Research Article

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Thumbsucking as Related to Placement and Acoustic Aspects of /s, z/ and Lingual Rest Postures

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Three hundred seventy-one second graders in rural public schools were evaluated for thumbsucking, rest and swallow postures of the tongue, and articulatory placement and acoustic aspects of /s,z/. Significant relationships were observed between thumbsucking and lower dental or interdental rest and swallow postures as well as acoustic errors for /s,z/. The implications of these relationships are discussed.

Thumbsucking or finger sucking is a common oral habit in children. These oral habits have been reported to occur in 10% - 22% of children ages 6 to 12 years (Baalack & Frisk, 1971; Roberts & Baird, 1971). Thumbsucking has gained the attention of a wide variety of professionals interested in child development including dentists, psychologists, pediatricians and speech-language pathologists.

As early as 1878 dental professionals cautioned that thumbsucking which continued after the eruption of the permanent teeth could cause abnormalities in dental development (Chandler, 1878). Current dental research supports the negative effects of oral habits on dentofacial development (Hanson & Cohen, 1973; Kelly, Sanchez, & Van Kirk, 1973; Little, Riedel, & Arun, 1988). Open bite and overbite malocclusion are the dental differences most frequently associated with persistent thumbsucking (Campbell-Reid & Price, 1984).

References to consequences of oral habits are found in the psychological and medical literature. Negative peer and parental attitudes toward digit habits in children are often reported in research on thumbsucking (Fletcher, 1975;

Illingworth, 1975; Wright, Schaefer, & Solomons, 1979). Psychologists have also frequently studied the treatment alternatives utilized to eliminate thumbsucking habits (Christensen & Sanders, 1987; Fletcher, 1975; Friman & Leibowitz, 1990) and the associated habit disorders that accompany digit sucking (Friman, Finney, & Christopherson, 1984; Friman & Hove, 1987). Physicians have been interested in the ingestion of poisonous substances by children who are thumb or finger suckers (Turbeville & Fearnow, 1976). Digital malformation is yet another area of study related to oral habits (Campbell-Reid & Price, 1984).

In the speech-language literature, researchers reported the presence of negative oral habits as behaviors associated with lisping, tongue thrusting, and anterior open bite malocclusion. Straub (1960), Fletcher, Casteel, and Bradley (1961), and Hanson & Barrett (1988) have reported the association of anterior open-bite malocclusions with frontal lisping and tongue thrusting. Additionally, Hanson & Barrett reported that some subjects with negative oral habits exhibited open-bite malocclusions. These studies have mentioned the presence of negative oral habits but focused on the association of abnormal swallow patterns, lisping, and dental differences. However, another general conclusion from these studies was that low forward tongue posturing was related to the lack of retroflexing of the tongue for swallowing and for speech.

Reports from practicing clinicians often indicate that children who exhibit /s, z/ misarticulations are thumbsuckers. It is reasonable to assume that the anterior tongue movement patterns associated with digit sucking may

influence or relate to the tongue placement for sibilant sound production and other lingual activities.

The current study assessed a variety of myofunctional factors in a typical public school group of 8 year old children. Some of the variables studied were oral habits, acoustic and placement differences for the sibilants /s, z/, and labial and lingual rest and swallow patterns. The purpose of the research presented in this paper was to determine if the children with an oral habit of thumb or finger sucking differed in acoustic or placement patterns for /s, z/ or in labial or lingual postures for rest and swallow activities. It was predicted that children who had thumbsucking habits would have a high rate of acoustic and placement articulatory differences for /s, z/ as well as low forward tongue postures for rest and swallow.

METHODS

Subjects

Subjects were 371 first and second grade children attending three public school systems in rural communities. One hundred ninety-seven of the children were males, 174 were females, 211 were African-American, and 160 were Caucasian. The mean age of the subjects was 7.75 (s.d. = .48, 5.7m).

This study was one component of a five year longitudinal investigation begun three years previously with a group of children who were in kindergarten. Most of the children were currently in the second grade while a few were first graders who had been retained in either kindergarten or first grade. At the beginning of the study, all children enrolled in the kindergarten program received information and parental consent forms. All of those children for whom parental permission was obtained were included in the study with the exception of children who had significant neuromotor dysfunction or hearing problems.

Measures

Morphological and physiological measurements of the dentofacial structures were obtained. Examples of these measurements included: maxillary arch width, rhinometry, open mouth posture, and rest, speech, and swallow patterns. Factors investigated in the current study were negative oral habits, acoustic and placement aspects of /s, z/, and labial and lingual rest and swallow postures. Dental occlusal pattern was not addressed because of the compounded factor of mixed dentition in many of the children.

Each subject was questioned regarding oral habits such as finger nail biting, thumbsucking, lip licking, and object biting. The oral habits were scored as present or absent depending on the child's response to the examiner's questions. Finger and thumbsucking were the only habits included in the current study and are referred to as thumbsucking throughout this manuscript.

The placement and acoustic aspects of the speech sounds /s, z/, which are typically considered lingual alveolar, were evaluated. The subjects' production of the sounds in word and sentence imitation tasks were scored as acoustically correct or incorrect. The lingual touch point or place of articulation was also determined from observations during the word imitation task. Utilizing clinician observation and subject report the tongue tip touch points for rest and swallow were determined. The touch points were noted as typical if lingual alveolar and upper lingual dental or atypical if interdental and lower lingual dental.

Procedures

The data on each subject were obtained by two certified speech-language pathologists experienced in craniofacial and myofunctional disorders. Each subject was individually evaluated for articulatory placement and production, labial and lingual rest and swallow postures, and oral habits.

