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Marvin L. Hanson
Mary V. Andrianopoulos

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TONGUE THRUST, OCCLUSION and DENTAL HEALTH IN MIDDLE-AGED SUBJECTS: A PILOT STUDY

Marvin L. Hanson, Ph.D. and Mary V. Andrianopoulos, R.D.H., M.S.

Marvin Hanson is chairperson of the Department of Communication Disorders, University of Utah, where Ms. Andrianopoulos is a doctoral candidate in speech pathology.

Introduction

A reasonable assumption for study would seem to be that all factors that contribute to intra-oral health are interrelated. These would include:

I. The teeth
   A. Inter-arch relationships (occlusion)
   B. Intra-arch factors
      1. Diastemas
      2. Health of the teeth
         a. Number of caries
         b. Number of restorations
II. Supportive structures
   A. The gingiva
   B. The periodontium
   C. The bones (mandible and maxillae)
III. Muscular forces from cheeks, tongue and lips

Any deficiencies or abnormalities in these factors, or in their interrelationships, should be apparent by middle-age. If, for example, malocclusions exert abnormal pressures upon certain teeth, or malocclusions preclude certain teeth from receiving necessary pressures from opposing teeth, and these deviations from normal result in periodontal disease, this should be apparent in a study of large numbers of middle-aged people. The general purpose of this pilot study was to carry out a preliminary investigation into interrelationship among all these variables in middle-aged persons.

Statement of the Problem

Children and adults get their teeth straightened for cosmetic reasons and/or to ensure better dental health. Three claims related to orthodontic treatments appear in the literature: (1) Malocclusion eventually results in poor periodontal health. (2) Orthodontic correction of malocclusion helps ensure better periodontal health. (3) Tongue thrust may contribute to malocclusions.

There is inadequate evidence in the literature to support any of the three claims. This is partly because it is extremely difficult to do controlled research on cause and effect relationships in human beings when treatment of any kind is involved. Studies that produce results showing unmistakably strong interrelationships among factors usually fall short of proving one factor *causes* a variation in another. Some presumptions have to be made involving varying degrees of certainty.

The most valid evidence of cause and effect relationship would come from a longitudinal study, beginning with a thorough examination of the nature and function of the oral structures in children with primary dentition. Subjects would then be studied periodically through middle-age and even old age. Various methodologies of treatment, and withholding of treatment, would be systematically applied to selected experimental and control subjects. The implausibilities of such research are obvious.

Short term studies involving the same variables present some ethical problems, along with some presumptions. It is difficult ethically to defend the practice of withholding treatment from control subjects. A study finding that malocclusions in patients exhibiting tongue thrusting behavior can be successfully treated without providing therapy for the tongue thrust would be limited in its conclusions only to the period of time covered by the research. In most cases it does not exceed post-mechanical retention time.

Two studies examined subjects several years after orthodontic treatment. Uhde (1981) found unacceptable occlusion in 49.2% of orthodontically treated patients examined 12 years after the completion of treatment. Examination of these subjects immediately following removal of braces or retainers would probably have found acceptable occlusion at nearly all articulation points. Andrianopoulos and Hanson (1987) found significantly less orthodontic relapse in patients seen an average of 7.4 years post-retention who had received therapy for tongue thrust.

Another approach to research is to examine subjects selected at random without regard to dental histories for evidences of interrelationships among variables. This approach is also fraught with shortcomings, but it is the approach we are using in this study. Shortcomings include: (1) Large numbers of subjects chosen randomly do not manifest the conditions needing study, i.e., relatively few have malocclusions, and (2) Case history information is not always reliable.

Specific research questions posed in the present study are:

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1. In a group of 24 subjects, ages 35-52, are malocclusions significantly related to: (a) dental health? (b) periodontal health?
2. In the same subjects, is tongue thrust significantly related to: (a) dental health? (b) periodontal health?

