Clinical Perspective

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Evaluation of Orofacial Muscle Dysfunction in Orthodontics

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SUMMARY

A prototype is presented for evaluating oral myofacial dysfunctions including oral breathing, abnormal swallowing, speech articulation errors, and chewing and sucking habits. An accurate assessment of these parameters prior to orthodontic treatment may aid in the completion and stability of orthodontic cases.

INTRODUCTION

The importance of the relationship that exists between oral myofacial dysfunctions and the completion and stability of the orthodontically treated cases has been discussed by various authors during recent years (Ponce, 1965; Proffit and Phillips, 1988). The accurate evaluation of orofacial dysfunctions in the orthodontic clinic may improve the outcome of treatment. The present work proposes a rapid, yet precise procedure

for evaluating these dysfunctions.

This evaluation is composed of a clinical chart, with attention being given to higher functionality, including simple application, visualization, and economy of time during the exam.

We suggest that the chart be part of the patients' clinical file, accessed from the treatment's initiation to its conclusion. This chart will include evaluations of swallowing, speech, breathing, and sucking and chewing. The presence of other oral myofacial dysfunctions that may impede or hamper the good completion or stability of the orthodontic treatment will also be noted.

BREATHING PATTERNS

It is frequently accepted that breathing functions may greatly affect the dento-facial development and consequently the etiology of malocclusions (Enlow, 1975;

FUNCTIONAL EVALUATION						
Name:	Sex:	Age:	Date:	/	/	No:
BREATHING						
			OBS:			
1. Myofacial characteristic	normal	()	altered	()		
2. Labial competence (rest)	yes	()	no	()		
3. Lingual competence (rest)	yes	()	no	()		
4. Mandibular competence (rest)	yes	()	no	()		
5. Shape of palate	normal	()	altered	()		
6. Tonsils	normal	()	altered	()		
7. Adenoids	normal	()	absent	()		
			altered	()		
			absent	()		
8. Associated Pathologies	no	()	sinus	()		
			rhinitis	()		
			bronchitis	()		
			asthma	()		
			others	()		
BREATHING EVALUATION		NASAL	()	ORAL	()	
OBS: _____						

Linder-Aronson and Backstrom, 1960; O'Ryan et al, 1982; Subtelny, 1980; Tourne, 1990).

Breathing patterns play an important role in the development of the support skeleton. See Theory of Functional Matrices (Moss and Salentijn, 1969). If the patterns are normal, the development should be normal. Any alterations may adversely affect the support skeleton (Padovan, 1976). Many authors agree that breathing obstructions may result in oral breathing (Gwinne-Evans and Ballard, 1948; O'Ryan et al, 1982; Tourne, 1990). In a comparative study between nasal and oral breathers, the latter were found to have an augmentation of the total and lower facial height, lower tongue position, dental arch disarrangements, clockwise rotation of the mandible, and muscular alterations of the face (Koski and Lahdemaki, 1975; Linder-Aronson, 1979; McNamara, 1981; Subtelny, 1975).

Some authors refer to this set of muscular alterations as the "Long Face Syndrome" or "Adenoid Facies." The most common characteristics of this syndrome are a long and narrow face, narrow nose and nostrils, short and hypotonic upper lip, lip incompetence, and altered posture of the head and neck (Leech, 1958; Linder-Aronson, 1979; Sollow and Kreiberg, 1977; Tourne, 1990).

The objective of this evaluation is to detect orthodontic aspects that may or may not indicate alterations in normal breathing. If alterations are indeed present, they will lead the practitioner in determining appropriate management for normalizing function.

The items of this evaluation, separately, are not conclusive; a correlation among them is necessary to arrive at a definite diagnosis.

A. Myofacial characteristics. First to be evaluated are the myofacial characteristics of the patient, where any alteration similar to the Long Face Syndrome should be noted. It is worth remembering that the long face is present in only 26% of oral breathers; they may breathe orally with the absence of such characteristics (Linder-Aronson, 1979). It is therefore necessary to evaluate the various items as a set.

B. Resting postures. Next, we will evaluate lip competence, which is the capacity of the lips to maintain contact during rest. Many oral breathers show this incompetence. However, not all of those with lip incompetence are oral breathers (Leech, 1958; Vig et al, 1981). Although their lips are not in contact, a posterior seal is formed by the tongue's dorsum and the soft palate (Gwinne-Evans and Ballard, 1948). This may be characterized as lingual competence, which is one of the items of the evaluation. In general, the oral breather carries the tongue in the lower position to facilitate the entrance of air through the oral cavity (Linder-Aronson, 1979).

