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Tutorial

A retrospective and prospective view of orofacial myology

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A RETROSPECTIVE AND PROSPECTIVE VIEW OF OROFACIAL MYOLOGY

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ABSTRACT

Orofacial myofunctional disorders include specific conditions or behaviors that can have a negative impact on oral postures and functions. Historically, interest has focused on behaviors in the horizontal plane, highlighted by tongue thrusting. Currently, the scope of practice also includes tongue forward posturing, lip incompetence, open mouth rest posture, thumb and finger sucking, bruxism, and biting habits involving lips, fingers, tongue and cheeks. The common denominator for myofunctional conditions is a change in the inter-dental arch vertical rest posture dimension, the dental **freeway space**. The purposes of myofunctional therapy include normalizing the freeway space dimension by eliminating noxious habits or postures related to freeway space change. Improving cosmesis with a lips-together rest posture is also an important treatment goal. The clinical significance of the freeway space is explained in terms of the dental consequences of differential eruption patterns that can develop from postural modification of the freeway space. When the freeway space is opened for extended periods beyond the normal range, the tongue can act as a functional appliance and contribute to the development of anterior open bite or a Class II malocclusion. A clinical procedure is proposed for evaluating the freeway space dimension and incorporating the information into treatment planning and evaluation of treatment success. **While dentistry/orthodontics has a primary focus on dental occlusion, or teeth-together relationships, orofacial myologists focus on teeth-apart behaviors and postures that can lead to, or have already resulted in malocclusion.**

KEY WORDS: Freeway space, myofunctional disorders, scope of practice, functional appliance, clinical assessment

INTRODUCTION

The pursuits of the orofacial myologist are varied, as are the backgrounds and education of those who provide services for orofacial myofunctional disorders. Orofacial myology is a uniquely interesting area of specialization, arising out of orthodontics and later motivated and honed by individuals from speech-language pathology. Its history is characterized by tumultuous growth. It has, in the past, been the object of some unmerited professional rancor and dismissive rhetoric.

Currently, myofunctional therapy is experiencing a steady infusion into courses in academic and clinical programs. An active international organization encourages participation and multidisciplinary inclusion. A specialized journal continues. Clinical standards and certification processes are operational.

Studies published about tongue thrusting and the efficacies of various treatment approaches are important to the history and development of orofacial myology. They provide a strong clinical and theoretical base for the further development of the discipline. Over time, these important studies, many of which are cited in Hanson and Mason (2003), have provided a core background from which to recast perspectives on treatment strategies as well as the theoretical basis for the discipline. Currently, there is an increased emphasis on the elimination of lip incompetence,

thumb sucking and other oral behaviors and habits. Once there was primarily tongue thrusting; now there are a host of behaviors and problems that are subsumed within the discipline.

As the discipline has grown and the range of oral behaviors and treatment strategies has expanded, the theoretical framework for the discipline has also matured. Historically, interest has focused on behaviors in the **horizontal** plane, highlighted by tongue thrusting pressures against the anterior dentition, and the possibility that there is or should be a balance of muscles on each side of the anterior dentition. We now appreciate that the concept of an orofacial muscle balance or imbalance is an incomplete perspective (Proffit, 1973, 1978; Mason, 1979; Hanson & Mason, 2003). It is now appreciated that the problems and causative mechanisms related to myofunctional disorders are mutifactorial, transcending a view of the disorders focused in the horizontal plane. Vertical and transverse influences are also involved as causative factors.

Dental studies have isolated a control mechanism within the periodontal membrane space that accounts for the stability of tooth position (Davidovich & Shanfield, 1975; Davidovich et al, 1976; Davidovich & Montgomery, 1976). This regulation has a central, brainstem control. Current orthodontic mechanotherapy embraces the concept of light continuous forces as being optimal for tooth movement. Nonetheless, research indicates that interrupted orthodontic forces can produce tooth movements similar to those generated by continuous forces, and with less damage to the structures of the periodontal ligament (King et al, 1991; Gibson et al, 1992; Lanyon & Rubin, 1994; King & Kessling, 1995; King et al, 1995; Ghafari, 1997). It now appears that light short-term or intermittent forces applied to teeth can alter their position in a comparable way to light continuous forces (Ghafari, 1997). For the myofunctional clinician, the message here from dental research serves to validate our history and interest in tongue thrusting and the horizontal dimension. While we continue to recognize the significance of a tongue thrust against the anterior dentition, there is more to our developing story and history.