Review of the Literature

Statements from the textbooks. A number of interrelationships between occlusion and periodontal health are described in dental textbooks:

1. Malocclusions may cause periodontal problems.
2. Orthodontic treatment of malocclusions may cause periodontal problems.
3. Occlusal trauma leading to periodontal problems may occur when occlusion is normal.
4. Insufficient occlusal force may cause periodontal problems.
5. Orthodontic treatment often must accompany periodontal treatment.

Representative statements found in Glickman (1972) and in Carranza (1979), for each of these contentions follow.

1. Malocclusions may cause periodontal problems. Glickman states, "The occlusion of the youngster casts the die for the condition of the periodontium in the adult" (p.472). He advocates early orthodontic treatment to arrest or prevent the progress of gingival and periodontal disorders. "Occlusion is the lifeline of the periodontium..." (p. 329). "Occlusion is the sustaining force of the periodontal tissues. Periodontal tissues depend upon normal functioning activities of the teeth for their health. Without sufficient functional stimulation, periodontal tissues atrophy" (p. 329).

"Trauma from occlusion may be acute or chronic." Glickman explains, "Acute trauma results from the placement of appliances that affect occlusion. Chronic trauma is more common; it develops from changes in occlusion produced to tooth wear, drifting of teeth, and extrusion of teeth, combined with aversive oral habits" (p. 331).

Glickman describes three stages of trauma from occlusion. First, injury; second, repair; and third, a change in the morphology of the periodontium. Injury can occur from only slightly excessive pressure or tension affecting the periodontal ligaments. Reparative processes occur constantly in the normal periodontium. Damaged tissues are removed and new connective tissue and bone are formed in an attempt to restore the injured periodontium. If destructive forces outpace reparative ones, the periodontium is remodeled in an attempt to defend against the injurious forces. The periodontal ligament becomes thickened and defects in the bones then result. "Occlusion is the constant monitor of the condition of the periodontium. It affects the response of the periodontium to inflammation and becomes a factor in all cases of periodontal disease" (p. 335).

Carranza attributes developing malocclusions to muscle activities of chewing, swallowing, and speech. These forces are transmitted through the teeth to the periodontium. "Tooth position and arch form are not static; they are maintained by the balance among the various forces of occlusion. Disturbance of this balance may lead to altered tooth positions and changes in functional environment that may be injurious to the periodontium" (p. 460). Carranza attributes much of the displacement of teeth to the forces of mastication, which tend to "displace the maxillary teeth facially and mandibular teeth lingually, and all the teeth mesially" (p. 460).

2. Orthodontic treatment of malocclusions may cause periodontal problems. Glickman states that orthodontic treatment may move teeth into functionally acceptable positions. However, he outlines four potential contributors to periodontal problems.

a. Patients who do not strictly follow oral hygiene instructions may retain food particles and plaque as they wear their orthodontic appliances.
b. When orthodontic bands extend into the gingival tissues they may force a detachment of the gingiva from the tooth, resulting in increased gingival recession.
c. Periodontal tissues may respond to externally applied forces by developing vascular changes that affect bone resorption and formation patterns.
d. If excessive force is applied and teeth are moved too rapidly, necrosis of the periodontal ligament and adjacent alveolar bone may occur.

Glickman also warns of possible harm done by retainers. "Hawley appliances should not be used as permanent retainers in orthodontically treated patients; they are periodontally contraindicated" (p. 964). Nighttime wearing of the retainer, he states, results in injury to the periodontium and loosening of the teeth. Daytime pressures exert force in one direction and nighttime pressures in the other. This interplay of pressures loosens the teeth. After the retainer's use is discontinued, the teeth may drift into unsatisfactory occlusal positions.

3. Occlusal trauma leading to periodontal problems may occur when occlusion is normal. "The dentition may be anatomically and aesthetically acceptable, but functionally injurious" (Glickman, p. 339). This is particularly true when the periodontium has a reduced capacity for withstanding occlusal forces.

