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Orofacial muscle and their influence in orthodontics

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Abstract

The form and function of masticatory muscles are believed to correlate with the craniofacial growth and subsequent orthodontic and dentofacial orthopaedic treatments. A good knowledge of relationship between different malocclusions and mandibular dysfunction enables the orthodontist to determine the functional objectives of the orthodontic treatment and hence evaluate the results of the treatment. This assessment has to be made in relation to the prevalence of dysfunction and responsible general aetiological factors. This review presents the role of orofacial musculature in the development of malocclusion and dentoskeletal changes which plays a major role in diagnosis and treatment planning in orthodontic practice.

Keywords: Orofacial muscle, craniofacial growth, orthodontics

Introduction

In general, when orthodontist discuss the importance of the orofacial soft tissue with regard to etiology and prognosis for treatment of malocclusion, they immediately think of the muscles of facial expression, lips, cheeks, and tongue etc. The part played by the muscles of mastication tends to be forgotten or ill-understood. The muscles of mastication may play pivotal roles, not only in contributing to the etiology of a malocclusion but also from point of view of the application of treatment mechanics and the potential success of treatment results. Several research groups around the world are now focusing on these important structures. Craniofacial

morphology is the result of a complex interaction between genetic and environmental factors. This relationship was investigated in both experimental animal and human clinical studies. Awareness of skeletal, muscular environment is necessary because orthodontic treatment plan is not dependent exclusively on biomechanical factor but masticatory muscles could affect the active treatment of malocclusions and jaw deformities, as well as the stability of such treatment.

Many factors such as size, fibre content, metabolism and biomechanics of masticatory muscles seem to be involved in the development of the craniofacial complex but their role is not completely clarified. Among the masticatory muscles, the masseter was mainly investigated and exploring the relationship between size and the vertical and transversal skeletal pattern. Size measurements were performed for orofacial muscle like masseter, Temporalis, Medial and Lateral pterygoid, orbicularis oris, Mentalis etc., using several techniques, including electromyography (EMG), computed tomography (CT), magnetic resonance (MR) and ultrasonography (US). Two variables play a role during growth: genetics and function. The morpho functional balance is given by the combination of these factors. With regard to genetics, science there is still much to learn. An altered function can be modified. Therefore, myofunctional therapy is an efficient support for orthodontics, because altered functional conditions can cause irreversible anomalies to the facial morphology. Abnormal form and functions can cause anomalies of the orofacial structure. To solve these problems, orthodontic treatment can be supported by myofunctional therapy in order to restore the normal functionality of the oral muscles. Hence, it is responsibility of an Orthodontist to assess the need of patients with neuromuscular dysfunction, from both the occlusion and the muscles consideration and their approach in order to obtain the structural balance needed for the stability of treatment outcome.

Discussion

Perioral muscles and labial posture are considered the most important factors responsible for the position of teeth and the dental arch form because of their moderate but steady activity. The masseter muscle thickness varied among three vertical dentofacial patterns, more in males as compared to females, positive correlation with facial width, maxillary width, symphyseal width, and intermolar width of maxillary first molars. This helps us to conclude that masseter muscle thickness has a positive influence on the transverse growth of the face and symphyseal width. Relationship between mandibular muscles and head dimensions in subjects with strong or thick mandibular muscles have wider transverse craniofacial dimensions. In addition, tendencies toward parallelism between the jaw bases and between the occlusal and mandibular lines, as well as small gonial angles and smaller lower anterior facial height. It is widely accepted that dolichofacial patients have relatively weak mandibular muscles compared with brachyfacial, it is still not known whether the strength of the mandibular muscles determines craniofacial morphology or vice versa.

If not corrected some habits (e.g. mouth breathing, finger sucking, tongue thrusting, Atypical swallowing) can cause relapses in patients who had previously underwent orthodontic treatment, therefore, these have to be corrected as early as possible. The goal of orthodontic/functional therapy is to correct abnormalities in muscle behaviour as follows: restoring muscle tone and activity; achieving antagonist muscle strength and correct posture in various regions, including the tongue, mandible, and lips; education in swallowing, phonation, chewing, and breathing; and eliminating defective posture and/or movements. Functional therapy is basically effective

during the growth period, affecting the epigenetic regulation of craniofacial growth. The optimal timing of therapy is during rapid sutural growth (prepubertal stages of development). It is important to underline that myofunctional therapy, can be very helpful when included in the orthodontic treatment.

sEMG study acts as a non-invasive, objective, and precise tool that expands the knowledge about anatomy, physiology, and pathology of the stomatognathic system. Abnormal EMG activity may indicate the need in solving of many malocclusion problems, stability of the treatment results from normal and coordinated masticatory muscle activity. However, studies presenting the comparison on the effect of orthodontic treatments on muscle behaviour between pre and post treatment are few due to unacceptable or uncontrollable experiment protocols 11.

Ultrasonography is proven to be a reproducible, simple, and inexpensive method for accurately measuring muscle thickness, provided the operator adheres to a strict imaging protocol. High-field MR imaging was used to study structural and physiologic alterations involving the muscles of mastication. CT is faster, more widely accessible and its advantage is the possibility to quantify the muscle density also termed as muscle attenuation or muscle radiation attenuation, which linearly depends on the muscle fat content.

Prevalence of dysfunction has to be made in relation to general aetiological factors as well as our knowledge of the indications for orthodontic treatment. Syndrome is a group of symptoms which consistently occur together or a condition characterized by a set of associated symptoms. Sometimes recognizing a syndrome is made more difficult by incomplete expression of the genes. Specific groups, such as those with Down's syndrome, Noonam syndrome, Treacher Collins syndrome, Ehler danlos syndrome etc. All medical conditions should be accurately understood before any treatment is planned. Patients should be well informed of all the options and made aware that any orthodontic treatment has been planned with their best interest.

