

## Research Article

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# ANALYSIS OF OROFACIAL MYOFUNCTIONAL FACTORS IN KINDERGARTEN SUBJECTS

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Practitioners of orofacial myofunctional therapy typically see patients who have been referred for orthodontic management of malocclusion and related dentofacial disorders. Their role is to assess and treat those who present negative oral resting postures or habits in an effort to improve orthodontic retention, speech characteristics, and cosmetic appearance. Valuable perspective in regard to the interaction of oral resting postures and habits with dentofacial factors may be gained from examining individuals who are not orthodontic patients.

Data from National Health Surveys (Grainger, 1967; Kelly, Sanchez, and Van Kirk, 1973) conducted by the U.S. Department of Health, Education, and Welfare have provided information regarding normal occlusal findings in children 6 to 11 years old in the United States. These studies indicate that approximately 22% of children in this age group have significant health or cosmetic deviations as a result of malocclusion. The 1973 study identified 13.3% of its subjects as engaging in thumb- or finger-sucking and associated the frequency of this behavior with malocclusion.

Typically, myofunctional behaviors have been examined in orthodontic patients. A recent study by Hale, Kellum and Bishop (1988) examined the prevalence of oral muscle and speech differences in patients reporting to an orthodontic practice during a one-year period, and found that more than 50% of the patients exhibited one or more of the following: Tongue thrusting; low forward tongue resting posture; open mouth resting posture; and, a history of mouthbreathing. Hanson (1988) compiled a 30-year review of the literature on the relationship of tongue thrust and its management to orthodontic intervention. In the same report, Hanson examined orthodontic patients' records and found significant relationships between occurrences of tongue thrust and mouthbreathing and occlusal relapse.

The orofacial myofunctional factor of lip competency was studied by Vig and Cohen (1979). They reported vertical growth of the lips after the age of six as having a positive influence on anterior dentition with lip separation predicated at ages younger than seven; however, they state that the extent to which habit patterns or unconscious lip postures were influential in their study was not determined.

Numerous studies have examined the effectiveness of orofacial myofunctional therapy as a preventive measure for malocclusion or orthodontic relapse, and many of the issues remain controversial (Mason and Proffit, 1974;

Hanson and Andrianopoulos, 1982; Hanson and Cohen, 1973; Andrianopoulos and Hanson, 1987; Pierce, 1988). Studies of cause-and-effect relationships between function and form have not been completely decisive; however, Hanson and Cohen (1973) suggest a reciprocal relationship between structure and function. The relationship of orofacial myofunctional factors in current and potential orthodontic patients continues to be a matter of interest and investigation.

Subjects from a normal population distribution can provide insight into behaviors that are typical during specified periods of development and atypical at other stages. Thus, the purpose of the current study was to evaluate kindergarten subjects for frequency of occurrence of oral facial postures or behaviors that have been associated with malocclusion, orthodontic relapse and cosmetic deviation in orthodontic patients as another step in the development of longitudinal, normative data.

## METHODOLOGY

### Subjects

One hundred thirty-seven kindergarten students, 65 males and 72 females, were screened during a 10-day period. Black/white groupings of the subjects are described in Table 1. The age range for the subjects was 5-10 to 6-11 with a mean age of 6-0 years.

**Table 1. Subjects' Race**

	Black	White	Other	Total
Male	40	22	3	65
Female	32	37	3	72
Total	72	59	6	137

### Screening Procedure

Six second-year Master's degree students in speech/language pathology were trained and supervised by two certified speech/language pathologists (SLP) with experience in craniofacial and myofunctional disorders. Each subject was individually evaluated using a standard protocol. Areas of assessment included: Oral diadochokinesis; oral resting posture; placement and acoustic characteristics for articulation of /t,d,l,n,s,z/; tongue resting posture; tongue thrusting patterns during dry swallow; type of occlusion; dental hygiene and

the presence of caries; primary/permanent/missing central and lateral incisors; lip postures during movement and at rest; labial and lingual frenum restriction; and, oral habits (i.e., thumbsucking, nailbiting, liplicking). Specific procedures for each area of assessment are described below.

Diadochokinesis was assessed by procedures established by Fletcher (1972). However, time constraints on repetitive measures and high frustration levels in some subjects precluded inclusion of reliable diadochokinetic measures in the data analysis.