4. Insufficient occlusal force may cause periodontal problems. "Insufficient stimulation causes degeneration of the periodontium manifested by thinning of the periodontal ligament, atrophy of the fibers, osteoporosis of the alveolar bone and reduction in bone height. Hypofunction results from an open bite relationship, absence of functional antagonist, or unilateral chewing habits that neglect one side of the mouth" (Glickman, p. 334). The detergent effects of some foods are also reduced in teeth that are not used regularly.

5. Orthodontic treatment often must accompany periodontal treatment. Orthodontic treatment is accomplished in many cases with the use of a Hawley retainer. Its purpose is to restore satisfactory functional relationships among the teeth.

The recommended procedure is to eliminate gingival and periodontal disease before introducing the appliance.

Journal Reports

Research articles address three questions:

1. What are the effects of orthodontic treatment on the periodontium?
2. Do malocclusions cause periodontal problems?
3. Does tongue thrust contribute to malocclusion?

What are the effects of orthodontic treatment on the periodontium? Considerable research reports that orthodontic treatment harms the dentition.

Polson and Reed (1984) reviewed nine studies of the possible detrimental effects of orthodontic treatment on crestal alveolar bone height, and found that six of the nine studies reported harmful effects. They cautioned, though, that all nine studies were relatively short-term investigations, the longest post-orthodontic observations occurring two years following treatment. They found only one study done ten years after orthodontic treatment.

Polson and Reed examined 180 subjects, 104 of whom had completed orthodontic treatment at least 10 years previously (mean 13 years). Age range was 21 to 36 years; mean age was 28.9 years. The other groups, matched for age, sex, socioeconomic status, and malocclusion class consisted of 76 subjects. The researchers found no significant difference between crestal alveolar bone levels of the two groups. It was concluded that harmful effects of orthodontic treatment may well be temporary in nature.

Sjolien and Zachrisson (1973) studied the combined effects of root resorption and alveolar bone loss after orthodontic treatment. Their treatment group consisted of 59 persons, all of whom had completed orthodontic treatment two years prior to the study, and all of whom had had four first premolars extracted as part of the treatment for a Class II, Division 1 malocclusion. All had used a Hawley retainer following removal of bands. A group of 61 subjects, untreated orthodontically, were matched to the experimental group on the bases of age, sex, and socioeconomic status. Paired comparisons were made between corresponding teeth and bone surfaces in the two groups. Statistically significant between-group differences were found in both root resorption and alveolar bone loss. Untreated subjects had longer teeth and more bone support than the orthodontically treated subjects.

Trossello and Gianelly (1979) studied 30 females, 18 to 25 years of age, who had completed orthodontic treatment at least two years previously, with a matched group of 30 who had not received orthodontic therapy. These investigators did not interpret their findings statistically, but they concluded that between-group differences were generally small and few. They did find more than twice as many mucogingival problems in the control group as in the orthodontically treated patients. "The findings of the present study suggest that the effects of orthodontic treatment on the periodontium, are, for the most part, small. Some, such as the lower incidence of mucogingival defects and the larger amounts of interradicular bone, appear to be beneficial. Others, such as the higher incidence of tooth resorption, the tissue hyperplasia in the maxillary molar region, and the slight loss of alveolar bone noted in the orthodontically treated patients can be harmful."

Trossello and Gianelly commented on the relationship between alveolar bone loss and orthodontic treatment. The areas most affected periodontally were the extraction sites, principally between the canine and second premolar.

Three studies report either no unfavorable periodontal changes, or favorable ones, in orthodontically treated subjects.

1. Brown (1973) studied the effects of uprighting molars in five adult patients on existing periodontal osseous defects. Results were described clinically. All five patients experienced a definite reduction in plaque deposition and a noticeable improvement in position and form of the marginal gingiva. Tissue that had been hyperplastic and edematous became thin, pink and firm, characteristics of normal gingiva.

