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PREVALENCE OF ORAL MUSCLE AND SPEECH DIFFERENCES IN ORTHODONTIC PATIENTS

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Four years of observations of speech and oral muscle patterns in orthodontic patients have led the examiners to expect certain factors to occur frequently. These factors include open-mouth posture, low forward tongue position at rest, linguodental instead of linguolabial articulatory placement, linguodental tongue position and lip movement during swallowing, upper lip restriction, mentalis wrinkling, frenum restriction, negative oral habits, and articulation and voice disorders. The emergence of these predictable patterns suggested the need for a systematic study of their occurrence. Thus, the incidences of speech differences, negative oral behaviors, and muscle factors identified as correlates to abnormal oral muscle, skeletal, and dental growth were examined in a retrospective study of the records of 229 orthodontic patients, the entire number of new patients reporting for records appointments to an orthodontic practice within a calendar year.

Data collected on all subjects at the time of their initial evaluations were re-examined in relation to the following research questions: (1) What was the occurrence of structural/functional muscle differences? (2) What negative oral behaviors were observed to occur? and, (3) What was the prevalence of articulation and voice disorders?

Historical controversies have surrounded the question of etiologic impact of oral-motor differences on dentofacial growth. While early studies supported the prominence of genetic factors in craniofacial development (Goldstein, 1953; Lundstrom, 1955), recent animal studies in which negative environmental factors have been induced (e.g., forced mouth breathing due to nasal occlusion) indicate that craniofacial deviations may specifically result from altered environments (Tomer & Harvold, 1982; Vargervik, Miller, Chierici, Harvold, & Tomer, 1984). Similar findings in chronic mouth breathing children have also been obtained (Rubin, 1986; Miller, Vargervik, & Chierici, 1982). A study of twenty-four middle-aged subjects by Hanson and Andrianopoulos (1987) indicated a strong relationship between the existence of malocclusion and the occurrence of tongue thrust (a behavior examined in the current study) but failed to find a relationship between tongue thrust and dental/periodontal health. A comprehensive review of the literature in regard to the definition and reported incidence of tongue thrust and its relationship to post-orthodontic relapse is reported by Andrianopoulos and Hanson (1987).

Muscle risk factors identified as having adverse effects on oral facial development, and which may be influenced by changes in behavior or structural modification, include: An open-mouth resting posture; a respiratory pattern of mouth breathing; low forward tongue carriage; forward articulatory tongue placement (linguodental/linguolabial); abnormal lip, tongue and facial muscle movements during swallowing; reduced upper lip length and mobility; overcontraction of the mentalis muscle; restriction of the labial or lingual frenums; and the presence of negative oral habits such as nailbiting, thumb or finger-sucking, lip biting, and lip licking (Mason & Profitt, 1974; Vig & Cohen, 1979; Garliner, 1980; Andrianopoulos & Hanson, 1987). These behaviors served as a basis for the construction of a checklist (see Appendix) for assessing the occurrence of muscle risk factors and negative oral habits in the subject group. This checklist was used during records appointments during the calendar year prior to the collection and analysis of the summary data reported in this study.

The American Speech-Language-Hearing Association (ASHA) has systematically studied the incidence of speech and language problems in the normal population and levels of occurrence for various age-groups have been identified (Lesko, 1981). The ASHA study reported a most-often quoted incidence of communicative disorders of 5% in the general population when factors such as school enrollment, age, etc., are eliminated. A speech screening was provided as the records appointment to each subject in the current study in order to determine the incidence of articulation and voice disorders in the sample in comparison to the ASHA findings.

METHODOLOGY

Procedures

Two hundred twenty-nine patients who reported to an orthodontist for complete records appointments during a one-year period served as subjects for this study. A certified speech/language pathologist with over 20 years experience in a variety of clinical settings completed an orofacial checklist and a speech screening for each patient at the initial visit. Disorders in speech and voice were traditionally defined and determined based on developmental norms for actual articulatory deviations (Templin & Darley, 1969) and the Wilson Voice Profile (Wilson & Rice, 1977). Data were compiled from the checklist in regard to the presence or absence of anatomical, physiological or behavioral differences which have been related to dentofacial development. Additionally,
articulation and voice disorders or a combination of the two were counted to determine their occurrence in this population. Fluency and language problems were noted during the initial assessment but were not included in this study since they would appear to be unrelated to oral muscle factors. The retrospective compiling of the data was used in order to eliminate examiner bias in reporting incidences of behaviors or muscle factors.

**Subject Profile**

**Sex:** 98 males (42.8%), 131 females (57.2%)

**Age:**
- Pediatric (6 & below) = 8 (3.5%)
- Pre-adolescent (7-11) = 111 (48.5%)
- Adolescent (12-18) = 82 (35.8%)
- Adult (19 & above) = 28 (12.2%)

**Dental Classification:**
- Angle’s Class I = 43 (18.8%)
- Class II = 134 (58.5%)
- Class III = 52 (22.7%)

**Management Phase:**
1. No previous orthodontic management = 207 (90.4%)
2. Previous pre-adolescent management = 22 (9.6%)

### TABLE 1

**Muscle Risk Factors Occurrence**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>% of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tongue-thrust on swallow</td>
<td>73.3</td>
</tr>
<tr>
<td>Low, forward tongue rest posture</td>
<td>71.6</td>
</tr>
<tr>
<td>Open-mouth posture</td>
<td>68.6</td>
</tr>
<tr>
<td>Reported history of mouthbreathing</td>
<td>63.3</td>
</tr>
<tr>
<td>Upper lip restriction</td>
<td>54.5</td>
</tr>
<tr>
<td>Lip movement during swallow</td>
<td>50.2</td>
</tr>
<tr>
<td>Lingua-dental/lingua-alveolar articulation without acoustic difference from normal production</td>
<td>48.0</td>
</tr>
<tr>
<td>Frenum restriction</td>
<td>26.2</td>
</tr>
<tr>
<td>Mentalis wrinkle</td>
<td>24.8</td>
</tr>
</tbody>
</table>

### RESULTS

A significant number of patients exhibited the risk factors noted in Table 1.