Sufficient history has been recorded and discussed concerning orofacial myology (Hanson & Mason, 2003) to inquire about the current status and tenets of this specialty area. On what basis does it do what it purports to do? Is there a biologic basis for the clinical pursuits of those engaged in myofunctional therapy? These questions are especially relevant to the evidence-based practice concept currently embraced by many clinical disciplines.

WHAT IS THE SCOPE OF PRACTICE IN OROFACIAL MYOLOGY?

Orofacial myofunctional disorders include specific conditions or behaviors that are identified as having a negative impact on oral postures and functions. The disorders include tongue thrusting related to speech and swallow activities, tongue forward posturing, lip incompetence, open mouth rest posture, thumb and finger sucking, bruxism, and biting habits involving lips, fingers, tongue and cheeks. These behaviors can be destructive to oral tissues or interfere with normal processes of orofacial growth and development and functions.

Orofacial myofunctional disorders may be related in a variety of ways to functions and pathological conditions of the temporomandibular joint apparatus and may accompany skeletal jaw problems and neuromotor deficits. Myofunctional problems can also result from restricted nasal airway breathing capabilities, or airway interference. In these situations, the myofunctional disorders are adaptive or compensatory behaviors resulting from other problems rather than representing a primary characteristic.

A challenge to clinicians in many disciplines is to avoid labeling a patient as being a “mouth breather” on the basis of having a lips apart, open mouth rest posture. Most myofunctional clinicians avoid this label in the absence of aerodynamic (airflow)

objective documentation of breathing, since "mouth breathing" is a physiological term rather than a descriptor of posture (Hanson & Mason, 2003). As is now well known in speech science and physiology, there is a poor correlation between the presence of any anatomical finding of nasal and nasopharyngeal obstruction and the ability of an individual to breathe nasally; that is, anatomy cannot accurately predict function (Watson, Warren & Fischer, 1968; Vig et al, 1981; Mason & Riski, 1983; Riski, 1983). Unfortunately, airflow instrumentation (Warren & DuBois, 1964) is not readily available to many clinicians.

In keeping with the scope of behaviors and conditions that are subsumed under the rubric of orofacial myofunctional disorders, those individuals providing myofunctional services should have a base of knowledge and skills adequate to competently evaluate and address orofacial myofunctional disorders. A knowledge and skills base should encompass information from several disciplines, especially dentistry and orthodontics, otorhinolaryngology-head and neck surgery (ENT), and behavior modification. Specialized training in speech-language pathology is necessary for some patient problems. At present no university training program offers a separate curriculum or degree in orofacial myology and hence, training is derived from many sources. The current primary source of information, education and certification of achievement level is the International Association of Orofacial Myology (IAOM), a non-profit interdisciplinary professional organization based in the United States.

IS THERE A COMMON DENOMINATOR FOR MYOFUNCTIONAL DISORDERS?

Myofunctional disorders, by definition, involve behaviors or postures that can be detrimental to dentofacial growth, development and functions. The commonality of these disorders is that each involves a change in the inter-dental arch vertical dimension; that is, in each instance where the disordered behavior is ongoing, there is a vertical increase of the normal freeway space. The **freeway space**, or interocclusal clearance, or rest position of the mandible as described in dental texts (Sicher & DuBrul, 1970; DuBrul, 1980), is the normal resting vertical space between the dental arches with lips comfortably together. The concept of the freeway space recognizes that in the normal rest position, teeth do not touch, leaving about 2 mm of space between the dental arches posteriorly, or 2-5 mm between the incisors (Sicher & DuBrul, 1970). As one would expect, for those patients who cannot comfortably achieve a lips-together rest posture, the freeway space dimension is likely to fall outside the normal range.

WHAT ARE THE PRIMARY PURPOSES OF MYOFUNCTIONAL THERAPY?

The procedures of myofunctional therapy should strive to achieve a normal interocclusal rest position (dental freeway space) by developing lip competency, properly positioning the tongue at rest, retraining a tongue thrust swallow, and eliminating thumb and finger habits (Hanson & Mason, 2003). Conversely, the cessation of bruxism is also an appropriate procedure. During bruxing, there is a vertical reduction, or absence, of the freeway space. In other instances, a myofunctional clinician may participate in interdisciplinary efforts to eliminate noxious habits related to tempormandibular disorders. Where there is airway interference, a team approach to evaluation and treatment is needed. Airway interference is not a myofunctional problem in the sense that therapy can alleviate blockage of the nasal cavity or pharynx. When the airway is cleared, however, myofunctional procedures are often needed to reestablish and normalize oral functions and the freeway space (Hanson & Mason, 2003).