Mandibular competence can be defined as the position of the mandible at rest, maintaining a small intermaxillary distance known as free functional space,

which measures approximately 3.0 mm (Bauer and Gutowsky, 1976). A change in normal rest position to a more retrognathic one may occur in oral breathers (Linder-Aronson, 1979; Subtelny, 1975). They tend to exhibit a downward and backward mandibular rotation as skeletal characteristics, facilitating mouth breathing (Koski and Lahdemaki, 1975).

C. Palatal configuration. Palatal vault can be altered, both transversely and vertically (Linder-Aronson, 1979). Individuals who breathe orally may have a high palatal vault. Two studies that compared the deciduous dentition of those individuals with the dentition of nasal breathers found an increase in palatal height and a decrease in intercanine distance in the oral breathers (Moreira and Lino, 1989; Morrison, 1931).

D. Tonsils and adenoids. Nasal impairments may result in temporary or permanent oral breathing, thus the importance of evaluating the presence of associated pathologies that may provoke obstructions. Hypertrophied tonsils and adenoids are common in oral breathers, as well as allergic rhinitis, recurrent respiratory infections and deviated septa (Bosma, 1963; Koski and Lahdemaki, 1975; Linder-Aronson, 1979; Tourne, 1990).

An examination of the foregoing can lead to a determination of the presence or extent of oral breathing patterns, and of the need to refer the patients to other specialists such as otolaryngologists or allergists.

SWALLOWING AND SPEECH

Swallowing

The teeth are kept in balance and harmony by two antagonistic muscular forces: one of internal contention (tongue), and the other external (buccinator mechanism). When out of balance, the teeth will move from their correct axial inclinations, developing dentofacial deformities in those areas of labial and/or tongue pressure (Ramfjord and Ash, 1984; Silva and Sincorette, 1984). Approximately 60% of individuals with malocclusion have deviant patterns of swallowing (Straub, 1961).

In the diagnosis of atypical deglutition, three characteristics are clearly defined:

1. Abnormal tongue pressure against the teeth. In normal swallowing, the tongue is contained within the oral cavity, with its anterior third touching the incisive papilla.
2. Lack of contraction of the masseter muscle, palpated during swallowing, which ordinarily promotes the occlusion of the posterior teeth by lifting the mandible.
3. Excessive action of the muscles of expression resulting from inadequate participation of peribuccal musculature during the act of swallowing.

Dentofacial deformities are intimately associated with areas where these pressures occur, as well as:

1. Anterior tongue pressure, possibly promoting an anterior open proclined bite, flared-incisors, or an anterior or posterior cross-bite.

SWALLOWING			
1. Labial pressure during swallowing	yes ()	no ()	_____
2. Facial expressions when swallowing	yes ()	no ()	_____
3. Tongue (anatomy)	normal ()	altered ()	_____
(rest)	normal ()	altered ()	_____
4. Masseter function	normal ()	altered ()	_____
5. Emission of phonemes			
a. Bilabials (p/b/m)	normal ()	altered ()	_____
b. Lingual alveolars (t/d/n/l)	normal ()	altered ()	_____
c. Fricatives (s/z/sh)	normal ()	altered ()	_____
EVALUATION OF SWALLOWING	NORMAL ()	ATYPICAL ()	_____
	Ant. Lat. Ant and Lat Type		
OBS: _____			

2. Lateral tongue pressure, possibly resulting in a lateral open bite and/or posterior cross-bite.

3. Anterior and lateral tongue pressure, which may develop a corresponding malocclusion. It is important to emphasize that the deformities may not be evident due to the rigidity of support structures.

Other authors contend that it is not the atypical function that may lead to deformities, but the incorrect rest position from which the function is carried out (Lino, 1990). The tip of the tongue should result against the incisive papilla. An increase in size or volume of the tongue creates excessive pressure on the teeth, altering the swallowing pattern and leaving visible "marks" on the lateral borders of the tongue. The short lingual frenum and/or extensive insertion at the base of the tongue disturbs normal swallowing, speech, and tongue rest position, limiting its movements, especially in superior excursions. Individuals with atypical swallowing sometimes have a short and thick upper lip, exposing upper incisors and possibly a portion of the alveolar ridge. The lower lip may be either tense, in hyperfunction, or flaccid. The tonicity of the lips must be considered as a contributing factor to malocclusion.