Individuals with large angles between the maxilla and the mandible generally show a lower than average muscle activity. In dolichofacial subjects, significantly smaller maximum molar bite forces during maximum effort than in mesofacial and brachyfacial subjects. This implies a correlation between bite force and facial morphology. Variation with weak muscles can belong to either the mesofacial or the dolichofacial group, an important determinant of the maximum force that can be produced by a muscle is apparently its cross-sectional area. Hannam and Wood found a statistically significant correlation between masseter and medial pterygoid cross-sectional areas and molar bite force but no correlation between cross-sectional areas and the muscle moment arms12.

According to Proffit and Fields, it is possible that the lower bite force in dolichofacial people might allow greater eruption of the posterior teeth than might otherwise occur, and so are directly related to the excessive tooth eruption and backward rotation of the mandible often seen in such subjects. Ingervall and Helkimo suggested that the interindividual form of the face is smaller in persons with strong muscles than in those with weak muscles. This would support the hypothesis that the muscles do actually contribute to the final shape of the face. Further support for this theory presumably came from the findings of Ingervall and Bitsanis who showed that training the jaw muscles in dolichofacial children strengthened these muscles and induced a favourable anterior mandibular growth rotation. Accprding to schudy, if condylar growth is greater than vertical growth in the molar region, the mandible rotates forward, resulting in a more horizontal movement of the

chin with less ultimate increase in anterior facial height and hypodivergent pattern. Conversely, if vertical growth in the molar region is greater than that at the condyles, the mandible would rotate backward, resulting in a greater anterior facial height with less effective horizontal projection of the chin and hyperdivergent pattern.

Staggers reported on the changes in the vertical dimension between premolar and second molar extraction groups and found no significant differences between them. It has been shown that, if premolars are extracted in dolichofacial patients, there is still likely to be a slight increase in the vertical dimension, whereas, in brachyfacial patients, there is likely to be no change or even a slight decrease. The position and function of the lips are well accepted to influence incisor alignment and stability. The facial and mandibular muscles are also critical influences. For instance, Ricketts et al suggested that preferred incisal positions and angulations at the end of active treatment might vary depending on the underlying vertical facial type, with brachyfacial patients tolerating more protrusive and proclined incisors than dolichofacial patients. It has been suggested that brachyfacial patterns might allow greater expansion of the arches during treatment, in contrast to dolichofacial patterns with generally weaker mandibular muscle forces that might allow less expansion during treatment. Although the pre-treatment vertical facial pattern has been discussed as a possible factor in determining occlusal stability after treatment no direct relationship has been found.

According to Ahlgren et al, in class II division 1 and normal occlusion, study of EMG activity of the masseter, orbicularis oris, anterior and posterior temporalis muscles during resting, chewing and swallowing shows no difference between types of occlusion in the EMG activity in the rest position, which was greatest for the posterior temporalis muscle for both types of occlusion. Class II occlusion group had a tendency to develop less EMG activity during chewing. Posterior temporalis activity dominated during rest and anterior temporalis during mastication. Less EMG activity in the anterior temporalis and masseter was found during swallowing. Antonini et al, study of EMG activity of masseter and temporalis muscles in class II division 2 and in class III subjects shows no significant difference at rest, significant difference was found during mastication and swallowing. According to Moyers et al, EMG activity of temporalis, masseter, internal and external pterygoid, suprahyoid, mental muscle during resting, occluding and moving in class II division 1 and in normal occlusion suggest variation of the spike potentials of EMG particularly when the temporalis muscle was in an occluded position and at rest. Increased EMG activity of the posterior temporalis was found in Class II subjects. 1907, Edward Angle said about the tongue, there are as many variations as there are cases met with, resulting and corresponding with variations in the malocclusion". At the time, these were recognized as wise words, and in 1918 A.P.Rogers created a series of exercises intended to train the tongue and lips. Unfortunately, few clinicians, either then or since, have been very successful in influencing the action or position of the tongue and, possibly as a result, soft tissue training or Myofunctional Therapy, as it is currently referred to, is hardly used in current Orthodontic practice. In fact, there is much evidence to suggest that unusual function of the soft tissues in general, and the tongue in particular, are related to malocclusion. Rare cases of aglossia show major collapse of the dental arches and Harvold showed that the surgical removal of part of a monkey's tongue caused a related reduction of arch size. Malocclusion is frequently associated with unusual form or function of the soft tissues which may range from a simple sucking habit to a 'full fan' tongue thrust with only the posterior molars

in contact. It seems that most of the speciality are of the opinion that the soft tissues respond to the shape of the hard tissues rather than the reverse, although there is little evidence to support this.

Conclusion

There is still much controversy regarding the complex relationship between masticatory muscle features and vertical facial pattern. Several reports in literature address the problem of controlling interferences with dentofacial growth caused by abnormal muscle function in the mixed dentition period.The effects of the mandibular muscles associated with different types of tooth movements should be considered during orthodontic treatment planning. The choice of treatment mechanics, the timing of treatment, and any extraction decision might well be quite different for different underlying vertical patterns, even for the management of similar malocclusions.Any one technique or philosophy of treatment in which all patients are managed similarly, without consideration of the vertical facial type and orofacial muscles, would appear to be inadequate. Correction of neuromuscular function is essential for a successful treatment of malocclusion, and it must always be a supplement to conventional therapies.

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