Another goal of myofunctional therapy is to improve cosmesis. It has been well discussed and documented (Case, 1988) that patients with a lips-apart, mouth-open posture may be perceived as dull or slow intellectually. Achieving lip competence can dramatically change the appearance and

social perception of such patients. In my view, this is an important contribution of myofunctional intervention for selected patients.

Myofunctional interventions have often contributed to positive dental changes, such as the reduction or elimination of anterior open bites. It is important to note that the achievement of dental change is not an appropriate stated goal of myofunctional therapy, although such changes may be facilitated spontaneously with the elimination of a myofunctional problem. Nonetheless, myofunctional therapy is not dental treatment.

THE CLINICAL SIGNIFICANCE OF THE FREEWAY SPACE

It is noteworthy that the dental arches are in contact for only a few minutes per day. The vast majority of each day, other than speaking or eating, is spent with teeth and mandible in a rest position. This is characterized by 2 to 3 mm of interocclusal clearance between opposing posterior teeth; a normal freeway space (Rugh & Drago, 1981; Peterson, Rugh, & McIver, 1983; Konchak, Thomas, Lanigan, & Devon, 1987; Nielson, Marcel, Chun, & Miller, 1990; Ferrario, Sforza, Miani, D'addona, & Tartaglia, 1992; Martin, Alarcon, & Palma, 2000; Hanson & Mason, 2003). An increase in the posterior freeway space related to the presence of a myofunctional disorder most often will lead to a variety of negative consequences, including malocclusion.

It is well accepted in orthodontic theory that a forward rest posture of the tongue between the incisors can trigger a process of differential eruption of teeth (increased eruption posteriorly and impeded eruption anteriorly) and lead to an open bite. In addition, differential supra-eruption of upper teeth with impeded eruption of lower teeth can result in the development of a Class II malocclusion. The growth principle here is that molar relationships can be changed by influencing the extrusion of teeth along their path of eruption (Harvold, 1974). In another abnormal dentofacial growth scenario, orthodontic texts and clinical reports have identified excessive posterior vertical eruption along with a downward rotation of the mandible as characteristics found in the "long face syndrome" (Proffit, 1986; Proffit & Fields, 2000).

There is little mention of the freeway space in dental texts, except in prosthodontics. In denture construction, the rest position of the mandible is important. If false teeth are set too high on the denture base, eliminating the freeway space so that teeth touch in this position, mandibular muscles are stressed and muscle spasms will occur (Sicher & DuBrul, 1970). The challenge in complete denture fabrication is to recapture the patient's previous freeway space. This is often a difficult dental challenge.

An increase in the freeway space by a myofunctional behavior can become a problem if the amount of time that the behavior persists is sufficient to result in differential dental eruptive changes. The control mechanism of the freeway space appears to have a central, brainstem regulation (Jankelson, 1990). The trigger mechanism for tooth eruption can be activated by a long-term vertical increase in the freeway space. For comparison, in an "ideal" occlusion with a normal freeway space dimension, there is harmony between the relative lengths of the jaws and the relative extrusion of teeth in the jaws (Harvold, 1974).

Lip incompetence, while not always a myofunctional disorder, is considered to be a problem when associated with a mouth-open posture and an increase in the freeway space. The disorders of bruxism and clenching, which involve habitual closure of the freeway space rather than an increase, can cause occlusal trauma and damage to tooth surfaces. Altogether, the maintenance of a normal freeway space is compatible with normal processes of orofacial growth, development and functions while behaviors that change the freeway space for extended periods are not compatible with normal dentofacial growth.

Orofacial myofunctional disorders often occur with freeway space excess and a related malocclusion. From a myofunctional

perspective, **when a myofunctional disorder and freeway space variation occur together, intervention is indicated**. **Without treatment, the malocclusion will worsen rather than spontaneously correct**. A tenet of myofunctional therapy is that establishing a normal resting freeway space is key to creating (or returning) oral structures to a postural rest environment where normal processes of growth and development and functions can proceed (Hanson & Mason, 2003).

DOES MYOFUNCTIONAL THERAPY WORK?

