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A Follow-up Study of a Longitudinal Research on Malocclusions and Tongue Thrust

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Incidence. Literature concerning the incidence of tongue thrust in children generally agrees that a decrease in incidence accompanies an increase in age. Fletcher, Casteel, and Bradley (1961) examined 1600 school children ranging from six to 18 years of age, and found some forty-one per cent to be swallowing improperly, with a marked decrease in incidence among the older children. At six years, the incidence was 52.3%; at eight, 38.5%; at 16, 20.0%; and at 18, 21.0%.

Werlich (1963) found an incidence of 30.4% in a group of 640 children. Incidence by age was: 6.6 years, 37.3%; 11.5 years, 27.6%; and 17.4 years, 26.4%.

Hanson and Cohen (1973) studied a group of 178 children for a period of four years and found a similar pattern of declining incidence. Percentages were: four years, nine months, 57.9%; five years, eight months, 43.8%; six years, seven months, 51.7%; and eight years, two months, 35.4%. This was the only longitudinal study of the three. No previous longitudinal study has examined the incidence of tongue thrust during the period between the mixed dentition stage and the onset of adolescence.

Malocclusion and tongue thrust. The relationship between malocclusion and tongue thrust continues to be a very controversial issue. A number of studies have found a strong relationship. In Werlich's study (1963), among those children with Class II, Division 1 malocclusions, 50.7% were thrusters. The lowest incidence of tongue thrust was found in the oldest groups of students with Class I malocclusions. In this group only 18.2% were tongue thrusting. The highest incidence was in subjects with open bite, where 98.5% were tongue thrusters.

Rogers (1961) compared a group of tongue thrust patients with a group of children from the public schools, some of whom had orthodontic problems, and some of whom had normal occlusion. He found that 56.9 percent of the normal population group and 62.8 percent of his own patients were tongue thrusting. Incidence of tongue thrust was high among subjects with deep overbite (79.7 and 62.8 percent in the two respective

groups). Subjects with open bites demonstrated a great tendency to tongue thrust. Ninety-eight and two-tenths percent from the normal population, and 92.8 percent of the orthodontic patients with open bite demonstrated tongue thrust.

Milne and Cleall (1970) found evidence that tongue thrust can be a transitory phenomenon. They studied 10 males and 12 females with a mean age of six years, eight months. All subjects had a Class I occlusion and normal swallows. Changes in tongue posture and function of structures were studied cinefluorographically. This was a longitudinal study, and the subjects were studied in three phases. In Phase I, the maxillary deciduous centrals were still present; in Phase II, no maxillary centrals were present, eight deciduous or permanent; in Phase III, the permanent incisors were fully erupted. There was a tendency for a forward positioning of the tongue in Phase II, but the tendency was not statistically significant. The tongue tip was positioned forward in Phase II, but posteriorly again in Phase III. This difference was significant at the .01 level.

The occluding of the molars during swallowing was found in progressively more subjects throughout the phases of the research. In Phase I, nine of 22 occluded their molars; in Phase II, 13 of 22 occluded the molars; and in Phase III, 15 of the subjects occluded the molars during swallows.

Milne and Cleall (1970) interpreted these findings as indicating that the prevalence of tongue thrust may be a normal, but transient occurrence during this developmental period. Those subjects who postured the tongue forward when the maxillary deciduous central incisors were lost, returned to their original pattern of swallowing with the eruption of the permanent incisors.

The Milne and Cleall study (1970), of course, provides information only about those children whose occlusion was normal and whose swallowing patterns were normal before the deciduous teeth were lost. It does not shed light on the larger number of tongue thrusters found in the mixed dentition stages who, according to several incidence studies, were tongue thrusters prior to that period.

Proffitt (1972) calls attention to the stable position of the teeth most of the time in most people as evidence for some kind of equilibrium. Tooth movement which occurs when additional forces are exerted is evidence that the equilibrium can be upset. He cites evidence, however, that transducer studies have consistently found maximum lingual pressures to outweigh labial pressures in subjects with normal occlusion.

