Research Article

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The Prevalence of Orofacial Myofunctional Disorders Among Children Identified With Speech and Language Disorders in Grades Kindergarten Through Six

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Introduction

The incidence of orofacial myofunctional disorders (OMD) has been investigated in several populations, including the general population, orthodontic patients, preschool children, and elementary school children. However, there has not been a systematic study of the prevalence of OMD among school children receiving speech and language services through the public schools. The American Speech-Language-Hearing Association (ASHA) has recognized a need for basic descriptive research regarding the various components of OMD and the interaction of those components with each other and with speech and language disorders. Therefore, the present study was designed to: 1) provide data regarding the incidence rates of OMD among children identified with speech and language disorders in grades kindergarten through six, and 2) investigate possible correlational relationships between the presence of various components of OMD with each other and with the presence of speech and/or language disorders. Two hundred children in grades kindergarten through six from various school districts in Fresno County, California were tested for the presence of various OMD components through examination of the orofacial complex. The resulting data was subjected to statistical analysis to determine the percentages of occurrence, and the possible relationships among various OMD variables were explored through cross tabulations and the Pearson Chi-square formula.

Review Of The Literature

The incidence of OMD in various populations has been the subject of numerous studies. Orthodontic patients and school children have been most commonly studied to determine the prevalence of OMD. Rogers (1961) found that 62.8% of 497 pediatric orthodontic patients had OMD compared to 56.9% of 290 elementary school pupils, ranging in age from 5 to 12 years. Hale, Kellum, and Bishop (1988) conducted a retrospective study by examining the records of 229 orthodontic patients, described as ranging in age from "pediatric" to "adult" (p.7). The data gathered from this study indicated that 73.3% of the patients had a tongue thrust swallow, 71.6% had an abnormal resting posture of the tongue, 68.6% exhibited open mouth posture, 63.3% had a reported history of mouthbreathing, and 48% had abnormal tongue placement for lingual-alveolar phonemes. They concluded that "oral muscle factors, negative oral habits, and articulation and voice

disorders are found at high incidences in orthodontic patients" (p.7).

Children have been the focus of other OMD prevalence studies. Numerous studies have been conducted which show a high percentage of tongue thrust swallow from infancy through the third grade level (Andersen, 1963; D'Asaro, Shapiro, Baum, & Jacoby, 1961; Fletcher, Casteel, & Bradley, 1961; Jann, Ward, & Jann, 1964; Lewis & Counihan, 1965; Ward, Minst, Malone, Jann, & Jann, 1961). A study by Hale, Kellum, Nason, and Johnson (1988) of 137 kindergarten students revealed a significantly lower incidence (33%) of tongue thrusting behavior than had previously been reported in that age group. Hanson and Andrianopoulos' (1982) 13-year longitudinal study produced data contradicting the popularly held belief that tongue thrust, while normal in infancy and the early elementary years, decreased with maturity. Among their subjects, the incidence of tongue thrust did not decline through adolescence, but slightly increased. Although the percentages varied in these studies, "most researchers agree that tongue thrust is normal in infancy, decreases in prevalence to about 50% at age five, and to 33% at age eight" (Christensen & Hanson, 1981, p.161).

There are few studies regarding the prevalence of OMD and the interaction of myofunctional variables among the generally distributed population (Hale et al., 1992). However, according to Kellum (1994), "The generally accepted prevalence of OMD is 38% in the general population" (p.3).

Studies regarding the incidence of OMD among regular education schoolchildren receiving speech and language services through the schools are non-existent. The present study was conducted to supply much-needed data regarding that population.

Furthermore, in a 1989 position statement, the American Speech-Language-Hearing Association called for, "Basic biologic and descriptive research of a multivariate nature" that "could increase understanding of oral myofunctional disorders" (ASHA, 1989, p.93). Examples of multivariate research of this nature include studies conducted to determine the relationships between swallowing patterns, modes of respiration, and development of malocclusion (Melsen, Attina, Santuari, & Attina, 1987); oral resting postures and habits and dentofacial characteristics (Hale, Kellum, Nason, & Johnson, 1988); dental, skeletal, and oral muscle functions

and dentofacial development (Gross et al, 1990); and oral motor control, posturing, and myofunctional variables and their relationship to diadochokinetic ability (Hale et al., 1992). Researchers have stressed the need for continued multivariate research on components of OMD (e.g. rest posture, oral habits, swallowing factors, and so forth) and their interrelationships with each other and with the production of speech (Fletcher, Casteel, & Bradley, 1961; Kellum, Hale, & Sisakun, 1989).

Because of the need for research that explores multiple variables related to OMD, this study is concerned with the interrelationships among a broad spectrum of components of OMD. These include:

- 1) Labial factors/Open mouth posture
- 2) Lingual factors/Swallowing
- 3) Dental and structural components
- 4) Speech differences

Research Questions

In view of the need for data regarding the prevalence of OMD among school-aged children receiving speech and language services and of the need for further research of a multivariate nature exploring possible relationships between components of OMD and speech and language disorders, the following research questions were pursued:

- 1) What is the prevalence of orofacial myofunctional disorders among children identified with speech and language disorders in grades kindergarten through six?
- 2) What correlational relationships exist between the presence of various components of orofacial myofunctional disorders with each other and with the presence of speech and/or language disorders?

Methods

Permission was obtained from the school boards of the Fresno County Office of Education and the Kings Canyon Unified School District to conduct the study. Credentialed speech-language pathologists (SLPs) working for the participating school districts helped locate qualified subjects. Subjects were selected for participation in the study based on the following criteria:

- 1) Each subject was enrolled in a speech-language therapy program directed by an SLP holding a California state license, ASHA certification, or a Clinical Rehabilitative Services Credential for speech-language pathology.
- 2) Each subject had an Individual Education Plan (IEP) that indicated the rationale for the provision of speech and language services (speech, fluency, voice, and language).
- 3) Each subject had written permission from a parent or legal guardian to participate in the study. A cover letter briefly explaining the study accompanied the permission form. Spanish translations were provided for all forms when needed.

Two hundred kindergarten through sixth grade children participated in the study. There were 73 females and 127 males, ranging in age from 5:1 to 12:5. There were 122

Hispanic children and 60 White children, representing 61% and 30.5% of the subject population, respectively. English was the primary language for 75% of the subjects and Spanish the primary language for 21.5%. The most common diagnoses qualifying the subjects for speech and language services were articulation disorders (47%) and language disorders (32.5%). Data concerning race, gender, primary language, age, grade, and diagnosed disorder are reported in Tables 1 through 5.

Two of the authors traveled separately to the various schools participating in the study, and each examined 100 subjects, for a total of 200 subjects. The examiners were trained in administering orofacial examinations by Dr. Steven D. Wadsworth. Dr. Jeffrey Smith, a licensed dentist and orthodontist, provided additional training in the identification of dental malocclusion.