There is a host of data to indicate that myofunctional therapy for the variety of conditions involved is effective and stable long-term. For the interested reader, a few selected evidence-based reports include: Toronto, 1975; Cooper, 1977; Christensen and Hanson, 1981; Ohno, Yogosawa, and Nakamura, 1981; Hanson and Andrianopoulos, 1982; Andrianopoulos and Hanson, 1987; Hahn and Hahn, 1992; Umberger, Forrest and Johnston, 1997; Alexander, 1999. Further discussions of treatment efficacy in the USA and internationally are found in Hanson and Mason (2003).

In the opinion of this clinician, the subsequent efficacy of myofunctional therapy should be evaluated according to several criteria: (1) Were myofunctional behaviors or postures present prior to treatment in some acceptable model of designation? (2) Did therapy intervention result in elimination of the myofunctional disorder? (3) Was there evidence that the freeway space was normalized following intervention? (4) Was the intervention result stable over time?

A MYOFUNCTIONAL VIEW OF THE TONGUE

Various applications of functional appliances in orthodontics have been well articulated and documented. An appliance such as the activator (Woodside, 1977) utilizes principles emphasized by Harvold (1974) relating to the "functional occlusal plane" and the role played by its manipulation with an activator appliance in the correction of certain malocclusions. The functional occlusal plane represents the functional table of posterior occlusion, the level and inclination of which normally is the result of neuromuscular, growth, and developmental forces acting on the dentition (Harvold, 1974). It should be noted that in normal eruption, maxillary posterior teeth follow a downward and forward curvilinear path, while mandibular posterior teeth erupt vertically in harmony with the vertical growth of the lower face (Woodside, 1977). Enlow and Hans (1996) point out that mesial and vertical drift also occur in addition to eruption as a basic growth function that helps to place the teeth anatomically as the jaws lengthen and widen. Vertical drift especially can be modified by orthodontic intervention, including functional appliances and can also be influenced negatively by habit patterns that increase the interocclusal space.

Manipulation of the functional occlusal plane with an activator appliance by inhibiting eruption of maxillary posterior teeth and permitting the mandibular posterior teeth to erupt vertically can change a Class II malocclusion into a Class I. In contrast, an activator could be designed to create a Class II malocclusion from Class I by inhibiting mandibular posterior eruption and encouraging maxillary downward and forward eruption (Harvold, 1974)

The tongue can also serve as a functional appliance by opening the freeway space and encouraging differential eruption, leading either to an anterior open bite or a Class II Division 1 malocclusion. As pointed out above, if the tongue demonstrates a myofunctional disorder by habitually resting forward between the incisors and hinging the mandible open slightly, an open bite can result (Proffit, 1986; Alexander, 1999). While posterior teeth supraerupt by increasing the posterior freeway space, anterior teeth are impeded in eruption by the inter-incisal presence of a tongue tip at rest. This process is characterized by excessive opening of the posterior freeway space for extended periods.

Tongue posture can also encourage the development of a Class II malocclusion in some patients. If a forward tongue position is accompanied by overlap of the tongue with the occlusal surfaces of all lower teeth, much like an activator design to correct a Class III malocclusion, continued eruption of maxillary teeth can proceed as the freeway space is enlarged and the lower teeth are impeded in eruption by the resting tongue. Over time, a Class II malocclusion can develop.

The concept that the **tongue can act as a functional appliance** in some patients is a tenet of myofunctional therapy and one which is compatible with orthodontic theory and experience with various functional appliances. This concept has not been widely disseminated or appreciated in dentistry

ASPIRATIONS FOR OROFACIAL MYOLOGY

The modern myofunctional clinician should be regarded as an expert in the evaluation and remediation of freeway space variations. This designation implies a biologic base from which the various disorders such as tongue thrust, sucking habits and lip incompetence can be addressed. **While dentistry has focused on dental occlusion, or teeth-together relationships, myofunctional clinicians have focused on teeth-apart behaviors and postures that can lead to, or have already resulted in malocclusion.**

The clear distinction between dentistry and orofacial myology in theoretical and clinical reference positions should be highlighted and appreciated. The dental focus on occlusion and contactual relationships of teeth as contrasted by the orofacial myology focus on teeth-apart events and problems is a significant difference in perspective and activity. Nonetheless, the two reference positions combine well where patient problems involve intrusive habit patterns. The contributions of each discipline to patient care should be appreciated, respected, and further enhanced by mutual interaction.

The biologic basis for myofunctional therapy includes concepts, perspectives and research findings from dentistry and orthodontics as well as data and experience from the specialty area of orofacial myology. Patients with myofunctional disorders present clinical challenges that indicate the need for continued interdisciplinary care and study.