Open-mouth posture was assessed during quiet listening activities. Three children at a time were instructed to watch a videotape very closely and to refrain from talking or moving about. During a five-minute viewing segment, the children were observed on three different occasions (at the end of 1½, 3, and 4½ minutes). A binary-choice was recorded of either (o)pen or (c)losed for the presence of lip-seal at the time of each of the three observations. If a subject received two open-mouth ratings, then posture was noted as *open* for that child.

Articulation measures included separate notations for both acoustic errors and placement deviations from a lingua-alveolar contact for the /t,d,l,n,s,z/. The subjects were asked to name pictures (*teeth, dog, leaf, nose, sun, zipper*) that had the target phonemes in word-initial position. They also imitated the examiner's production of sentences (*Tom saw the duck. Look I have new shoes. I see the zebra.*) that included words with each of the target phonemes.

Tongue postures were observed at rest by asking the child to face the examiner and, when needed, the examiner retracted the lips manually in order to observe the tongue's relationship to the anterior dentition. A criterion proposed by Andrianopoulos and Hanson (1987) to define tongue-thrusting was also used to define the tongue resting posture. The child was judged to have an anterior resting posture if the tongue remained in contact with the lingual surfaces of any incisors or cuspids at rest. A dry swallow was used to measure tongue thrusting behavior on the basis of the conservative definition (i.e., the tongue protruded between the upper and lower teeth; Hanson and Cohen, 1973). Lingual frenum mobility was judged in relation to ability to make appropriate lingua-alveolar contacts and to lick the lips.

Molar occlusion and anterior dental relationship were assessed and a notation regarding the presence of the central and lateral incisors was recorded for each child. Due to the presence of mixed dentition in most of the subjects, the occlusion measure was difficult to judge conclusively since the examiners were not trained in dentistry. While the data are reported, it appears that the findings are somewhat atypical when compared with other normative data. Caution is suggested in use of these interpretations. Determination of dental hygiene and the presence of caries was made in order to make appropriate referrals for dental examinations.

Lip posture was observed at rest and during grin/pucker activities in order to measure symmetry and range of movement. A judgment of symmetrical lip movement required equal displacement of the lips on each side

of the midline during the grin/pucker activity. Conversely, lip asymmetry was recorded when a greater amount of displacement from midline on one side or the other was observed.

Oral habits reported by the children included thumb-sucking, nailbiting, liplicking and other idiosyncratic behaviors (e.g., toenailbiting or blanket-sucking). Verification of the presence of an oral habit was made by observation or by teacher report when possible.

Summarization of these observations was accomplished with frequency counts for each measure for all subjects, and calculation of percentages of occurrence. However, as previously noted, insufficient data areas were not included.

### Follow-up Procedures

Since parental permission had been obtained in order to screen each child, a recommendation regarding follow-up to the screening was disseminated to parents by means of individual letters. Follow-up information included at least one of the statements summarized below. The number at the end of each statement reflects the total of the subjects who received statements to that effect. (Many children received more than one referral statement.)

1. Contact the family or pediatric dentist for evaluation of possible dental hygiene (including caries) or occlusal problems (75).
2. Negative oral habits were noted; consult with a dentist, orthodontist, or pediatric dentist regarding possible effects on dentition (35).
3. Negative habits or postures, dental differences, and speech errors were not noted. Annual dental and medical check-ups are recommended (34).
4. If home observations concur with screening determinations of habitual open-mouth posture and consistent nasal congestion, see an ENT or family physician for evaluation for possible nasal blockage (32).
5. A speech disorder was noted and referral to the school speech/language pathologist for follow-up testing was made (19).

Local health care providers were alerted about the screening process and potential of follow-up referrals. The project was defined as a screening procedure which implied only a recommendation for further observation by parents and, in some cases, professionals to determine if the need for management existed.

### RESULTS

The kindergarten subjects frequently exhibited the resting postures and habits typically associated with patients in orthodontic management. Thirty percent of the subjects in the sample exhibited an open-mouth resting posture during the quiet listening activity. Dentalized articulation for one or more of the phonemes measured was noted in 74% of the subjects while 14% exhibited what would be identified as acoustic articulation errors. These results are summarized for the individual sounds in Tables 2 and 3 on page 13.

