

A PERSPECTIVE ON THE ROLE OF THE TONGUE IN CLOSURE OF ANTERIOR OPEN BITE

T. Michael Speidel,
Clark D. Starr,
University of Minnesota

ABSTRACT

In the early 1960's, Walter Straub, a dentist, published a series of articles (13, 14) in which he referred to tongue malfunction as a cause of malocclusion, particularly anterior open bite. The principle form of malfunction he described involved thrusting the tongue against or between the anterior teeth while swallowing. He noted that a lack of normal masseter activity and excess of lip muscle activity accompanied this form of swallowing. He concluded that swallowing may cause malocclusion or prevent successful orthodontic treatment, and he recommended a training procedure designed to modify patient's swallowing.

Straub's observations and assertions have provided impetus for a wide range of studies, clinical reports and theorizing. Also, they have encouraged dentists and speech clinicians to devote extensive time and effort in attempts to treat or prevent malocclusions by exposing patients to tongue training regimens. The phenomenon of which Straub wrote has become known as tongue thrust, infantile, or reverse swallowing and the training procedures are called tongue thrust or myofunctional therapy.

The editors of this journal have invited us to comment on the concept of tongue thrust and its relation to malocclusion, and we have decided to organize our response first by referring to recent reviews of the literature, second by describing orthodontic strategies and principles used in the treatment of anterior open bite and, third, by commenting on the role of the speech clinicians in the treatment of dental problems.

Literature Review

Because of the controversy surrounding the subject of tongue thrust, there have recently been several complete reviews of the literature. Each author has reviewed the literature from a slightly different perspective and each has drawn important conclusions from their reviews.

Fletcher (4), in his extensive review of the literature, noted that within and between various groups of patients diagnosed as tongue thrust swallowers, no consistent pattern of characteristics was present.

Profitt and Norton (11) focused on the relationship between tongue function and oral morphology. They concluded that at present, there is no evidence that in horizontal directions muscular activity during swallowing, speaking or other oral functions is related to arch form. They suggest that additional studies are needed to quantitate the relationship between tongue function and oral morphology in the vertical dimension.

Weinberg (17) in an extensive review of deglutition notes that the definition of tongue thrust swallow as a syndrome appears questionable and correct scientific data does not provide sufficient information for specifying normal patterns of swallow as they relate to occlusion. He further states that on the basis of available evidence, malocclusion is related to factors other than muscle function.

Mason and Profitt (9) in their presentation of the tongue thrust controversy, describe the various clinical orthodontic approaches to patients with malocclusions and tongue thrust.

They state that correction of the malocclusion will usually result in a disappearance of the tongue thrust swallowing pattern without any particular therapy directed at the tongue thrust.

The Joint Committee on Dentistry and Speech Pathology of the American Speech and Hearing Association and the American Association of Dental Schools (10) concluded that, based upon these reviews and their own extensive review of current literature, "There is insufficient scientific evidence to permit differentiation between normal and abnormal or deviant patterns of deglutition, particularly as such patterns might relate to occlusion and/or speech".

Orthodontic Strategies and Principles

From the foregoing survey of the literature, it is apparent that there is no conclusive relationship between tongue function and the object of our concern, anterior open bite. Anterior open bite remains a concern to the dentist and the patient. The dentist must distinguish between those cases in which the open bite may be a temporary transitional stage and those which may not be self-correcting and are candidates for orthodontic intervention. In treating those who are candidates for orthodontic intervention, the dentist must select appropriate treatment regimens and have reasonable expectations for both short term and long term success.

Cause of Anterior Open Bite

It is generally accepted that anterior open bite is the result of overall facial growth disharmony, or some local interference to dental development such as thumb habits, or a combination of both of these factors. Of greatest concern to the orthodontist is the patient whose malocclusion is the result of overall facial growth disharmony since they occur with the greatest frequency and are the most difficult to treat.