Areas of assessment and procedure closely followed criteria established in studies by Andrianopoulos and Hanson (1987), Hale, Kellum, Nason, and Johnson (1988), Kellum, Hale, and Sisakun (1989), Gross et al. (1990), and Hale et al. (1992). Each subject was evaluated individually using a protocol developed by the researchers (Appendix A). Areas of orofacial myofunctional assessment included: articulatory placement and acoustic differences; labial factors; lingual factors including resting postures; dental and structural components; swallowing factors; open mouth posture and airflow; and oral habits.

The examiners made independent judgments on all myofunctional variables on the predetermined protocol. Responses were recorded as "abnormal" (indicated by circling the minus sign) if a behavior or factor was present; and "normal" (indicated by circling the plus sign) if the behavior or factor did not appear. These terms were selected in order to provide the examiners with a binary choice and did not imply that the presence of a factor could always be presumed to place the subject at risk for a myofunctional disorder.

Some behavioral observations required the examiners to make specific choices among two or more predetermined variables within a major category. For example, for the category of *Lingual Factors at Rest*, the examiners were required to make a choice between normal alveolar resting position of the tongue and abnormal resting positions, which included upper dental, lower dental, and interdental resting positions.

Intertester reliability was measured by duplicated examinations of 10 subjects randomly selected from the total subject pool. Each subject was examined independently by each researcher. Reliability was then calculated for each observation of the specific myofunctional variables listed on the assessment protocol. The number of times the two researchers were in agreement was divided by the total number of observations, resulting in a figure representing the percentage of agreement between the two researchers on each myofunctional variable observed. Items not receiving at least a 70% general reliability rating were then eliminated.

The one major variable examined for which good intertester reliability could not be established was oral muscle control, evaluated by observation of diadochokinetic tasks. Reliability percentages for that variable ranged from 40% to 70%, therefore, the resulting data was not included in the data analysis.

Reliability ratings for the retained items ranged from 80% to 100%, which were considered to be adequate for purposes of further data analysis. Percentages of reliability ranged from 90% to 100% for functional labial factors, lingual factors, dental and structural components, and swallowing function. Percentages of reliability ranged from 80% to 100% for articulatory placement and acoustic differences, structural labial factors, open mouth posture, and airflow (See Table 6).

Results

Data resulting from observations made during the orofacial examinations were entered into the *Statistical Program for the Social Sciences* ver. 6.1.3. (SPSS) data base for further analysis. The data were recorded by one researcher and rechecked by another to ensure data was recorded and formatted correctly. A statistical consultant performed further analysis generated by the SPSS program. Percentages of occurrence, cross tabulations, and Pearson Chi-square analysis were used to analyze each specific myofunctional variable.

It should be noted that data on some variables examined were not subjected to further statistical analysis. Due to poor intertester reliability, data on diadochokinetic rates were not analyzed. Also, some variables examined, such as lip retraction, tongue protrusion, and soft palate, revealed very low percentages of abnormal ratings among the subjects and were not deemed to occur in great enough numbers to warrant further analysis. An arbitrary criterion of 25% or more abnormal ratings in the total subject population ($n = 200$) was therefore applied, and only those variables meeting that criteria were subjected to data analysis.

As an initial step in the examination of the data, percentage or frequency of occurrence rates were tabulated for each of the myofunctional variables. Tables were generated showing percentages of occurrence for the total sample population and for three major divisions of subjects: 1) female subjects and male subjects; 2) subjects with articulation disorders and subjects with language disorders; and 3) Hispanic subjects and White subjects, the two major ethnic groups represented in the total subject population (see Tables 7 through 10).

The resulting data were also subjected to Pearson Chi-square analysis to explore possible statistical relationships between the myofunctional variables examined. Three major myofunctional variables - abnormal resting posture of the tongue, tongue thrust swallow, and dental malocclusions - were selected for chi-square analysis. These three variables were analyzed against each other and the following OMD variables:

- 1) Open mouth posture
- 2) Anterior, lateral, and bilateral open bite
- 3) Overbite
- 4) Overjet
- 5) Dentalization of / t / and / d / phonemes
- 6) Dentalization of / l / and / n / phonemes
- 7) Dentalization of / s / and / z / phonemes
- 8) Diagnosis of articulation or language disorders

Several statistically significant relationships were discovered through chi-square analysis for each of the three major myofunctional variables analyzed.

Tongue Thrust Swallow: Tongue thrust swallow was significantly related to resting posture of the tongue; open bite; phonemes / t / and / d /; and phonemes / s / and / z /. With an increased alpha level ($p > .01$ but did not exceed .05), tongue thrust swallow was also related to phoneme / l / and speech and language diagnosis. Tongue thrust swallow was not found to be significantly associated with Class II and III malocclusions, open mouth posture, overbite, or overjet. Chi-square relationships between tongue thrust swallow and specified OMD variables are summarized in Table 11.

Abnormal at rest lingual posture: Abnormal resting posture of the tongue was found to be significantly related to open mouth posture, open bite, phonemes / t /, / d /, / l /, / s /, and / z /, and Class II and III malocclusions ($p < .01$). Resting posture of the tongue was not significantly related to overbite, overjet, or speech and language diagnosis. Chi-square relationships between abnormal resting posture of the tongue and specified OMD variables are summarized in Table 12.

Dental Malocclusions: Class II and III malocclusions were significantly related to abnormal resting posture of the tongue, open bite, and overbite ($p < .01$). With an increased alpha level ($p > .01$ but does not exceed .05), dental malocclusions were also related to overjet, phoneme / l /, phonemes / t /, / d /, / s /, and / z /, and speech and language diagnosis ($p = .01$). Dental malocclusions were not significantly related to tongue thrust swallow and open mouth posture. Chi-square relationships between dental malocclusions and specified OMD variables are summarized in Table 13.

In addition to Chi-square analysis, cross tabulations were calculated for specific myofunctional variables with abnormal ratings in 25% or more in the total subjects to investigate the frequency distribution of OMD variables with each other. Each possible pair of myofunctional variables having abnormal ratings in 25% or more of the total population was subjected to cross tabulation. The resulting data were analyzed, and those pairs of variables showing a percentage rate of co-occurrence greater than 39% were selected for further discussion.

Table 14, therefore, lists those pairs of myofunctional variables with co-occurrence rates of 39% or greater. The two variables cross tabulated (V1 and V2) are listed in the first two columns of the table. The third column lists the number of subjects who exhibited abnormal ratings for *both*

VI and V2. The percentage of co-occurrence for VI and V2 was then calculated by dividing the number of subjects having abnormal ratings for *both* V1 and V2 by the number of subjects having abnormal ratings for VI *only*. The resulting percentages of co-occurrence are listed in the fifth column of Table 14. It is understood that cross tabulations do not show statistical significance but may indicate possible areas that lend themselves to further controlled research.