**Table 2**  
**Occurrence of Acoustic Articulation Errors**

Phoneme	Number of Errors in all Ss	%
t	1	0.7
d	2	1.5
l	3	2.2
n	1	0.7
s	14	10.2
z	15	10.9

Subjects demonstrating acoustical errors = 19 (14%)

**Table 3**  
**Percent of Dentalized Articulation Across all Subjects**

Phoneme	Linguadental (upper)	Linguadental (lower)	Interdental	Total %
t	18	11	6	35
d	14	11	3	28
l	29	5	14	48
n	17	3	5	25
s	9	38	15	62
z	9	38	15	62

Dentalized resting postures were noted in 65% of the subjects while tongue-thrusting occurred in 33%. Lip asymmetry at rest or during movement was observed in 25% of the subjects, and labial or lingual frenum restriction occurred in 17%. Twenty-three percent of the subjects reported and exhibited habitual thumbsucking behavior, while other negative habits occurred in 44% of the subjects. Referral for dental evaluation because of poor dental hygiene or health was made for 61% of the subjects.

Based on the determinations of the examiners, the following molar occlusal findings were observed: Class I, 61%; Class II, 19.5%; and, Class III, 19.5%. However, due to the confounding factors of mixed dentition and examiner inexperience, these findings are open to question.

## DISCUSSION

This study suggests that the oral resting postures and habits which are often observed in orthodontic patients occur at a high rate of incidence in a kindergarten population. Dentalized articulation (particularly for /l, s, and z/) and dentalized tongue resting postures occurred so frequently that these behaviors should be expected at this stage of development.

While 30% of the children demonstrated open-mouth resting postures, it may be assumed that vertical growth of the lips by age eight years would eliminate this posture in some of the children (Vig and Cohen 1979). However, the observed incidence would also include some children who had lip competence and also exhibited behavioral patterns of open-mouth posture either in the presence of nasal patency or nasal resistance. Objective measures

of lip length and nasal airflow would be necessary to distinguish cause/effect relationships for open-mouth postures. It is expected that these measures would relate the postures to one of the following: Incomplete growth of the lips; nasal obstruction or congestion necessitating mouthbreathing consistently or inconsistently (Riski, 1988); maxillary or mandibular protrusion; and, sub-conscious or habitual behavior not associated with physical differences or nasal obstruction. Further studies including these objective measures would be of interest in distinguishing the bases for the open-mouth postures. In the absence of such measures, and in view of the extremely high incidence of allergic rhinitis in the geographical area (Murry, 1984), we felt these postures should be brought to the attention of the parents to determine if medical assessment would appear appropriate. Follow-up letters to parents suggested that observation and medical referral might be indicated for those children who exhibited habitual open-mouth resting postures and consistent nasal congestion.

Acoustic articulation errors, which occurred in 14% of the subjects, included those with misarticulation of one or more sounds in the target phoneme group. An incidence of 9.7% of children of comparable age were determined to exhibit moderate and severe articulation deviations in a study conducted by the American Speech-Language-Hearing Association (Leske, 1981). Some of the children identified in the current study and counted in the incidence of 14% would certainly have been encompassed in the ASHA findings of 90.3% of six-year-olds who exhibit accurate articulation or mild deviations.

Tongue-thrusting behavior was observed at a lower incidence (33%) than in previous longitudinal studies for this age group. Hanson and Cohen (1973) reported an incidence of 43.8% in subjects aged 5-8 and 51.7% in subjects aged 6-7 using the same conservative definition of tongue thrust employed in the current study. In that study Hanson and Cohen observed subjects swallowing solids and liquids and used cinefluorography to measure tongue thrust behavior. These methods would predictably result in more identified instances of tongue thrust.

Subjects in the current study who exhibited *both* dentalized resting postures and tongue thrusting yielded an incidence of 27%. Additionally, only 3 subjects (2%) exhibited tongue thrusting in the absence of dentalized resting postures. Since many of the behaviors or habits in the study occurred at high levels when observed individually and might thus be judged to be normal for the age group, constellations of behaviors which might later contribute to malocclusion would serve as an appropriate focus for further study. Additionally, definitive measurements of nasal airway as related to the myofunctional behaviors in the current study would be valuable.

The challenge facing orofacial myologists is to systematize these observations in the interest of conducting longitudinal and serial studies to determine the distinction between "normal" and "abnormal" behaviors, and to determine more precisely the role of orofacial myofunctional therapy as preventive of dental malocclusion, cosmetic problems and speech differences. Pierce



(1988) and Mason (1988) offer valuable insights into this dilemma.

The current study suggests that speech/language pathologists and other professionals who screen children for various behavioral, medical, dental and educational problems should be aware of oral behaviors, resting postures and habits which interact with dentofacial development. Delineating the precise nature of these interactions and their long-term effects on dental occlusion continues to challenge those engaged in orofacial myofunctional therapy.

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