2. Reed, Polson, and Subtelny (1985) examined 12 persons at least ten years after orthodontic treatment, compared them with a control group of subjects with no history of orthodontic treatment, and found no differences between the groups in crestal alveolar bone levels. Bone height differences favoring the control group were attributed to the influence of root resorption rather than to crestal height. The authors concluded that orthodontic movement of teeth into extraction sites had had no harmful effect upon adjacent periodontal status.

3. Artun (1984) found that patients who wore bonded lingual retainers experienced no apparent damage to hard and soft tissues adjacent to the wire.

Do malocclusions cause periodontal problems? Three investigations found *no* significant positive relationships between malocclusions and the presence of periodontal problems.

1. Shefter and McFall (1984) evaluated 33 adult female and 33 adult male subjects, all of whom had at least 28 natural teeth and no history of occlusal adjustment. The distribution of malocclusions in these dental school patients was found to be consistent with other population samples in the literature. Eighty percent were Angle Class I; 9% had bilateral Class II; 5% had bilateral Class III; the other 6% had unilateral malocclusions in various combinations. Twenty-eight patients had parafunctional habits. The researchers concluded that the periodontium in the patients was only minimally affected, and that occlusal factors played only a minimal role in the development of periodontal disease. "It would seem prudent to minimize the role of occlusal dysharmonies in the initiation of inflammatory periodontal disturbances."

2. Geiger (1962) examined dental occlusion in 188 consecutive cases of periodontal disease. Most of the patients were in the 35 to 54 year age group. Only six had a history of orthodontic treatment. Patients were divided into three groups:

(1) Ideal normal occlusion without imperfections; (2) Individual normal occlusion with minor irregularities; (3) Malocclusions which were classified according to Angles's classifications.

Normal occlusions (groups I and II combined) were found in 13.3% of the subjects. Malocclusions were found in 86.7%. No statistically significant relationships were found between type of occlusion and severity of periodontal disease. Some trends were pointed out. For example, in the normal occlusion group there appeared to be a larger percentage of mild and a smaller percentage of severe periodontal cases than in the total sample. The Class II, Div. 1 Subdivision group demonstrated a trend toward a larger percentage of severe and a smaller percentage of mild periodontal cases than in the total sample.

3. Ditto and Hall (1954) studied 143 periodontal cases and concluded that Angle classification did not affect the percentage distribution of cases in periodontal classifications. They attributed much periodontal disease to crowding.

Does tongue thrust contribute to malocclusion? Several studies find interrelationships between tongue thrust and malocclusions, but few provide any basis for concluding whether one causes the other. Rogers (1961), Werlich (1962), Hanson and Cohen (1973), Mitani (1976), and Lowe and Johnston (1979) all found significant relationships between malocclusion and the presence of tongue thrust. Negri and Croce (1965), and Harvold and colleagues (1973, 1981) found that forced anterior tongue postures produced anterior malocclusions in rhesus monkeys. Andrianopoulos and Hanson (1987) found that patients with Class II, Division I malocclusions who received therapy for tongue thrust relapsed significantly less following orthodontic treatment than did those who received no therapy.

Summary of review of the literature. Interrelationships among the factors studied in this pilot project, i.e., periodontal health, dental occlusion, and tongue habits, have been found to be statistically significant in some studies and non-significant in others. The literature reports that some good and some harm may be done to the periodontium by orthodontic treatment. Little evidence is found to support the claim that malocclusions adversely affect periodontal or dental health. The role of the tongue in causing or preventing malocclusions and/or periodontal health has not been studied adequately. The most needed type of research are longitudinal, multidimensional investigations that follow large numbers of patients selected randomly through childhood and adulthood. The unlikeliness of such research occurring warrants the application of other types of research, such as that set forth in the present endeavor.