Discussion

The present study was designed to fulfill two purposes: 1) to determine the prevalence of various myofunctional disorders in children enrolled in speech and language services in Fresno County, California, and 2) to investigate possible relationships between various myofunctional disorders and speech and/or language disorders. Observations were carefully made and the resulting data were subjected to chi-square analysis and cross tabulations for analysis.

Some caution must be used in interpreting these data due to acknowledged limitations in subject selection. The population examined was indigenous to Fresno County, California, and limited to those children for whom it was possible to obtain parental permission and cooperation. Therefore, the sample was not entirely random and differed from known statistics describing the racial characteristics of caseloads of speech-language pathologists (SLPs) practicing elsewhere in the public schools. According to a 1995 survey conducted by the American Speech-Language-Hearing Association (ASHA), the typical caseload of SLPs in public schools consisted of 67% White children, 18% African American, 11% Hispanic, 4% Native American, and 3% Asian/Pacific Islander (Butler, 1997). The subjects in the present study consisted of 61% Hispanic children, 30.5% White, 1% Black, .5% Asian, and 7.5% other ethnic groups.

Prevalence

The generally accepted incidence rate of OMD for the population as a whole is 38% (Kellum, 1994). However, prevalence figures for the population examined, e.g., regular education elementary school children receiving speech and language services in the schools, were unavailable for the presence of OMD prior to this study. Analysis of the data revealed four major categories of OMD occurring in large percentages among the population examined: 1) tongue thrust swallow; 2) open bite; 3) abnormal resting position of the tongue, and 4) open mouth posture.

Tongue thrust swallow was found in 50.5% of the total subjects. Prevalence of tongue thrust swallow increased to 55.3% among the articulation-disordered subgroup. Interestingly, the prevalence of tongue thrust swallowing among the subgroup of language-disordered children, with no accompanying articulation disorder, was 36.9%. Among

female subjects, 53.5% exhibited a tongue thrust swallow and among males, 48.8%. Among the two major ethnic groups comprising the total subjects, 51.7% of the Hispanic and 50% of the White subjects exhibited a tongue thrust swallow.

Twenty-four percent of the entire group had some type of open bite, which did not strictly conform to the 25% criterion established for data analysis. However, the percentage of occurrence increased to 29.8% among the articulation-disordered children, and on that basis, open bite was subjected to further data analysis. Prevalence of open bite among language-disordered children declined to 18.4%. Among female subjects, 31.5% had some kind of open bite, and among male subjects, 20.4%. Prevalence of open bite among Hispanic subjects was 23.8% and among White subjects, 28.3%.

Abnormal resting posture of the tongue was present in 59% of the total subjects and constituted the largest percentage of abnormal ratings among all variables observed. There was little variance between percentage of occurrence in articulation-disordered children (59.6%) and language-disordered children (53.8%). Among female subjects, prevalence of abnormal resting tongue position was 65.7% and among male subjects, 55.2%. Abnormal resting tongue position was present in 61.4% of the Hispanic subjects and in 51.7% of the White subjects.

Of the whole group, 32.5% of the subjects exhibited an open mouth posture during performance of an assigned activity. There was little variance between subjects with articulation disorders (33.8%) and subjects with language disorders (34%). Open mouth posture was observed in 23.3% of the female subjects and in 37.8% of the male subjects. Among Hispanic subjects, 28.7% exhibited open mouth posture and among White subjects, 38.3%.

As previously discussed, there have been no published studies of the prevalence of OMD among regular education elementary school children receiving speech and language services in the public schools. Further research is needed in other areas of the country and with as representative a sample as the limitations of scientific ethics allow, in order to determine if these figures are representative of the prevalence of OMD among the population studied.

It is possible, however, to compare prevalence figures for the population in the present study to populations that have been studied in the past. Although the number of children in each age group examined by this study is small, prevalence rates for tongue thrust can be determined for individual age groups and compared against the rates determined by other researchers.

The present study revealed prevalence rates for tongue thrust among the various age groups examined as follows: 53.9% of 5-year olds (total n=13); 58.3% of 6 year-olds (total n=36); 58.3% of 7-year olds (total n=36); 41.7% of 8-year olds (total n=36); 50% of 9-year olds (total n=28); 42.8% of 10-year olds (total n=28); 50% of 11-year olds (total n=20). There were only three 12-year olds examined for the study, two had a normal swallow, and one had a

tongue thrust swallow. Table 15 lists these prevalence rates for tongue thrust swallow among the population in the present study and compares them to prevalence rates for tongue thrust swallow among the general population of school-aged children determined by other studies.

Relationships Among Variables

Cross Tabulations

Simple cross tabulations were performed on those variables receiving abnormal ratings in at least 25% of the total subjects. Every possible pair of variables was analyzed in this manner. For those cases where at least 39% of subjects showing an abnormal rating in one variable also showed an abnormal rating in the other, results were listed in Table 13. While statistical significance cannot be shown with cross tabulations, a high co-occurrence of two variables can reveal possible statistical significance and suggest directions for further research.

Some high percentages of co-occurrence revealed by the cross tabulations were expected. It is expected, for instance, that a child with an abnormal / s / production would also have an abnormal / z / production, and cross tabulations revealed that, indeed, 88.3% of the children with an abnormal / s / also had an abnormal / z /. Not so obvious, however, is the high co-occurrence of the abnormal production of / l / with the abnormal production of / s / (47.4%) and / z / (44.7%).

As many have suspected, the abnormal production of / s / and / z / co-occur to a high percentage with certain OMD variables. Abnormal at rest tongue position was observed in 76.6% of children with an abnormal / s /, and in 78.9% of those with an abnormal / z /. A tongue thrust swallow was exhibited by 76.3% of children with an abnormal / s / and 80% of those with an abnormal / z /. Open mouth posture observed during an activity was present in 39% of children with an abnormal / s / and in 40.8% of those with an abnormal / z /. In addition, children with an abnormal / l / also had a high co-occurrence of abnormal at rest tongue position (76.3%) and open mouth posture (39.5%). Based on these observations, it would seem reasonable to conclude that a high percentage of children who misarticulate / s / and / z /, and to a lesser extent / l /, would also exhibit an abnormal resting tongue posture, a tongue thrust swallow, and/or an open mouth posture.

Cross tabulations also revealed some high percentages of co-occurrence between several orofacial myofunctional variables, analyzed without reference to diagnosed articulation and language disorders. A tongue thrust swallow, for example, had a high percentage of co-occurrence with resting tongue posture (63 %), open bite (86.1%), overjet (57.4%), abnormal palatal contour (60%), pronounced rugae (66%), and open mouth posture (39.1%). These high percentages of co-occurrence emphasize the inter-relatedness of myofunctional variables. Further scientific research is needed to definitively describe the effects of myofunctional variables acting upon each

other. It is evident from this study, however, that school SLPs must be alert to the possibility that several components of OMD may occur simultaneously in individual students on their caseloads.