For a more complete treatment of tongue thrust and malocclusion, the reader is referred to Barrett and Hanson's *Oral Myofunctional Disorders* (1974).

Unstandardized definitions of tongue thrust make it difficult for incidence studies to completely agree with one another. Yet there is enough basic agreement among the three studies cited above to indicate that a number of researchers are probably identifying the same behavior with the same name, "tongue thrust." Certainly more data are needed regarding incidence of tongue thrust in older children. In addition, no one who has surveyed the literature on relationships between malocclusions and tongue thrust would disagree that a controversy exists in this area.

Purpose. In 1966, Marvin Hanson and associates randomly selected 225 children ranging in age from four-and one-half to five years, to participate in a longitudinal study of swallowing. The purpose of that study was to investigate relationships between the teeth and swallowing during the mixed dentition period. Each subject was evaluated annually for five years. At the end of the study, 178 subjects remained. The subjects were

individually evaluated by one of three speech pathologists for the presence or absence of tongue thrust during the swallow of liquids, solids, and saliva. Each year, a dental impression was taken by an orthodontist and a model was prepared of the maxillary and mandibular dental arches of each subject. The models were measured and malocclusions were classified in terms of overbite, overjet, open bite, underbite, and corssbite.

The purpose of the present investigation was two-fold: 1) To determine the incidence of tongue thrust and of malocclusion in a group of twelve-year old children who were subjects in the earlier longitudinal study; and 2) to examine relationships between malocclusion and the retention or loss of the tongue thrust pattern, and between degree of malocclusion and persistence of tongue thrust.

Subjects. An attempt was made to contact all the subjects from the longitudinal study completed four years earlier. Of the 178 subjects, 92 were willing to participate in the present study.

Each subject was asked whether or not he had had tongue thrust therapy and whether or not he had received treatment by an orthodontist for any malocclusion between the end of the initial study and the time of the examination. Tonsils were examined and subjectively judged as to their size. Tonsils were classified into four groups – Absent, Small, Medium, and Large.

The subject was then tested as to the presence or absence of tongue thrust in the swallow of solids, liquids, and saliva. Sugar wafers were used to test the swallow of solids. The tester spread the lips of the subject to view the position of the tongue at the moment of swallowing. This procedure was repeated until the tester was certain of his judgment. The subject was then instructed to take a sip of the water in his mouth and hold it until the command was given to swallow. The lips were separated by the tester on the command and a judgment was made. The subject was then asked to gather saliva in his mouth and to swallow on command. The lips were again spread by the tester and a judgment was made.

The swallows were judged and classified into four categories; 1) a "0" rating was given to those swallows in which the tongue contacted no anterior teeth (canines, lateral and central incisors) during the swallow. 2) A "1-" rating was given to those swallows in which the tongue contacted the anterior teeth during the swallow, but in the judgment of the tester, did not exert pressure against those teeth. 3) A "1+" rating was given to those swallows in which the tongue exerted a visible pressure against the anterior teeth but did not extend past their cutting edges during the swallow. 4) A "2" rating was given to those swallows in which the tongue protruded past the cutting edges of the anterior teeth during swallowing.

Each subject was then classified into one of the four rating groups on the basis of the swallows of the three media. When two of the three types of swallows were rated the same, the subject received that rating. If the three swallows were all rated differently, the subject was classified according to the middle rating. For this study, all subjects classified with either a "0" or a "1-" rating were considered "normal" swallowers. Those with either a "1+" or a "2" rating were considered tongue thrusters.

Twenty six of the subjects were tested by both clinicians to determine rater reliability. One clinician spread the lips of the subject and both observed the same swallows and recorded their judgments independently. Later, a comparison was made of the judgments. The raters were in complete agreement on 22 of the 26 (84.6%) subjects

tested. On three of the subjects, a "1+" rating was given by one of the judges and a "2" rating was given by the other. One of the subjects was given a "1-" rating by one of the judges and a "0" rating by the other. Therefore, there was 100% agreement on whether or not the subject was a tongue thruster.