Methodology

Subjects. Twenty-four adult subjects were randomly selected from the University of Utah Telephone Directory on the basis of age and sex only. A total of 24 subjects, 12 females and 12 males, participated in the study. Ages of the subjects ranged from 35 years 6 months to 52 years with a mean of 43 years.

Subjects were contacted by telephone. Personal information, biographical and medical-dental data were unknown to the investigators when the subjects were selected. The nature of the research project was explained, testing procedures were described and subjects' participation was invited. Anonymity and confidentiality were assured by assigning numbers to the subjects. To avoid testing biases, minimal information regarding the nature of the research project was provided to the subjects. Subjects received a modest stipend for their participation.

Variables studied. The following variables were investigated in the study: Presence or absence of tongue thrust; Number of decayed surfaces; Number of missing teeth; Number of filled surfaces; Periodontal Disease Index; Radiographic evaluation of periodontium; Occlusion according to Angle's classification; Degree of overjet; Degree of overbite; Presence of an open bite.

Procedures

Subjects were individually evaluated during a two hour testing session. They completed a biographical, medical, and dental history (contact the first named author for a copy of these materials). They were interviewed to review the information in the questionnaires and to check for accuracy in interpretation. Subjects' current dental health was assessed by two dental residents at the University of Utah Medical Center Dental Clinic. Both dental residents had completed a five hour training session wherein instructions, testing procedures, and screening criteria were described. The dental evaluation consisted of two right and left bitewing x-rays, a Panorex, dental impressions for study models, a DMF survey, and periodontal evaluation.

Each subject's dentition was evaluated for anomalies. Subjects were examined for the presence or absence of any malocclusions. Persons exhibiting Class I molar relationships with overjets of less than 3 mm and with no other dental deviations were considered to have no malocclusion. Subjects with Class I, II, III, and mixed occlusions with 3 mm or greater overjets, open bites and/or other deviations were noted as having malocclusions. Following the dental evaluation, subjects proceeded to another examination room where a tongue thrust evaluation was performed. Three trained orofacial myologists independently evaluated each subject for the presence or absence of a tongue thrust swallow. Subjects were given a "O" score if no tongue thrust was observed, and a score of "1" if a tongue thrust was observed during swallows of each of three media: saliva, water, and a wafer.

Results

The research questions addressed in the present pilot study were: (1) In a group of 24 subjects, ages 35-52, are malocclusions significantly related to (a) dental health? (b) periodontal health? (2) In the same group of subjects, is tongue thrust significantly related to (a) dental health? (b) periodontal health?

Occlusion

Fourteen (58.3%) of the subjects had a Class I molar relationship; five (20.8%) exhibited a Class II molar relationship, and two (8.3%) had a Class III occlusion. Three subjects (12.5%) exhibited a mixed occlusal relationship; right and left molar relationships were not of the same classification.

Eighteen (75%) of the subjects exhibited malocclusions. Eight (45%) of the 18 had Class I, five (28%) Class II, and two (11%) Class III, and three (16%) had mixed occlusions. Four (22%) of the 18 with malocclusions had an anterior open bite. Fourteen (78%) had overjets of 3 mm or more.

Missing teeth. Subjects with malocclusions exhibited a mean of two missing teeth (S.D. = 2.7). The number of missing teeth ranged from 0 to 10 teeth for this group. Subjects with no malocclusion demonstrated a range of 0 to 17 missing teeth with a mean of four (S.D. = 6.6).

Teeth with restorations. The number of filled surfaces per subject was determined during the clinical examination. The number of restored surfaces for the subjects ranged from 0 to 63 restored surfaces with a mean of 28.8.

A group mean of 30 restored surfaces was found among the subjects with malocclusions (S.D. = 12). The number of restored surfaces for this group ranged from 11 to 63. Subjects with no malocclusions had 0 to 58 restored surfaces, with a mean of 26 restored surfaces (S.D. = 18). Differences between group means were not significant.