Chi-Square Analysis

Three major OMD variables (tongue thrust swallow, at rest lingual posture, and dental malocclusion) were selected for chi-square analysis. Separate hypotheses for these three variables analyzed against each other and against eight other OMD variables were submitted to the chi-square test, as detailed in the Results section of this study. For investigative purposes, some relationships were reported in the Results chapter using alpha level $p > .01$ but no more than .05. In order to make the strongest statements possible regarding the relationships revealed by this study, however, the major focus of the following discussion will be on those relationships found to be statistically significant using an alpha level of $p < .01$, although those relationships found using alpha $p > .01$ but no more than .05 will be noted.

Tongue Thrust Swallow

Tongue thrust swallow was found to have a statistically significant relationship with resting tongue posture ($p = .00$). This finding would seem to confirm the suspicions of Bateman and Mason (1984) that, "It is quite possible that most individuals classified as having a *tongue thrust*, also have an anterior resting tongue posture" (p.244), and Moore's (1991) report of the consistent co-occurrence of tongue thrust swallow and tongue posture problems.

Tongue thrust swallow was also found to have a statistically significant relationship with open bite positions ($p = .00$). This is in direct opposition to a finding by D'Asaro, Shapiro, Baum, and Jacoby (1961) who found no significant relationship between abnormal swallow and open bite, using chi-square. They did, however, believe there was a "trend" toward a significant relationship between those two variables, and the high percentage of co-occurrence of open bite and tongue thrust swallow has consistently been verified by numerous researchers. Rogers (1961) examined fifty-six school children with open bites and found only one who did not demonstrate a tongue thrust swallow. Hanson and Barrett (1988) reported that 98% of orthodontic patients with open bites have tongue thrusts. Concern over the relapse of orthodontically-treated cases of open bite in patients whose abnormal swallowing patterns persisted was the basis for the development of myofunctional therapy. Although direct causal relationships cannot be proven through chi-square analysis, the results of this study lend further credence to the validity of that concern.

Although several researchers have noted a high percentage of a tongue thrust swallow co-occurring with dental malocclusions, overbite, and overjet (Andersen, 1963; Bateman & Mason, 1984; Blythe, 1959; Hanson &

Andrianopoulos, 1982; Straub, 1961; Subtelney, Mestre, & Subtelney, 1964; Subtelney & Subtelney, 1962), chi-square analysis revealed no significant relationships between tongue thrust swallow and those three variables. Open bite, therefore, was the one dental abnormality significantly associated with tongue thrust swallow.

Several researchers have also noted a high percentage of co-occurrence of tongue thrust swallow with open mouth posture (Neiva & Wertzner, 1996; Zimmerman, 1994). However, the results of chi-square analysis in the present study revealed no significant relationship between tongue thrust swallow and open mouth posture ($p=.11$).

Tongue thrust swallow was also found to be related to the production of alveolar consonants /t/, /d/, /s/, and /z/. A significant relationship between tongue thrust swallow and lisping has long been suspected (Fletcher, Casteel, & Bradley, 1961; Hanson & Andrianopoulos, 1982; Harrington & Breinholt, 1963; Jann, Ward, & Jann, 1961; Ward, Minst, Malone, Jann, & Jann, 1961). Even those who are not convinced of a direct link between tongue thrust swallow and incorrect production of the sibilant sounds admit to the high co-occurrence of tongue thrust and sibilant distortion (Subtelney, Mestre, & Subtelney, 1964; Subtelney & Subtelney, 1962). The relationships revealed by the present study between production of alveolar consonants /t/ and /d/ and tongue thrust swallow have received much less attention in the literature. Due to the relationships demonstrated between tongue thrust swallow and four of the alveolar phonemes tested, it would seem logical to expect all of the alveolar phonemes tested to be significantly related to tongue thrust swallow. However, there were no significant relationships revealed between incorrect production of alveolar consonants /l/ and /n/ and tongue thrust swallow; however, with an increased alpha level of $p<.05$ ($p=.04$), production of /l/ with tongue thrust swallow was found to be statistically significant.

At Rest Lingual Postures

Chi-square analysis also revealed abnormal resting tongue posture to be related to a number of OMD variables other than tongue thrust swallow. Abnormal resting tongue posture was found to be significantly related to open mouth posture, open bite, misarticulation of phonemes /t/, /d/, /l/, /s/, and /z/ and to Class II and III malocclusions.

Many researchers have commented on the tendency of children who exhibit open mouth posture, whether or not such a posture is accompanied by mouthbreathing, to carry the tongue in a low, forward position, sometimes between the teeth (Bateman & Mason, 1984; Harrington & Breinholt, 1963; Joseph, 1982; Zimmerman, 1994). As Gross et al. (1990) stated, "Youngsters displaying open mouth posture maintain the tongue in a forward plane" (p.251). The findings of the present study support their observations.

Abnormal resting tongue posture was also found to be significantly related to open bite. This finding appears to confirm the observation of Bateman and Mason (1984) that,

"The individual with a mouth-open, lips-apart resting posture whose tongue is also seen to rest forward between the anterior teeth is likely to develop an anterior open bite" (p.244). Mason (1994) and an ASHA position statement (1989) stated that abnormal resting posture of the tongue is a more likely etiological agent in the creation of an anterior open bite than is tongue thrust swallow. The results of this study show significant relationships between open bite, abnormal resting posture, and tongue thrust swallow. These findings, taken by themselves, would appear to support Hanson and Peachey's (1991) suspicions that the forces involved with tongue thrust swallow and abnormal at rest lingual posture work together to create anterior open bite, and it may not be possible to assign greater etiological importance to one factor than to the other.

However, unlike tongue thrust swallow, abnormal resting tongue posture was also found to be related to the presence of dental malocclusion (Class II and Class III malocclusions were combined for the purposes of chi-square analysis). Abnormal at rest lingual posture, then, was found to be significantly related to more types of dental abnormalities than was tongue thrust swallow. This additional finding lends support to the generally accepted belief that the resting position of the tongue is a more significant factor in the development of dental malformation, than is tongue thrust swallow.

Chi-square analysis also revealed significant relationships between abnormal resting posture of the tongue and incorrect production of the phonemes /t/, /d/, /s/, /z/, and /l/. In regard to production of /t/, /d/, /s/, and /z/, which were also significantly related to tongue thrust swallow, there appears to be a close inter-relatedness between the incorrect production of those phonemes, tongue thrust swallow, and abnormal at rest lingual posture. Interestingly, abnormal at rest lingual posture was significantly related to one additional phoneme, /l/, not found to be significantly related to tongue thrust swallow, using alpha $p<.01$. This again suggests that the resting posture of the tongue is a more important factor in OMD and in articulation disorders than is the tongue thrust swallow.