An impression was made of the upper and lower dental arches of each subject, except those subjects who, at the time of examination, were wearing bands on their teeth. A plaster of paris model was then made of each set of impressions. On those subjects for which no models were taken, direct measurements of overjet and open-bite were taken at the time of examination.

The dental models were measured for the presence of overjet and open-bite. The upper and lower models were occluded by means of a wax impression of the subject's bite at the time of examination. Measurement of the overjet was obtained by taking the mean of the difference, in millimeters, between the two greatest distances between the most anterior lingual points on the maxillary central or lateral incisors and the two corresponding points, along the occlusal plane, or the buccal surface of the mandibular incisors. A malocclusion was classified to an overjet if the mean of the two points exceeded 2.0 mm. Open-bite was determined by measurement of the distance between the maxillary central or lateral incisors and the mandibular central or lateral incisors during molar occlusion. The malocclusion was considered an open-bite if the mean of the two closest points (measured vertically) was 0.5 mm. or more.

Statistical Procedures. Using a Chi Square formula for two independent groups the following relationships were tested for significance:

1) tonsil size and persistence of tongue thrust
2) total malocclusions at 12 years and the persistence of tongue thrust
3) number of tongue thrusters in the normal occlusion group and number of thrusters in the malocclusion group
4) number of thrusters in cases with open bite only and number of thrusters in the normal occlusion group
5) number of thrusters in cases with overjet only and number of thrusters in the normal occlusion group
6) degree of malocclusion in 12-year-olds and the persistence of tongue thrust
7) degree of malocclusion in 12-year-olds with open bite only and the persistence of tongue thrust
8) degree of malocclusion in 12-year-olds of overjet only and the persistence of tongue thrust
9) degree of malocclusion in eight-year-olds and the persistence of tongue thrust
10) degree of malocclusion in eight-year-olds with open bite only and the persistence of tongue thrust
11) degree of malocclusion in eight-year-olds with overjet only and the persistence of tongue thrust.

RESULTS

Incidence of tongue thrust. Thirty-one of the 92 subjects (33.7%) were tongue thrusting at eight years of age. Four years later, 22 of the 31 were still tongue thrusting,

but an additional 23 who had swallowed normally (not *protruding* the tongue between the upper and lower teeth) at eight years were now tongue thrusting. Hence, a total of 45 of the 92 twelve-year-olds (48.9%) were manifesting a definite tongue thrust. This represented an increase of 15.2% in incidence among the twelve-year-olds.

Incidence of malocclusion. Eleven of the 92 had received, or were receiving, orthodontic treatment. Another child had had his maxillary centrals knocked out in an accident; they had been replaced by a partial plate. These twelve were taken out of the study.

Of the eleven who had received orthodontic treatment, eight were presently wearing bands; one had worn bands for one year; one was now wearing a retainer; and one had worn a retainer (no bands) for one year.

It is interesting that all nine who had had bands on their teeth had had an overjet at eight-years (mean: 2.4 mm., range 1.5 to 3.0 mm.), but only two of them were diagnosed as tongue thrusters at that time. However, four years later, five of the nine were tongue thrusters. None had received therapy for tongue thrust.

An additional 45 subjects had malocclusions, according to our definition. Since the research sought to investigate relationships between malocclusions and tongue thrust, occlusal measurements of those patients who had received orthodontic care were not taken. The following results pertian only to the 80 who received no orthodontic care. The incidence of malocclusion, however, in the total group was 58 in 92 (63.0%).