Various other phenomena, acquired or induced, also contribute to atypical swallowing. These phenomena include hypertrophied and infected tonsils and adenoids, deviate septa, respiratory allergies, and functional habits, such as thumb-sucking, nail biting, and lip and cheek sucking (Cohen and Vallado, 1978). Such factors may lead not only to atypical swallowing but also to unsuccessful treatment, and consequently, to relapse of the malocclusion.

Speech

The swallowing pattern has been consistently related to the pattern of phonemic production. Individuals with muscular orofacial dysfunctions frequently produce inadequate articulation of specific speech sounds (Padovan, 1976; Ruscello et al, 1986). These misarticulations lend support to the final evaluation of swallowing dysfunction since both the speech and swallowing processes share the same musculature and nervous impulses (Ruscello et al, 1986). Tongue thrusting during speech suggests the same problem during deglutition and in lingual rest position (Fletcher and Bradley, 1961).

For our evaluation, we have selected phonemes that are most commonly related to oral muscular dysfunctions and malocclusions (Fletcher et al, 1961). The evaluation proceeds with the presentation to the patient of some specific words containing sounds that must be checked during articulation. The patient is asked to repeat the words and we note the correctness or incorrectness of the speech sound production.

The evaluated phonemes are:

1. Bilabial phonemes /m/, /b/, and /p/, which are produced with a brief contact of the upper and lower lips. All incomplete bilateral contacts are considered inadequate. For example, in the cases of accentuated overjet, where the lip contact is difficult, it is likely that the production of these sounds may not be bilabial, but labio-dental.

2. Lingua-alveolar phonemes, /t/, /d/, /n/, and /l/. The correct production occurs when the anterior third of the tongue touches the incisive papilla. Tongue thrusters

frequently produce these sounds by placing the tongue between or against the anterior teeth.

3. Sibilant phonemes, /s/, /z/, /sh/, /ch/ and /"j"/, which are produced by lightly contracting the masticatory musculature and centrically occluding the teeth, such that the tongue does not touch the dental arches. Alterations in the production of these sounds produce the lisping, frequently found in anterior lateral open bites, with tongue thrusting during swallowing. We suggest the following list of English words, in which the evaluated sounds appear initially, are short, easy and part of the patients' vocabularies.

BILABIALS

- mum, milk, money
- ball, baby, bird
- puppy, pig, people

LINGUALVEOLARS

- teacher, tape, top
- daddy, doll, day
- night, now, new
- light, lemon, lens

SIBILANTS

- so, seal, sun
- zoo, zone, zoom
- shop, show, shower
- jump, just, jealous

SUCKING HABITS

Sucking habits may provoke malocclusions and, therefore, should be detected early to prevent further alterations. These habits may be the consequence of inadequate sucking activities in early feeding (Wiser, 1962), that is, a short period of natural sucking (Johnson, 1939; McCornick, 1967). The persistence of pacifier use or thumb-sucking habits during the eruption of permanent incisors may lead to dentofacial malocclusions. In a favorable skeletal pattern, there is a tendency towards natural normalization after the habit is discontinued.

In Angle Class II and III malocclusions, the sucking habit is considered a supporting factor which tends to aggravate the condition. These disturbances induce parallel dysfunctions such as atypical swallowing, suc-

tion of cheeks and lips, or nail-biting (Bowden, 1966; Subtelny, 1973). Suction of the lower lip may accentuate lingual tipping of the lower incisors, especially in cases in which the tongue does not exert normal pressure (Heskia and Deplagne, 1967).

The persistent sucking of pacifiers and bottles frequently leads the patient to atypical deglutition (Straub, 1960). Malocclusions provoked by thumb-sucking habits depend on the position of the thumb in the mouth, the association of the orofacial muscle contractions, the mandibular position during sucking, the facial skeletal pattern, and the duration, frequency, and intensity of sucking. Depending on these variables, the patient may present an open bite, cross-bite, high palatal vault, and/or Angle Class II (Sorokolit and Nanda, 1989). This portion of the evaluation is devoted to the detection of the presence or absence of oral habits which may interfere with the normal development of the dental occlusion and with orthodontic treatment.

CHEWING

The effects of functional stimuli of chewing on the internal architecture and shape of the bones are well known (Proffit et al, 1983). The masticatory disturbances may develop or aggravate malocclusions, and should be detected and treated as soon as possible. The magnitude and direction of occlusal forces in chewing, and the degree to which these forces may be contributing to the movement or stabilization of the teeth should be evaluated (Nanda, 1983).

