follows: C1V1/s/ through C1V1O/s/ and then /s/V1C1 through /s/V10C1.

The net result is that the phoneme /s/ has been placed into 100 common contexts that account for 81% of the standard General American English productions. While comprehensive testing appears time consuming, the process allows the SLP to systematically identify contexts that improve sound production as well as contexts that do not improve sound production. Often these contexts will have systematic tongue positions associated with the place of production for the preceding and following sounds which influence the production of the target sound.

Identification of Facilitating and Non-Facilitating Contexts: The value of a comprehensive phoneme interactive assessment is the ability to identify two important variables. First, the SLP can identify those phonemic environments that facilitate correct production. If the beneficial context is not systematic, then coarticulation therapy may not facilitate general tongue

retraction. For those contexts that are systematic and posterior in place of production, the SLP will use the correct sound production to help the client "feel" a more posterior tongue posture. Second, the SLP can use the facilitative aspects of posterior consonants and vowels to reposition the tongue for all communication drills. A building program which moves from basic CVC units to posterior-loaded connected utterances will habituate general retraction of the tongue.

Oral Myofunctional Drills: Success in generalized retraction of basic tongue position can now be used to integrate swallowing patterns as paired associates of correct sound production. Combining the two behaviors in a speech-to-swallow pair reinforces the patterns for both behaviors. The client can concentrate on the "feel" of success while the SLP concentrates on accepting or rejecting the acoustics of the speech production and the visible attributes of the swallow pattern.

A structured myofunctional therapy program, such as ***Swallow Right*** (Pierce, 1993), ***Oral Myofunctional Therapy*** (Zickefoose, 1976) or treatment protocols designed by the individual clinician provide the sequence of muscle exercises, swallow training, and habituation activities necessary to make the correct resting posture and swallowing pattern automatic.

Reassessing the New Behavior: Periodic reassessment of the articulation and swallowing pattern is required. Reassessment allows for the ongoing monitoring of skills and the prevention of relapse while new motor patterns are being habituated. Gentle reminders of technique and skills can be reinforced. The use of maintained success in one of the two skills can always be used to help in the re-establishment of the other. Hanson (1994) advocated a holistic approach to the evaluation and treatment of oral myofunctional disorders and accompanying phonological disturbances. He suggested that "retraining of eating and drinking patterns occur simultaneously with the correction of articulatory errors." In summary, the ability to integrate both articulation assessment/therapy and oral myofunctional therapy allows for dynamic treatment that can place high demands on the frequency of practice production of the new behaviors. The client may appreciate the variety, but the SLP knows that both improved speech production and a corrected oral myofunctional pattern can be mutually taught.

Conclusion

The authors have attempted to summarize the current state of knowledge about the relationships between oral myofunctional therapy and articulation therapy. Considerable evidence has been obtained that indicates that oral myofunctional therapy techniques can improve articulation of sibilant sounds. These findings present an optimistic direction for future research and successful use of myofunctional therapy and coarticulation. There remains the need for clinical practitioners and laboratory scientists to continue to investigate the commonalities and differences of oral myofunctional and articulation disorders. We have suggested that the SLP can use techniques that are fundamentally sound for modifying both biological and articulatory behaviors. The use of coarticulation assessment and intervention processes combined with oral myofunctional retraining can coexist in a program designed to retract the resting and ballistic movements of the tongue.

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Appendix

The Efficacy of Oral Myofunctional and Coarticulation Therapy

ASHA Position Statement 1974

Joint Committee on Dentistry and Speech Pathology-Audiology

Review of data from studies published to date has convinced the Committee that neither the validity of the diagnostic label tongue thrust nor the contention that myofunctional therapy produces significant consistent changes in oral form or function has been documented adequately. There is insufficient scientific evidence to permit differentiation between normal and abnormal or deviant patterns of deglutition, particularly as such patterns might relate to occlusion and speech. There is unsatisfactory evidence to support the belief that any patterns of movements defined as tongue thrust by any criteria suggested to date should be considered abnormal, detrimental, or representative of a syndrome. The few suitably controlled studies that have incorporated valid and reliable diagnostic criteria and appropriate quantitative assessments of therapy have demonstrated no effects on patterns of deglutition or oral structure. Thus, research is needed to establish the validity of tongue thrust as a clinical entity.

In view of the above considerations and despite our recognition that some dentists call upon speech pathologists to provide myofunctional therapy, at this time, there is no acceptable evidence to support claims of significant, stable, long-term changes in the functional patterns of deglutition and significant, consistent alterations in oral form. Consequently, the Committee urges increased research efforts, but cannot recommend that speech pathologists engage in clinical management procedures with the intent of altering functional patterns of deglutition.

ASHA Position Statement 1990

Ad Hoc Committee on Labial-Lingual Posturing Function
American Speech-Language-Hearing Association

It is the position of the American Speech-Language-Hearing Association (ASHA) that:

1. Oral myofunctional phenomena, including abnormal fronting (tongue thrust) of the tongue at rest and during swallowing, lip incompetency, and sucking habits, can be identified reliably. These conditions co-occur with speech misarticulations in some patients;
2. Tongue fronting may reflect learned behaviors, physical variables, or both;
3. There is published research that indicates that oral myofunctional therapy is effective in modifying disorders of tongue and lip posture and movement;
4. Investigation, assessment, and treatment of oral myofunctional disorders are within the purview of speech-language pathology;
5. The speech-language pathologist who desires to perform oral myofunctional services must have the required knowledge and skills to provide a high quality of treatment. The provision of oral myofunctional therapy remains an option of individual speech-language pathologists whose interests and training qualify them;
6. Evaluation and treatment should be interdisciplinary and tailored to the individual. The speech-language pathologist performing oral myofunctional therapy should collaborate with an orthodontist, pediatric dentist, or other dentists, and with medical specialists such as an otolaryngologist, pediatrician, or allergist, as needed;
7. Appropriate goals of oral myofunctional therapy should include the retraining of labial and lingual resting and functional patterns (including speech). The speech-language pathologist's statements of treatment goals should avoid predictions of treatment outcome based on tooth position or dental occlusal changes; and
8. Basic and applied research is needed regarding the nature and evaluation of oral myofunctions and the treatment of oral myofunctional disorders.