A pressing need in orthodontics and orofacial myology is the recognition of the importance of the freeway space in initial examination, in establishing goals of treatment, and in evaluating the results and stability of treatment.

CLINICAL ASSESSMENT OF THE FREEWAY SPACE

A clinical procedure for evaluating the dental freeway space is needed. This need presents an opportunity for interdisciplinary collaboration and cooperation.

Kinematic recordings have been made of freeway space dimensions in a variety of dental patient categories (Rugh & Drago, 1981; Konchak, Thomas, Lanigan, & Devon, 1987; Martin, Alarcon, & Palma, 2000). These and other studies have involved kinesiographic recordings of the rest position of the mandible and during dynamic excursions and other mandibular movements. In the research of Martin, Alarcon, and Palma (2000), for example, using a kinesiograph (K6, Myo-Tronics, Seattle, WA), 3-dimensional (vertical, anteroposterior, and lateral) jaw movements were made without interfering with the motion of the jaw. Their system used a sensor array strapped to the patient's head that tracks the spatial location of a magnet fixed on the mandibular incisors. Mandibular position was recorded at rest and during jaw movements in maximum excursions, during swallowing and chewing.

Martin, Alarcon, and Palma (2000) found that the freeway space ranged from 2.63 mm to 2.7 mm. These dimensions fall within the normal range of variability defined in previous studies by Nielsen, Marcel, Chun,

and Miller (1990); and Ferrario, Sforza, Miani, D'addona, and Tartaglia (1992).

While our primary clinical interest in the freeway space is at the posterior dentition, it is impractical to obtain direct measures of the posterior freeway space in the typical clinical situation. Borrowing principles gleaned from kinesiographic studies of mandibular position and functions obtained anteriorly and with external reference points, a simple clinical assessment of freeway dimensions can be proposed.

A procedure for assessment of the dental freeway space should be accomplished by the orofacial myologist under three conditions: (1) **The patient's mandibular rest position**. Ask the patient to moisten his/her lips, swallow, breathe deeply, and relax his/her jaws with eyes closed (Martin, Alarcon, & Palma, 2000). For most patients with a myofunctional disorder, the lips will be parted for this task. Use a millimeter ruler to obtain a measure of the vertical distance between the base of the nose and the bottom of the chin. This dimension is referred to as the *lower face height* in facial esthetic evaluations. (2) **The patient's mandibular rest position with lips gently approximated.** Follow the patient instructions given for condition (1), with the added instruction to gently approximate the lips. (3) **The patient's habitual occlusion position.** Ask the patient to bite on his/her back teeth, and record the lower face height distance from base of nose to bottom of chin. For this measure, patients with a myofunctional disorder may exhibit a lips-apart posture. Comparison of the millimeter differences in lower face height between conditions (1) and (3), and (2) and (3) will yield two separate measures of freeway space. For patients with a myofunctional problem, these measurement comparisons may differ at initial examination. At the completion of treatment, a decrease or equalization of initial differing freeway space dimensions can be considered a therapy success.

Comparisons of measures between conditions (1) and (2), with occlusion (3) would be expected to range from 2 to 5 millimeters. The freeway space values obtained in initial examination provide a baseline for evaluating progress during treatment and at completion, as well as in follow-up evaluations of stability. Such data should be included in clinical reports to referral sources.

Prior to examination, it is suggested that young patients be asked to blow their nose. This suggestion is based on aerodynamic studies of the airway showing that many children have poor nasal hygiene. Nasal debris can increase nasal resistance during quiet respiration by up to 50% (Riski, 1983; Mason & Riski, 1983, Hanson & Mason, 2003). An inability to properly manage nasal debris encourages a mouth open posture and mouth breathing. Teaching a patient to monitor and clear nasal debris is an appropriate component of a myofunctional treatment plan

SUMMARY AND RECOMMENDATIONS

A retrospective and prospective view of orofacial myology has been presented. The clinical significance of the dental freeway space has been described. The role of the tongue as a functional appliance has been elucidated. A clinical procedure for evaluating the freeway space has been delineated. A distinction between the focus in dentistry on occlusion and contactual relationships of teeth and the contrasting emphasis in orofacial myology on teeth-apart events and problems has been proposed.

It is the opinion of the author that an appreciation of these differences should serve to enhance interdisciplinary communication and collaboration, while also enhancing the contributions of the orofacial myologist in the interdisciplinary treatment process. Further, the differing emphases of dentistry/orthodontics and orofacial myology represent a marketing opportunity to further educate the public about the discipline of orofacial myology.

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