Dental Malocclusions (Class II and Class III Malocclusions)

Much attention has been paid to the possible role OMD may play in the etiology of dental malocclusions. In an effort to contribute to the body of knowledge regarding this issue, the variable "dental malocclusion" was subjected to chi-square analysis to determine if any statistically significant relationships existed between that variable and the other selected OMD variables. One such relationship, with resting posture of the tongue, has been previously discussed. In addition, dental malocclusion was found to have statistically significant relationships with open bite and overbite. With an increased alpha level of $p<.05$, dental malocclusion was also significantly related to overjet. These findings were expected and consistent with the frequent presence of multiple problems with the dentition of orthodontic patients

(Graber, 1972).

More surprising was the absence of statistically significant relationships between dental malocclusions and several variables commonly linked to the presence of dental malocclusion. Tongue thrust swallow, for example, had no relationship to dental malocclusion ($p=.14$), which was previously discussed.

Also, using alpha level $p<.01$, there were no statistically significant relationships found between dental malocclusion and the dentalization of phonemes /t/, /d/, /s/, /z/, and /l/.

The finding would also be consistent with those who have pointed out the lack of a direct one-to-one correspondence between the presence of dental malocclusion and speech errors, since many people with dental malocclusion have no speech errors and many with no malocclusions do (Bernstein, 1954; Blythe, 1959; Mason, 1980, 1994; Subtelney, Mestre, & Subtelney, 1964; Subtelney & Subtelney, 1962). However, when the alpha level was increased to $p<.05$, dental malocclusion was then found to be significantly related to the dentalization of phonemes /t/, /d/, /s/, and /z/ and phoneme /l/.

Summary

Based on the results of this study, the following conclusions may be drawn:

- 1) Speech-language pathologists working in the public school setting might expect to find some kind of orofacial myofunctional disorder in approximately 50% of the children comprising their caseload.
- 2) Chi-square analysis revealed statistically significant relationships between tongue thrust swallow and; a) resting posture of the tongue, b) open bite, and c) dentalization of phonemes /t/, /d/, /s/, and /z/.
- 3) Chi-square analysis revealed statistically significant relationships between abnormal resting posture of the tongue and; a) open mouth posture, b) open bite positions, c) dentalization of phonemes /t/, /d/, /l/, /s/, and /z/, and d) Class II and III malocclusions.
- 4) Chi-square analysis revealed statistically significant relationships between dental malocclusions and; a) abnormal resting posture of the tongue, b) open bite positions, and c) overbite.
- 5) The probable OMD profile of a child who dentalizes /s/, /z/, /t/, and /d/ may include tongue thrust swallow,

abnormal resting tongue position and/or open mouth posture.

6) Children with an abnormal resting posture of the tongue and/or tongue thrust swallow may be at risk for developing an open bite.

Need for Further Research

The data generated by the present study suggest several areas for further research. First and foremost, the study should be replicated to compare prevalence rates for OMD in school children receiving speech and language services in other parts of the country with those found in the present study.

Secondly, research of a multivariate nature is badly needed to further explore the relationships revealed in this study. In particular, carefully controlled experimental research is needed to address the issue of causation that has historically been the crux of controversy surrounding the treatment of OMD. Although the present study once again established a significant statistical relationship between the presence of tongue thrust and open bite, and between the presence of abnormal resting posture of the tongue and various dental abnormalities, no direct causal relationship between those variables was proven. Thus, the question of whether the forces involved in tongue thrust swallow and abnormal at resting posture cause dental abnormalities or whether the abnormal tongue function is caused by the presence of dental abnormalities, is still unresolved.

In view of the lack of a definitive answer to that basic question, efficacy studies are needed to assess the value of OMD treatment in remediating dental abnormalities and speech errors. SLPs working in the private sector with orthodontic patients should assume the role of "clinician researcher" and carefully record and report baseline information and progress achieved in aiding and maintaining the correction of dental malocclusion. Similarly, SLPs working in schools should contribute to efficacy research by documenting the success of articulation remediation with and without treatment of accompanying OMD. If it can be proven repeatedly that providing myofunctional therapy facilitates remediation of dental abnormalities and articulation disorders, then that therapy can be justified, with or without the resolution of controversy regarding causative relationships between OMD, dental abnormalities, and speech differences.

Table 1: Race and Gender Composition for Total Subjects

Race	Female n (%)	Male n (%)	Total n (%)
Hispanic	47 (64.4)	75 (59.1)	122 (61.0)
White	18 (24.7)	42 (33.1)	60 (30.5)
Black	1 (1.4)	1 (0.8)	2 (1.0)
Asian	0 (0.0)	1 (0.8)	1 (0.5)
Other	7 (9.6)	8 (6.3)	15 (7.5)
Total	73 (36.5)	127 (63.5)	200 (100.0)

Table 2: Primary Language for Total Subjects by Gender

Language	Female n (%)	Male n (%)	Total n (%)
English	51 (69.9)	99 (78.0)	150 (75.0)
Spanish	18 (24.7)	25 (19.7)	43 (21.5)
Hmong	2 (2.7)	2 (1.6)	4 (2.0)
Punjabi	2 (2.7)	1 (0.8)	3 (1.5)
Total	73 (36.5)	127 (63.5)	200 (100.0)

Table 3: Age and Total Subjects by Gender

Age	Female n (%)	Male n (%)	Total n (%)
5:1 to 5:9	6 (8.2)	7 (5.6)	13 (6.5)
6:0 to 6:9	2 (15.1)	25 (19.7)	36 (18.0)
7:0 to 7:9	17 (23.3)	19 (15.1)	36 (18.0)
8:0 to 8:9	12 (16.5)	24 (18.8)	36 (18.0)
9:0 to 9:9	7 (9.6)	21 (16.7)	28 (14.0)
10:0 to 10:9	7 (9.6)	21 (16.7)	28 (14.0)
11:0 to 11:9	12 (16.4)	8 (6.3)	20 (10.0)
12:1 to 12:5	1 (1.4)	2 (1.6)	3 (1.5)
Total	73 (36.5)	127 (63.5)	200 (100.0)

Table 4: Grade and Total Subjects by Gender

Grade	Female n (%)	Male n (%)	Total n (%)
Kindergarten	9 (12.3)	23 (18.1)	32 (16.0)
First	18 (24.7)	24 (18.9)	42 (21.0)
Second	15 (20.5)	22 (17.3)	37 (18.5)
Third	7 (9.6)	23 (18.1)	30 (15.0)
Fourth	7 (9.6)	21 (16.1)	28 (14.0)
Fifth	16 (20.9)	12 (9.4)	28 (14.0)
Sixth	1 (1.4)	2 (1.6)	3 (1.5)
Total	73 (36.5)	127 (63.5)	200 (100.0)

Table 5: Percentages of Occurrence of Diagnosed Speech and Language Disorders for Total Subjects as Stated on the Most Current IEP