The negative oral habits which occurred are reported in Table 2. Specific habits were reported by the parent, patient or were observed during the records session.

Speech differences occurred in 11.8% of the subjects, a significantly higher incidence than the 5% of the general population reported in the ASHA study (Leske, 1981). The differences measured by the speech screening and included in the current study by percentage and type of occurrence were: Articulation disorders, 81.5%; voice disorders, 7.4%; and, both voice and articulation problems, 11.1%.

### CONCLUSIONS

This study suggests that oral muscle factors, negative oral habits, and articulation and voice disorders are found at high incidences in orthodontic patients. A component of the assessment procedure for orthodontic patients should include an evaluation of those factors and behaviors which influence the oral environment into which orthodontic appliances will be inserted. The implications for multidisciplinary treatment programs and retention of orthodontic correction should continue to be the focus of further investigation.

### TABLE 2

**Negative Oral Habits**

<table>
<thead>
<tr>
<th>Habit Exhibited</th>
<th>% of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nailbiting</td>
<td>27.0</td>
</tr>
<tr>
<td>Thumb/finger sucking</td>
<td>3.0</td>
</tr>
<tr>
<td>Lip biting</td>
<td>1.0</td>
</tr>
<tr>
<td>Lip licking</td>
<td>2.0</td>
</tr>
<tr>
<td>Multiple habits</td>
<td>9.6</td>
</tr>
<tr>
<td>Other habits (blanket/pencil sucking, etc.)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Total exhibiting negative habits 45.6
APPENDIX

ORAL FACIAL EXAMINATION FORM
For Orthodontic At-Risk Patients

NAME ___________________________ DATE OF BIRTH ___________________________
PARENTS ________________________________________________________________
ADDRESS ________________________________________________________________
PHONE ________________________________________________________________

DATE OF BIRTH ____________________________________________
AGE __________________________________________________________
GRADE _______________________________________________________
SCHOOL _______________________________________________________
REFERRED TO __________________________________________________

LIP STRUCTURE AND MOBILITY
upper lip
length ___________________________
thickness ___________________________
size ___________________________

lower lip
mentalis wrinkle
sublabial furrow

balance ___________________________
mobility ___________________________
tone ___________________________
symmetry at rest ___________________________
symmetry of movement ___________________________

LIP POSTURE
upper lip
at rest ___________________________
during speech (word) ___________________________
(during swallowing ___________________________
bilabial contact ___________________________
at rest ___________________________
bilabial symmetry ___________________________
of movement ___________________________
(grin & pucker) ___________________________
lip line ___________________________

lower lip

TONGUE POSITION FOR SWALLOWING
observed ___________________________
reported ___________________________

TONGUE POSITION AT REST
observed ___________________________
reported ___________________________

TONGUE POSITION/PLACEMENT DURING SPEECH (ARTICULATION)
sh ___________________________
ch ___________________________
"j" ___________________________
lateral ___________________________
tongue movement patterns (puhthuhkuh) ___________________________

PALATAL WIDTH ___________________________

FRENUM ATTACHMENT
lingual: ___________________________
labial: inferior ___________________________ superior ___________________________

MUSICAL INSTRUMENT (what) ___________________________
(how long) ___________________________
APPENDIX (Continued)

RESPIRATORY HISTORY (Parent/Patient Report)
Allergies ____________ Asthma ____________ Sinus ____________ Frequent Colds ____________
Other ____________ Comments ____________

ESTIMATE OF NASAL AIRWAY
Adequate: yes __________________ no __________________
Potential blockage: adenoid _______ deviated septum _______ allergies _______

MOUTH BREATHING (Parent/Patient Report)
observed: during day __________________ sleeping __________________
history __________________
gingiva __________________ chapped lip __________________

TONSILS AND ADENOIDS
tonsils intact __________________ adenoids intact __________________
tonsils removed __________________ adenoids removed __________________

ORAL HABITS (frequency, history, posture)
thumb/finger sucking __________________ pacifier __________________ other __________________
lip biting/sucking __________________ clenching __________________
nail biting __________________ pencils __________________
comments: __________________

CRANIAL FACIAL STRUCTURAL DIFFERENCES
______________________________

OTHER __________________

SPEECH, LANGUAGE, HEARING (note cosmetic differences)
______________________________

MOTIVATION ASPECTS
generally __________________

ORTHODONTIC/DENTAL ASPECTS
generally __________________

SUMMARY OF CONCERNS
generally __________________

RECOMMENDATIONS
ok __________________
review __________________
re-eval __________________ (date) ________
TCE __________________
TX1 __________________
TX2 __________________
TX3 __________________

INTERVENTION TARGETS/GOALS
(check appropriate items)
__________ mouth breathing
__________ mouth posture
__________ lip approximation
__________ lip length and mobility
__________ lip symmetry
__________ lingual-uvular postures
at rest _______ speech _______ swallow _______
__________ reduce oral habits
__________ parents monitor night mouth breathing

REFERRAL EVALUATION NEEDED
airway ENT __________________
oral surgeon (frenum) __________________
plastic surgeon (lip) __________________
Sp/L __________________
Other __________________

FINAL REVIEW
# of TX sessions __________________
end result __________________
______________________________
Examiner __________________
REFERENCES