Normal occlusal masticatory forces do not move the teeth as long as the teeth are stable. There are some parafunctions such as bruxism, incorrect feeding habits, and alterations in the intensity and direction of the muscular force, that may provoke dental movement, as well as deviation of the craniofacial morphology (Moyers, 1979).

There is also a relationship between the chewing function and the physical consistency of the food. Chewing activities influence the growth of the maxilla and mandible. Populations that live in more primitive conditions, feeding on harder diets, exhibit more vigorous

SUCKING	
1. Sucking habits	pacifier () _____
	thumb () _____
	bottle () _____
	lip () _____
	Others () _____
OBS: _____	

CHEWING			
1. Eating Habits	adequate ()	inadequate ()	_____
2. Chewing preference	bilateral ()	unilateral ()	_____
3. Masseter Musculature	symmetrical ()	asymmetrical ()	_____
4. Chewing dysfunctions		nail biting ()	_____
		bruxism ()	_____
		others ()	_____
OBS: _____			

chewing functions and possess relatively healthier dentition, occlusal and proximal dental friction, more vigorous alveolar and bone support, and better dimensioned and wider arches (Corrucini and Beecher, 1984; Kiliaridis et al, 1985; Nanda, 1983).

Research shows that the administration of soft diets in animals like rats or monkeys leads to chewing with less muscular function and results in deviation of orofacial and dento-occlusal structures, altering the normal occlusion (Corrucini and Beecher, 1984; Kiliaridis et al, 1985). In human beings, research confirms that the masticatory muscular function influences not only the bone remodeling in isolated parts, but also the general pattern of craniofacial growth (Horio and Kawamura, 1989; Proffit et al, 1983; Varrella, 1990). The relationship between normal masticatory force and facial pattern, when in use of soft diets, takes the dolichofacial form, with the tendency towards an open bite due to a lack of use of masticatory muscles.

These findings confirm the hypothesis that the shape of the face and the occlusion depend particularly on the force of the muscles (Ingervall and Bitsanis, 1987; Ingervall and Helkimo, 1978). Therefore, individuals with unilateral chewing may develop asymmetrical musculature in the region, affecting the face as a whole. Normal chewing is bilateral, and the individual carries the alimentary bolus from one side to the other, or chews on both sides simultaneously. Unilateral chewing is characterized by a large difference in the muscular activity of the masseters (Ingervall and Thilander, 1975).

Bruxism: The term *bruxism* is frequently utilized to represent the grinding of teeth. Among others, the symptoms of bruxism are friction of the teeth, hypertrophy of masticatory muscles, loss of muscular strength, facial aches when awakening, and headaches (Reding et al, 1968). Bruxism presents itself as a parafunction of chewing (Moyers, 1979). This seems reasonable since studies indicate the influence or utilization of the masticatory muscles, especially the masseter muscle, during bruxism (Cash, 1988; Faulkner, 1989; Moyers, 1979). The etiopathology is widely discussed and ranges from psychological to genetic and systemic factors, passing by occlusal and premature contacts.

Nail biting: In nail biting habits, there also exists a hyperfunction of the masticatory muscles, as during this act, the mandible opens and closes several times. We, therefore, group nail biting with the chewing habits. The biting of lips, pencils, pens or even shirt collars are, likewise, included among the chewing habits.

The literature has recently cited some methods to evaluate chewing efficiency (Nakashima et al, 1989; Reding et al, 1968). However, these tests are difficult to utilize routinely in the clinic. The palpation of each muscle at rest and in function is frequently employed to reveal asymmetries of size and position. These muscles can individually be lightly touched during the specific functions as part of the functional analysis. These proceedings, though only superficial evaluations, are very useful.

COMPLEMENTARY EVALUATION	
SPEECH PATHOLOGIST	() _____
OTORHINOLARYNGOLOGIST	() _____
OTHERS:	_____
FINAL OBSERVATIONS: _____	

CONCLUSION

This evaluation does not possess an objective value when isolated factors are observed, but only with the sum of all the data here described. The orthodontist who follows these procedures should be able to evaluate the

presence or absence of facial musculature dysfunctions, and, once detected, refer the patient to a specialist such as an otolaryngologist, speech pathologist, or orofacial myologist for further evaluation and more specific treatments.

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