Disorder	Female n (%)	Male n (%)	Total n (%)
Articulation	33 (45.2)	61 (48.0)	94 (47.0)
Language	31 (42.5)	34 (26.8)	65 (32.5)
Articulation/Language	6 (8.2)	20 (15.7)	26 (13.0)
Fluency	2 (2.7)	6 (4.7)	8 (4.0)
Other	1 (1.4)	7 (4.8)	7 (3.5)
Total	73 (36.5)	127 (63.5)	200 (100.0)

Table 6: Summary of Interrater Reliability Data

Components	Reliability Rating (%)
Articulatory Placement and Acoustic Differences	80-100
Labial Factors (Structure)	80-100
Labial Factors (Function)	90-100
Lingual Factors	90-100
Oral Muscle Control	40-70
Dental and Structural Components	90-100
Swallowing	90-100
Open Mouth Posture and Airflow	80-100

Table 7: Percentage of Occurrence of Abnormal Ratings for Specified Myofunctional Variables for Total Subjects and for Subgroups "Female" and "Male"

Articulation Placement:	Total n (%)	Female n (%)	Male n (%)
1. Phoneme / l /	76 (38.0)	36 (49.3)	40 (31.5)
2. Phoneme / s /	77 (38.5)	30 (41.1)	47 (37.0)
3. Phoneme / z /	71 (35.5)	30 (41.1)	41 (32.3)
4. Sentence 1	94 (47.0)	43 (58.9)	51 (40.2)
5. Sentence 2	86 (43.0)	37 (50.7)	49 (38.6)
Labial Factors:			
6. Lips-apart posture	57 (28.5)	16 (21.9)	41 (32.3)
7. Lower lip	66 (33.0)	21 (28.8)	45 (35.4)
Lingual Factors:			
8. Upper linguadental	4 (2.0)	2 (2.7)	2 (1.6)
9. Lower linguadental	59 (29.5)	26 (35.6)	33 (26.0)
10. Interdental	55 (27.5)	20 (27.4)	35 (27.6)
Dental and Structural Components			
11. Class II	47 (23.5)	3 (17.8)	34 (26.8)
12. Class III	24 (12.0)	13 (17.8)	1 (8.7)
13. Anterior open bite	24 (12.0)	12 (16.4)	12 (9.4)
14. Lateral open bite	7 (3.5)	3 (4.1)	4 (3.1)
15. Bilateral open bite	18 (9.0)	8 (11.0)	10 (7.9)
16. Combined 13, 14, 15	49 (24.5)	23 (31.5)	26 (20.4)
17. Overbite	75 (37.5)	25 (34.2)	50 (39.4)
18. Overjet	63 (31.5)	27 (37.0)	36 (28.3)
19. Palatal contour	67 (33.5)	24 (32.9)	43 (33.9)
20. Pronounced rugae	52 (26.0)	18 (24.7)	34 (26.8)
Swallowing:			
21. Simple tongue thrust	42 (21.0)	18 (24.7)	24 (18.9)
22. Complex tongue thrust	59 (29.5)	21 (28.8)	38 (29.9)
23. Bolus formation	60 (30.0)	27 (37.0)	33 (26.0)
Open Mouth Posture:	65 (32.5)	17 (23.3)	48 (37.8)

Table 8: Percentage of Occurrence of Abnormal Ratings for Specified Myofunctional Variables for Subjects with Articulation Disorders (total n=94)

	Total subjects n (%)	Female n (%)	Male n (%)
Articulation Placement:			
1. Phoneme / t /	25 (26.6)	6 (18.2)	19 (31.1)
2. Phoneme / d /	28 (29.8)	10 (30.3)	18 (29.5)
3. Phoneme / n /	26 (27.7)	6 (18.2)	20 (32.8)
4. Phoneme / l /	42 (44.7)	19 (57.6)	23 (37.7)
5. Phoneme / s /	44 (46.8)	16 (48.5)	28 (45.9)
6. Phoneme / z /	39 (41.5)	16 (48.5)	23 (37.7)
7. Sentence 1	50 (53.2)	21 (63.6)	29 (47.5)
8. Sentence 2	47 (50.0)	19 (57.6)	28 (45.9)
Labial Factors:			
9. Lips-apart posture	24 (25.2)	4 (12.1)	20 (32.8)
10. Lower lip	60 (63.8)	11 (33.3)	2 (37.7)
Lingual Factors:			
11. Upper linguadental	2 (2.1)	1 (3.0)	1 (1.6)
12. Lower linguadental	23 (24.5)	8 (24.2)	15 (24.6)
13. Interdental	31 (33.0)	11 (33.3)	20 (32.3)
14. Lateral tongue move.	27 (28.7)	8 (24.2)	19 (31.1)
Dental/Structural:			
15. Class II	24 (25.5)	8 (24.2)	16 (26.2)
16. Class III	9 (9.6)	4 (12.1)	5 (8.2)
17. Anterior open bite	15 (16.0)	7 (21.2)	8 (13.1)
18. Lateral open bite	5 (5.3)	2 (6.1)	3 (4.9)
19. Bilateral open bite	8 (8.5)	3 (9.1)	5 (8.2)
20. Overbite	36 (38.3)	13 (39.4)	23 (37.7)
21. Overjet	31 (31.9)	15 (45.5)	15 (24.6)
22. Palatal contour	40 (42.6)	15 (45.5)	25 (41.0)
23. Pronounced rugae	29 (30.9)	11 (33.3)	18 (29.5)
Swallowing:			
24. Simple tongue thrust	24 (25.5)	8 (24.2)	16 (26.2)
25. Complex tongue thrust	28 (29.8)	12 (36.4)	16 (26.2)
26. Bolus formation	31 (33.0)	15 (45.5)	16 (26.2)
Open Mouth Posture	32 (34.0)	8 (24.2)	24 (39.3)

Table 9: Percentage of Occurrence of Abnormal Ratings for Specified Myofunctional Variables for Subjects with Language Disorders (total n=65)

Articulation Placement	Total subjects n (%)	Female n (%)	Male n (%)
1. Phoneme / l /	17 (26.2)	13 (41.9)	4 (11.8)
2. Phoneme / s /	19 (29.2)	13 (41.9)	6 (17.6)
3. Phoneme / z /	18 (27.7)	12 (38.7)	6 (17.6)
4. Sentence 1	25 (38.5)	8 (58.1)	7 (20.6)
5. Sentence 2	22 (33.8)	14 (45.2)	8 (23.5)
Labial Factors:			
6. Lips-apart posture	21 (32.3)	9 (29.0)	12 (35.3)
Lingual Factors:			
7. Upper linguadental	1 (1.5)	1 (3.2)	0 (0.0)
8. Lower linguadental	22 (33.8)	15 (48.4)	7 (20.6)
9. Interdental	12 (18.5)	7 (22.6)	5 (14.7)
Dental/Structural:			
10. Class II	8 (12.3)	4 (12.9)	4 (11.8)
11. Class III	7 (10.8)	5 (16.1)	2 (5.9)
12. Overbite	25 (38.5)	11 (35.5)	14 (41.2)
13. Overjet	20 (30.8)	11 (35.5)	9 (26.5)
Swallowing:			
14. Simple tongue thrust	11 (16.9)	9 (29.0)	2 (5.9)
15. Complex tongue thrust	13 (20.0)	6 (19.4)	7 (20.6)
Open Mouth Posture	22 (33.8)	10 (32.3)	12 (35.3)