Reliability

Reliability of assessment was obtained for

each measure. Twenty percent of the subjects experienced a second assessment approximately five minutes after receiving the initial evaluation. Pearson product moment correlations were computed on each pair of scores. Reliability coefficients were significant for all measures ($p < .01$). Correlations ranged from .54 - .95 with a mean of .75. Lower reliabilities were associated with those items for which subject report was required.

RESULTS

Subjects ranged in age from 6.7 to 9.3 years old. A 2 X 2 (Race X Gender) analysis of variance was performed using age as the dependent variable. No main effects or interacting effects relative to age were found.

Seventy-nine subjects (26%) were determined to be thumbsuckers, 32 males and 47 females (see Table 1). Pearson chi-square contingency tests revealed that significantly ($\chi^2 = 6.39, p < .05$) more girls than boys displayed this negative oral habit. Thumbsuckers did not differ by race.

Pearson chi-square contingency tests were also performed to examine the relationship between thumbsucking and tongue placement and acoustic errors for /s, z/. Analyses revealed

that relative to non-thumbsuckers, the thumb suckers made significantly more acoustic errors for /s/ ($\chi^2 = 13.85, p < .001$) and /z/ ($\chi^2 = 13.85, p < .001$). No significant differences were observed for tongue placement points for these sounds. Seventy-one percent of all subjects, both thumb suckers and non-thumbsuckers, exhibited a lower linguadental articulatory placement for /s, z/.

Youngsters exhibiting thumbsucking were also compared to non-thumb suckers for inappropriate tongue rest and swallow postures. Lingual alveolar and upper lingual dental postures were scored as typical while inter-dental and lower lingual dental postures were scored as atypical. Pearson chi-square contingency tests revealed that compared to non-thumb suckers, children who exhibited thumbsucking showed significantly more inappropriate postures during rest ($\chi^2 = 8.96, p < .003$) and swallow ($\chi^2 = 7.49, p < .006$).

DISCUSSION

Thumbsucking, rest and swallow tongue postures, and articulatory placement and acoustic errors for /s, z/ were measured in a large bi-racial sample of children with a mean age of 7.75 years. It was observed that compared to controls, thumb suckers exhibited significantly greater frequency of acoustic errors for /s, z/. Thumbsuckers also

TABLE 1
Thumbsuckers & Non-thumbsuckers
by race by gender. (Total N = 371)

	Thumbsuckers		Non-thumbsuckers	
	MALE	FEMALE	MALE	FEMALE
AFRICAN-AMERICAN	21	31	88	71
CAUCASIAN	11	16	77	56
TOTAL	32	47	165	127

displayed a significantly higher rate of inappropriate rest and swallow postures. Surprisingly, thumbsucking was more common among girls than boys.

Apparently, the muscle movement patterns associated with thumbsucking involve an intra-oral suction with downward pressure from the thumb co-occurring with anterior and inferior lingual movement. Based on the above findings, these patterns appear to promote an anterior rather than a retroflexed pattern for other tongue movement postures, notably those associated with rest and swallow postures. Viewed anatomically, it might be presumed that the intrinsic muscle involved in shortening the curling the tongue tip upward, the superior longitudinal, may be underutilized. Conversely, the muscles which flatten the tongue and curl the tip downward, the inferior longitudinal and vertical, are overutilized in this group. A study of the activity levels of these muscle groups would be needed to investigate this premise.

The correlation between thumbsucking and /s, z/ errors could have clinical implications for this age group. Clinicians who are involved in intervention programs for /s, z/ errors should make observations and ask questions about digit habits to ascertain if they exist. Intervention goals might then be established to target reduction of the oral habits as well. Clinicians wishing to initiate these habit reduction programs should review appropriate methods as suggested in the behavioral literature on thumbsucking (Clowes-Hollins & King, 1982; Friman, 1988; Friman, 1990; Friman, Barone, & Christopherson, 1986; Friman & Liebowitz, 1990; Hanson & Barrett, 1988; Lichstein & Kackmarik, 1980; MacKenzie, 1987; VanNorman, 1985).

Additionally, open mouth posture and interdental or lower lingual dental rest postures should be targeted for remediation. The significant relationships that exist would suggest that habit reduction for thumb or digit sucking and establishment of appropriate rest patterns might positively influence remediation programs

addressing /s, z/ errors. Further research is needed to determine the appropriateness of therapy for swallowing patterns for this age population. Current methods for effective oral myofunctional therapy are discussed in a number of recent publications (Hanson & Barrett, 1988; Mason, 1988).

A predicted relationship between /s, z/ placement and thumbsucking did not occur. This may be attributed to the significant number of children exhibiting lower lingual dental placement for these phonemes. In the current study, 71.1% of the subjects, both thumbsuckers and non-thumbsuckers, produced tongue-down /s, z/. This was consistent with the findings from a group of eight-year-old subjects during a pilot study (Hale, Kellum, Gross, Richardson, & Sisakun, 1992) which indicated that 84.3% of subjects used an inferior tongue placement for these phonemes. This factor will be assessed in the following years of the longitudinal study to determine if, and when, /s, z/ are produced with lingual alveolar placement or tongue tip retroflex by the majority of the children.

Additional research would be warranted to determine if these habit patterns have a maintaining role in misarticulations of /s/ and /z/ and if early habit reduction might have a preventive effect on the occurrence of /s/ and /z/ errors. In older children where permanent dentition is present, the relationship between dental occlusal patterns, particularly the open bite, and the placement and acoustic aspects of /s, z/ should be investigated. Further study might also focus on the possible long term effects of the habit pattern on dentofacial or speech development relative to gender differences.

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