Untreated caries. The total number of decayed surfaces per subject was determined by a clinical examination and a radiographic evaluation. The number of untreated caries ranged from 0 to 5.7 surfaces. A mean of 1.3 decayed surfaces was found among all subjects. Twelve (67%) of the 18 subjects with malocclusions were found to have untreated caries. A mean of 1.6 surfaces were found to be decayed among the 18 subjects with malocclusions (S.D. = 2.1). The number of surfaces with caries ranged from 0 to 8 for this group. Subjects with no malocclusions had 0 to 5 surfaces with caries, with a mean of 2.3 (S.D. = 2.2). Differences between group means for untreated caries were not significant.

Occlusion and Periodontal Health

Periodontal disease. Scoring criteria outlined by Russell (1956) were used in evaluating each subject's gingival index. Gingival index scores ranged from a score of one (mild gingivitis), to a score of five (gingivitis with pocket formation). Eleven (45.8%) of the 24 subjects exhibited mild gingivitis (score of one), and another 11 (45.8%) exhibited gingivitis which completely circumscribed the tooth, but exhibited no apparent break in the epithelial attachment. Only two (8.4%) exhibited gingivitis with pocket formation. The mean gingival score was 1.7 among all subjects. The mean score for subjects with malocclusions was 1.6; for those with normal occlusion, 2.2. The difference between means was not statistically significant.

Radiographic evaluation. Radiographic criteria for determining periodontal health (Russell, 1956) ranged from a score of 0, a radiographic appearance essentially normal, to a score of six, a radiographic appearance depicting horizontal bone loss up to half of the length of the tooth root. Among all the subjects, the mean score was 2.17, depicting essentially normal radiographic appearance.

Radiographic evaluations of 12 (50%) of the subjects were essentially normal (score of 0). Ten (41.7%) subjects exhibited early, notch-like resorption of the alveolar crest (score of 4). Only two (8.3%) subjects exhibited horizontal bone loss (score of 6) involving the alveolar crest up to half of the root length. The variable, periodontal disease index, was highly correlated with the variable, Radiographic evaluation. (Spearman Correlation Coefficient = .59,$p < .002$).

Tests to determine mean differences between subjects with malocclusion and subjects without malocclusion were not statistically significant for the variables: missing teeth, restored surfaces, untreated caries, and periodontal health.

Tongue Thrust and Occlusion

Among the 24 subjects, nine (37.5%) exhibited a tongue thrust swallow pattern. A significant relationship between type of occlusion and presence of tongue thrust was found. Of the nine subjects who exhibited a tongue thrust swallow, only one (4.2%) had a Class I relationship. Four (20.8%) had a Class II relationship, one (4.2%) was a Class III and three (12.5%) subjects exhibited mixed occlusal relationships. Among the 15 subjects who did not tongue thrust, 13 (54%) exhibited Class I, 1 (4.2%), Class II, and 1 (4.2%), Class III. A significantly greater number of subjects with Class I were non-tongue thrusters. A significantly greater number of subjects with Class II were tongue thrusters. Collectively, a significantly greater number of persons with malocclusions, based on the Angle classification system, were tongue thrusting ($X = 14.44, p < .002, \phi = .61$).

In addition to molar occlusal relationships, anterior malocclusions (open bite and overjet) were measured. Among the nine subjects found to tongue thrust, the degree of overjet ranged from 1 mm to 9 mm, with a mean overjet of 3.9 mm. The degree of overjet for the 15 subjects who did not tongue thrust ranged from 2 mm to 4 mm, with a mean of 2.7 mm. The difference between means was not significant statistically. Among the five subjects (29.8%) with open bites, four (16.7%) were tongue thrusters. The two variables, tongue thrusting and presence of an open bite, were found to be significantly related ($X = 4.85, p < .05, \phi = .45$).

The central tendency, range, standard deviation and standard error of measurement per group for each of the variables are shown in Table 1 on page 12.