Table 10: Percentage of Occurrence of Abnormal Ratings for Specified OMD Variables by ethnic background (Hispanic subjects: n=122; White subjects: n=60; Other subjects: n=18)

	Hispanic n (%)	White n (%)	Other n (%)
Articulation Placement:			
1. Phoneme / l /	43 (35.2)	25 (41.7)	8 (44.4)
2. Phoneme / s /	50 (41.0)	23 (38.3)	4 (22.4)
3. Phoneme / z /	47 (38.5)	20 (33.3)	4 (22.2)
4. Sentence 1	57 (46.7)	29 (48.3)	7 (38.9)
5. Sentence 2	53 (43.4)	27 (45.0)	7 (38.9)
Labial Factors:			
6. Lips-apart posture	35 (28.7)	17 (28.3)	5 (27.8)
7. Lower lip	36 (29.5)	22 (36.7)	7 (38.9)

Lingual Factors:

8. Upper linguadental	2 (1.6)	1 (1.7)	1 (5.6)
9. Lower linguadental	40 (32.8)	16 (26.7)	2 (11.1)
10. Interdental	33 (27.0)	14 (23.3)	7 (39.9)

Dental/Structural:

11. Class II	29 (23.8)	17 (28.3)	0 (00.0)
12. Class III	16 (13.1)	5 (8.3)	3 (16.7)
13. Anterior open bite	14 (11.5)	8 (13.3)	1 (5.6)
14. Lateral open bite	3 (2.5)	3 (5.0)	1 (5.6)
15. Bilateral open bite	12 (9.8)	6 (10.0)	0 (00.0)
16. Overbite	43 (35.2)	29 (48.3)	2 (11.1)
17. Overjet	35 (28.7)	19 (31.7)	7 (38.9)
18. Palatal contour	35 (28.7)	29 (48.3)	3 (16.7)
19. Pronounced rugae	27 (22.1)	22 (36.7)	2 (11.1)

Swallowing:

20. Simple tongue thrust	23 (18.9)	17 (28.3)	2 (11.1)
21. Complex tongue thrust	40 (32.8)	13 (21.7)	4 (22.2)
22. Bolus formation	34 (27.9)	19 (31.7)	3 (16.7)

Open Mouth Posture	35 (28.7)	23 (38.3)	7 (38.9)
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Table 11: Pearson Chi-Square Analysis of “Tongue Thrust Swallow” and Specified Myofunctional Variables

Tongue thrust swallow and...	df	Chi-square	Significance
1. At rest lingual posture	6	38.07	.00 *
2. Malocclusions (Class II & III)	4	6.95	.14 ***
3. Open mouth posture	2	4.40	.11 ***
4. Open bite position	6	43.01	.00 *
5. Overbite	2	5.61	.06 ***
6. Overjet	2	3.36	.19 ***
7. Phonemes / t / and / d /	2	34.20	.00 *
8. Phoneme / l /	2	6.61	.04 ***
9. Phonemes / s / and / z /	2	37.22	.00 *
10. Speech and language diagnosis	4	11.65	.02 **

Note: For alpha levels * $p < .01$

** $p > .01$ but less than .05

*** $p > .05$

Table 12: Pearson Chi Square Analysis of “at Rest Lingual Postures and ...” Specified Myofunctional Variables

At rest lingual posture and...	df	Chi-square	Significance
1. Tongue thrust swallow	6	38.07	.00 *
2. Malocclusions (Class II & III)	4	29.11	.00 *
3. Open mouth posture	3	14.58	.00 *
4. Open bite	9	33.75	.00 *

5. Overbite	3	.36	.95 ***
6. Overjet	3	1.96	.58 ***
7. Phonemes / t / and / d /	3	19.86	.00 *
8. Phoneme / l /	3	15.35	.00 *
9. Phonemes / s / and / z /	3	19.77	.00 *
10. Speech and language diagnosis	6	5.12	.53 ***

Note: For alpha levels: * $p < .01$
 ** $p > .01$ but less than .05
 *** $p > .05$

Table 13: Pearson Chi-Square Analysis of "Dental Malocclusions and..." Specified Myofunctional Variables

Dental malocclusions and...	df	Chi-square	Significance
1. At rest lingual postures	6	29.11	.00 *
2. Tongue thrust swallow	4	6.95	.14 ***
3. Open mouth posture	2	2.50	.29 ***
4. Open bite	6	21.77	.00*
5. Overbite	2	18.86	.00 *
6. Overjet	2	7.90	.02 **
7. Phonemes / t / and / d /	2	7.23	.03 **
8. Phoneme / l /	2	9.99	.01 **
9. Phonemes / s / and / z /	2	6.79	.03 **
10. Speech and language diagnosis	14	28.60	.01 **

Note: For alpha level: * $p < .01$
 ** $p > .01$ but less than .05
 *** $p > .05$

Table 14: Cross Tabulation of Specified Myofunctional Variables in Total Subjects

Variable 1 (V1)	Variable 2 (V2) V1 and abnormal V2	Ss with abnormal	Ss with abnormal	%
Phoneme / l /	/ s /	76	36	47.4
Phoneme / l /	/ z /	76	34	44.7
Phoneme / l /	At rest tongue position	76	58	76.3
Phoneme / l /	Open Mouth Posture	76	30	39.5
Phoneme / s /	/ z /	77	68	88.3
Phoneme / s /	At rest tongue position	77	59	76.6
Phoneme / s /	Open Mouth Posture	77	30	39.0
Phoneme / s /	TT swallow	70	56	80.0
Phoneme / z /	At rest tongue position	71	56	78.9
Phoneme / z /	TT swallow	70	56	80.0
Phoneme / z /	Open Mouth Posture	71	29	40.8
Lower lip	At rest tongue position	66	49	74.2
At rest tongue position	TT swallow	113	71	63.0

At rest tongue position	Open Mouth Posture	118	47	40.0
Bite position	TT swallow	49	42	86.1
Overbite	Overjet	75	41	56.6
Overjet	TT swallow	61	35	57.4
Overjet	Open Mouth Posture	63	33	52.4
Palatal contour	Rugae	67	35	52.2
Palatal contour	TT swallow	65	39	60.0
Palatal contour	Open Mouth Posture	67	31	46.2
Rugae	TT swallow	50	33	66.0
Rugae	Open Mouth Posture	52	21	40.4
TT swallow	Open Mouth Posture	101	39	39.1