The following are malocclusion data on the 80 subjects at the ages of eight and twelve years:

Occlusion	**at eight years**	**at 12 years**
combined overjet and openbite	6	1
overjet only	31	38
openbite only	5	5
anterior crossbite	1	1
end on occlusion	1	1
totals	44	46

When individuals, rather than numbers, are considered, the following data emerge:
Number of subjects with:

1) malocclusion at eight-years, normal occlusion at 12-years: 12.
2) malocclusion at eight-years, improved occlusion at 12-years: 17.
3) malocclusion at eight-years, more severe malocclusion at 12-years: 12.
4) malocclusion at eight-years, no change at 12-years: 4.
5) normal occlusion at eight-years, normal at 12-years: 23.
6) normal occlusion at eight-years, malocclusion at 12-years: 12.

During the four-year period, occlusion improved in 29 of 45 children who had had malocclusion at eight-years. Only 12 of the 45 (26.7%) had normal occlusion at 12-years. A total of 24 children had poorer occlusion at 12-years than at eight, including eight whose occlusion at eight-years had been normal.

Examining modifications in specific types of malocclusions, we find the following:

Of the 80 patients, 32 had an overjet without open bite at eight-years of age, and 38 at 12-years. Extent of overjet increased in ten subjects and decreased in eight, over the

four-year period. Four subjects retained the same degree of overjet. Ten subjects progressed from having an overjet at eight-years to normal occlusion at 12. Ten whose occlusion was normal at eight-years developed overjets by the age of 12. Six of the overjets at 12 had open bites at age eight. In only ten of 80 subjects did the overjet correct spontaneously between the ages of eight and 12.

During the four-year period, all four children who had open bite at eight-years showed a decrease in severity of that malocclusion:

One's decreased from 1.5 mm. to 0.5 mm.

One's decreased from 4.0 mm. to 2.0 mm. but an anterior crossbite developed.

One's changed from a 1.5 mm. open bite to an end-on occlusion.

Of the group of seven subjects with combined openbites and overjet at eight-years, at 12-years:

Both overjet and open bites were reduced in three subjects.

Both overjet and open bites were increased in one subject.

Both remained the same in one.

Open bites reduced and overjet increased in two subjects.

Results of statistical analyses. None of the relationships tested was found to be significant at the .05 level.

DISCUSSION

Incidence. We were surprised to find an increase in incidence at 12-years of age. We found that 23 of the 80 subjects who had received no orthodontic treatment manifested incomplete eruption, or absence, of one of both maxillary canines. Twenty-one of these children protruded the tongue into these spaces, which would soon be filled with fully-erupted teeth. According to our definition, we had to diagnose these subjects as tongue thrusters.

Ten of the 21 had otherwise normal occlusions. If we were to assume these ten were "transitional thrusters," in essential agreement with Milne and Cleall, and withdraw them from the data tabulations, the results on the remaining 70 subjects would be:

Number of subjects with normal occlusion and tongue thrust: 13.
Number of subjects with normal occlusion and normal swallows: 13.
Number of subjects with malocclusions and tongue thrust: 29.
Number of subjects with malocclusions and normal swallows: 15.

Nearly twice as many tongue thrusters as normal swallowers would then have been found among subjects with malocclusions. Viewed in another way, excluding the "transitional thrusters" with normal occlusion, 65.9% of the children with malocclusions were tongue thrusters.

We are not satisfied with our definition of tongue thrust. A much more objective definition, specific to the medium being swallowed, the number of teeth receiving lingual pressure, the amount of pressure being exerted, and the nature and force of lingual resting postures, would be preferable to our subjective definition. Our present knowledge, though, does not provide us with a sound basis for determining tongue thrust with pressure measures.

Those orthodontists who prefer to postpone myofunctional therapy until adolescence, expecting spontaneous improvements in occlusion and swallowing, are likely to be disappointed in both areas, according to the results of the present research. The

number of subjects with tongue thrust increased by nearly half (from 31 at eight-years to 45 at 12-years). The incidence of malocclusion remained about the same over the four-year period (44 at eight-years, 46 at 12-years). There are no longitudinal studies, to our knowledge, that follow swallowing and malocclusion beyond the age of 12. Possibly by the age of 14, the transitional period will have terminated, but then again perhaps not until much later.