Although mean differences between the tongue thrust group and the non-tongue thrust group were noted, differences between the two independent groups were not statistically significant at the .05% level for any of these variables. In addition, subjects with tongue thrust swallows did not differ markedly with regard to periodontal health.

TABLE 1

COMPARISON BETWEEN TONGUE THRUSTERS AND NON-TONGUE THRUSTERS WITH VARIABLES: MISSING TEETH, DECAYED SURFACES AND FILLED TEETH.

Variables =	Tongue Thrust	No Tongue Thrust
Number of Missing Teeth		
Mean =	3 teeth	2 teeth
Range	0-10 teeth	0-17 teeth
Standard deviation	3.54	4.35
Standard error between groups = 1.71 independent samples		
Numbers of Decayed Surfaces		
Mean =	1.1 surfaces	2.24 surfaces
Range	0-5 surfaces	0-8 surfaces
Standard deviation	1.67	2.27
Standard error between groups = .87 independent samples		
Percent Filled Surfaces		
Mean =	33%	26%
Range	16-63%	0-58%
Standard deviation	14.70	18
Standard error between groups = 5.75 independent samples		

Multiple regression analysis procedures were used to determine the magnitude of direct and indirect influence that each variable had on the variable "tongue thrust". The variables which most represented a presumed causal influence of a tongue thrust swallow were the presence of an open bite, and the number of filled surfaces ($F = 3.47$, df: 2, 21, $p < .05$).

CONCLUSIONS:

1. No significant relationships were found in this pilot group between dental occlusion or malocclusion, and dental or periodontal health.
2. No significant relationships were found between presence or absence of tongue thrust, and dental or periodontal health.
3. A significantly greater percentage of persons with Class I occlusion had no tongue thrust than those who had tongue thrust.
4. A significantly greater percentage of persons with Class II occlusion had tongue thrust than those with no tongue thrust.
5. Only two subjects had Class III malocclusions. One had a tongue thrust, the other did not.
6. Three subjects had "mixed" molar occlusion. All were tongue thrusters.
7. Significantly more persons with open bite had tongue thrust than those whose tongue habits were normal.
8. No significant difference was found in degree of overjet between tongue thrusters and non-tongue thrusters.

DISCUSSION

Limitations of the study. The research was a pilot study. As such, its worth is limited by the small number of subjects involved. Subjects were chosen at random from the Directory of the University of Utah. They do not represent all socioeconomic groups, although staff and faculty members were selected. No effort was made to select a group of subjects who had had orthodontic work done, or who had tongue thrust, or malocclusions, or poor periodontal health. The groups formed were thus natural, rather than contrived. This imposes some limitations on equality of numbers in the groups, and on sizes of special groups. For example, it would have been much better, for statistical purposes, to have twelve people with normal occlusion. It would also have been helpful to have eight persons in each of three specified age groups, i.e., 40-45 years, 46-50, and 51-55. If a larger study is undertaken, care should be taken to match groups precisely.

The above limitations, then, restrict the researchers in their attempts to generalize to a larger population. The purpose of a pilot study is to determine whether a more extensive study is feasible or worthwhile. The results of this research indicate that such a study would contribute a great deal to the body of knowledge available in the areas of periodontics, orthodontics, and orofacial myology.

Implications of the results. Claims found in the literature regarding the importance of dental occlusion to the prevention of dental and periodontal problems were not supported by this study. The occasional reference in the literature to the role of tongue thrust elimination in the furtherance of dental health was also unsupported by this study. The considerable evidence for a strong relationship between the existence of malocclusion and the occurrence of tongue thrust was given support.

The review of the literature provided in this article, coupled with the finding of this study, seem to justify an extensive study, with large numbers of subjects in well-matched groups, to determine whether, in fact, claims that orthodontic work and therapy for orofacial habits are effective in maintaining better dental and periodontal health. In the meantime, it would seem prudent to be conservative about such claims, and to focus instead on the cosmetic and functional values of such treatments.

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