Note: $\bar{n}$ represents a portion of the total sample

Table 15: Prevalence Rates for Tongue Thrust Swallow Determined by this Study Compared to Prevalence Rates for Tongue Thrust Swallow Determined by Previous Studies of the General Population of School-Aged Children

AGE (% of Prevalence) STUDY	5	6	7	8	9	10	11	12
Current Study (1997)	53.9	58.3	58.3	41.7	50.0	42.8	50.0	33.3
Fletcher, Casteel, & Bradley (1961)		52.3	32.5	38.5				
Werlich (1962)		37.3					27.6	
Bell & Hale (1963)	82.0	82.0						
Andersen (1963)		21.3					14.6	
Hanson & Cohen(1973)	43.8	51.7	35.4	35.0				

APPENDIX A

MYOFUNCTIONAL PREVALENCE STUDY California State University, Fresno - 1996 Subject Evaluation Form

Name: _____ DOB: _____ Age: _____ Gender: _____

School: _____ Grade: _____ Date of Evaluation: _____

Ethnic Group: Asian _____ Black _____ Hispanic: _____ White: _____ Other: _____

Primary Language: _____ Secondary Language: _____

1. ARTICULATORY REPLACEMENT AND ACOUSTIC DIFFERENCES:

("+" indicates normal lingua-alveolar and dental placement or normal lingua-palatal placement for /sh and /ch/; "-" indicates upper lingua-dental (ULD), interdental (ID), or lower dental placement (LD)). Words from GFTA

"+" indicate NORMAL and "-" indicates NOT NORMAL

						ULD	ID	LD
1a.	telephone	bathtub	carrot	/t/	+	-		
2a.	duck	window	bed	/d/	+	-		
3a.	knife	Santa Claus	gun	/n/	+	-		
4a.	lamp	yellow	squirrel	/l/	+	-		
5a.	scissors	pencils	house	/s/	+	-		
6a.	zipper	scissors	scissors	/z/	+	-		
7a.	shovel	fishing	brush	/sh/	+	-		
8a.	church	matches	church	/ch/	+	-		
9a.	My sister Suzy lives by the seashore.				+	-		
10a.	The zebra lives at the zoo.				+	-		

Problems with fluency, voice, other: _____

2. LABIAL FACTORS:**a. Structure:**

- 1a. Touch when mouth is in repose: + -
- 2a. Touch when teeth are in contact: + -
- 3a. Normal upper lip length: + Short: - Markedly short: -
- 4a. Normal lower lip: + Inverted: - Puffy: - Large: - Dry: -
- Chapped: - Asymmetrical: - Sublabio furrow: -
- 5a. Bowed upper lip (White line contour): + - Bowed lower lip: + -
- 6a. Upper/lower vermillion tissue differences: + -
- 7a. Labial frenum: Inferior: + - Superior: + -
- 8a. Sulcus: + -

b. Function:

- 1a. Can protrude: + -
- 2b. Equal retraction bilaterally: + -
- 3b. Can retract laterally: Right: + - Left: + -

3. LINGUAL FACTORS:

- a. At Rest: Normal alveolar: + Lingua-dental: UD - LD - Interdental -
- b. Move tongue tip to alveolar ridge: + -
- c. Normal lingual frenum: + Restricted: - Short/Tight: -
- d. Move tongue laterally to opposite corners of mouth: + -
- e. Move tongue around lips: + -

4. ORAL MUSCLE CONTROL (Diadochokinesis)

- 4a. /p/ (20) _____ + -
 4b. /t/ (20) _____ + -
 4c. /k/ (20) _____ + -
 4d. Overall coordination of single syllable: Yes No
 4e. /p/ /t/ /k/ (25) _____ + -
 4f. /p/ /t/ /k/ (10) _____ + -
 4g. Overall coordination of 4e and 4f: Yes No

5 DENTAL AND STRUCTURAL COMPONENTS:

- a. Diastemas: + -
 b. Dental Occlusion Classification:
 b1. Angle's Class I: 2b. Angle's Class II: b3. Angle's Class III:
 Right: + Right: - Right: -
 Left: + Left: - Left: -

Left:

Right:

b2. Mixed dentition: Yes No

b3. Missing teeth: Yes No

- d. Normal Bite: +
 d1. Anterior open bite: - d2. Lateral open bite: - (circle): Left Right
 d3. Bilateral-anterior open bite (Incisors touch; open on sides): -
 e. Over jet: - _____
 f. Overbite: - _____

Comments: _____

g. Palatal Region:

- 1g. Normal palatal contour: + Flat: - Deep: - Narrow: - Cleft: -
 2g. Torus palatinus: Yes No Torus mandibularis: Yes No Pronounced rugae: Yes No
 3g. Normal soft palate: + Bifid: - Short: - Very short: -
 Normal length for structure: + Short: - Very Short: -
 4g. Normal uvula: + Bifid: - Deviated from midline: R L Absent: -
 h. Tonsils: + - Enlarged: - Removed: Yes No
 i. Adenoids: + - Removed: Yes No

6. SWALLOWING:

a. Swallow: ("0" indicates no contact with anterior teeth (normal swallow); "1" indicates contact with lingual surface with any of the anterior teeth (simple tongue thrust swallow); "2" indicates tongue protrusion over incisal edge of one or more anterior teeth (complex tongue swallow))

* Codes: lip protrusion (LP), visible facial tension (FT), molar contact (MC), and abnormal head movement (AHM), Mentalis wrinkle (MW)

1a. Saliva:	0	1	2					+	-
LP:	-	FT: -	MC: -	AHM: -	MW: -				
2b. Water:	0	1	2					+	-
LP:	-	FT: -	MC: -	MW: -					
Tongue Placement on cup:		+	-						
3c. Cracker:	0	1	2					+	-
LP:	-	FT: -	MC: -	AHM: -	MW: -				

Comments: _____

7. OPEN MOUTH POSTURE AND AIRFLOW:

a. Observed open mouth posture:	+	-					
b. Activity:	1.5 Min. +	-	3.5	+	-	5 min. +	-
- Open mouth Posture: Total (2 out 3)			+	-			
c. Mouth breather	+	-					
d. Nasal airflow:	Left naris (circle)	0-25%	26-50%	51-75%	76-100%		
	Left naris (circle)	0-25%	26-50%	51-75%	76-100%		

8. Oral Habits:

a. Nail biting:	-	Lip biting:	-	Object chewing:	-		
b. Thumb or digit habit:	-	Current habit:	Yes	No	Specify:	_____	
c. Lip licking:	-	tongue sucking:	-	teeth grinding/clenching:	-		

9. Miscellaneous:

Reported:	a.	Allergies:	-	Asthma:	-		
c. Plays instrument:	Yes	No	what type:				

Additional Comments: _____

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