One of the findings of interest to us was that, of the six eight-year-olds who had combined overjet and open bite, only one retained this type of malocclusion at 12-years. We determined that this decrease in incidence was due to minor shifts in occlusion. When we combined subjects with combined overjet and open bite with subjects with overjet alone we found a total of 37 who had overjets at eight-years and 39 with overjets at 12-years.

Another observation was that the two patients, one of whom had an end-on occlusion and the other an anterior crossbite at 12-years, were not the same subjects who had manifested these malocclusions at eight-years.

Malocclusion and tongue thrust. We had anticipated finding statistically significant relationships between malocclusion and tongue thrust. No such relationships were found. This finding disagrees with the studies of Werlich (1963) and Rogers (1961), as well as with the clinical experience of countless orthodontists. There are many possible explanations and implications.

1) It is possible that there is no significant relationship between the presence, or retention, of malocclusion and the existence of tongue thrust.
2) Tongue thrust may exist in people with normal occlusions as well as in those with malocclusions. If so:
   a) Tongue thrust is not always the result of malocclusions, nor will it always be eliminated when the occlusion is corrected orthodontically.
   b) Other factors, such as bone density and/or thickness; ratio of lingual to buccal pressure; maxillary arch circumference, width, and depth; tongue size; whether the teeth occlude in the resting state; whether there is good centric occlusion; tone of the circumoral muscles; and number of missing teeth, may be important determinants of the effect of the tongue thrust upon the dentition.
3) The very difficult-to-measure factor of lingual resting position may make the difference between normal and abnormal occlusion.
4) In this study, the incidence of tongue thrust was high in spite of rigid requirements set for the diagnosis of tongue thrust. The great number of patients with missing or partially erupted cuspids, and accompanying tongue thrust limited to openings eventually to be filled by these teeth raises the possibility that statistical results were heavily influenced by transitory thrusting patterns.

When we looked at occlusion data on the ten subjects with the most severe overjets, we found that eight were tongue thrusters. The range of overjets on these ten was from 4.5 mm. to 7.5 mm., with a mean of 5.5 mm. The two who swallowed normally had overjets of 4.5 mm. and 5.0 mm.

The findings underscore the importance of rising to ASHA's challenge for more and better research. We really need to know more about the basic nature and effects of this disorder. In the meantime, it would be well to be conservative in our conversations with

referring agents, parents, and patients concerning cause-and-effect relationships between oral myofunctional disorders and malocclusions. Complete, accurate clinical records could contribute greatly to the body of information the IAOM is striving to collect.

SUMMARY

Ninety-two twelve-year-old subjects were examined for type of swallow and types and degrees of malocclusions. All were subjects who had been chosen at random eight years previously to participate in a longitudinal study of swallowing. Four years had lapsed since the children had been evaluated. Purposes were: 1) To determine incidence of tongue thrust, and 2) To examine relationships between malocclusion and tongue thrust.

The incidence of tongue thrust was found to be 48.9%. This was considerably higher than had been expected. It is probable that ten of the 45 with a tongue thrust were transitional thrusters. If these ten are excluded, the incidence would be 38.9%.

A chi square formula was used to determine possible relationships between various types and degrees of malocclusions and manner of swallowing. No significant relationships were found. However, all but one of the subjects with overjets of 5 mm. or more were tongue thrusters.

RECOMMENDATIONS

The need for more basic research is apparent. We do not know the relative effects of tongue and lip resting pressures on occlusion. Information is lacking about differentiating characteristics of the transitional and "permanent" tongue thruster. Longitudinal studies are needed to examine in depth patients who experience orthodontic relapse. Perhaps our attention to tongue thrust is obscuring other more important contributors to relapse. Well-controlled research comparing matched groups on the basis of time required to achieve corrected occlusion and permanence of corrected occlusion would help determine the validity or efficacy of oral myotherapy in preventing such relapse.

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