Many orthodontic patients exhibit extreme variations in facial growth. Sassouni and Nanda (12) examined skeletal characteristics associated with open and deep bites. They reported that in patients with anterior open bites the mandibular condyle was superiorly positioned, the ramus was shorter and maxillary dental height was greater in both incisors and molar areas. They concluded that local interference to dental development was not a primary factor in anterior open bite.

Isaacson *et. al.* (7) and Droel and Isaacson (2) have reported a number of morphologic characteristics which constitute a variation in facial growth known as the high mandibular plane syndrome. In addition to lack of vertical incisor overlap or anterior open bite, these patients exhibit significantly increased lower facial height from ANS to menton (LEH), a decrease in ramus height (RH), a superior positioning of the condylar fossa (CF), an increase in the upper posterior dental height from tooth tip to palatal plane (UPDH), an increase in anterior dental height, an increase in the distance from menton to lower incisor tip (LADH) and a higher narrow palatal vault (Fig. 1, 2, 3).

Patients with the high mandibular plane syndrome frequently exhibit a soft tissue resting posture without lip contact resulting in an appearance of a short upper lip. Biewald (1) studied the lip length of vertically diverse facial types. He reported upper lip length in the high mandibular plane syndrome closely resembles that of the overall population with a resulting inability to adequately cover the increased alveolar process length common to this group. He found that the lower lip has a tendency to compensate for the greater lower facial height, probably through the influence of chronically hyperactive muscle.

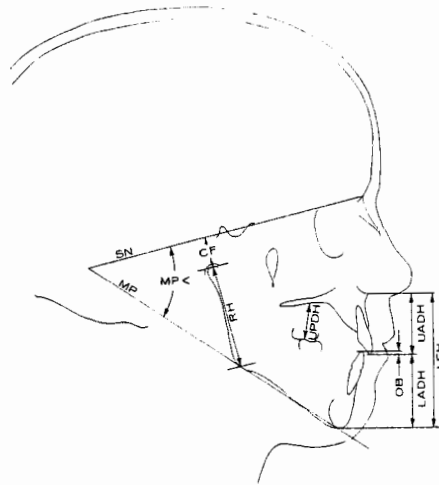


Figure 1. Dental and skeletal morphology characteristic of high mandibular plane angle facial growth pattern.



Figure 2. Dental and skeletal morphology characteristic of low mandibular plane angle facial growth pattern.

Figure 3. Skeletal and dental parameters evaluated in contrasting extreme variations in facial growth pattern.



The chronically hyperactive mentalis musculature is especially noticeable during functional activities requiring lip closure such as swallowing and production of bilabial phonemes. From the need for oral closure may arise other so-called perverted muscular activity such as interdental tongue position or facial grimaces during swallowing, pursing of the orbicularis oris, and labiodental production of bilabial phonemes.

Since the muscular rest position of these individuals is normally a lip-apart posture they are commonly labeled mouth breathers in the absence of any demonstrated functional nasal insufficiency. Gundlach (6) studied upper respiratory tract disorders in patients with diverse facial growth patterns. He reported no significant functional difference which could be considered causative for the difference in growth patterns between groups.

The evidence suggests that the presence of the so-called perverted muscular activity characteristic of the anterior open bite patient is in the vast majority of cases quite likely compensating for an existing morphological configuration.

Treatment of Anterior Open Bite

Historically, the treatment of anterior open bite has involved attempts at changing the local dental configuration. Only recently have efforts been directed toward changing overall skeletal growth. Selection of the most appropriate treatment plan requires a full understanding of the various factors that may contribute to a particular patient's problem. The orthodontist must recognize the patient's overall skeletal growth pattern, evaluate the dental developmental stage, appraise the contribution of local factors impeding the eruption of teeth, predict naturally occurring changes as the patient matures and estimate the importance of factors beyond his/her control.

Primary and Transitional Dentition

The earliest developmental stage in which one might encounter an anterior open bite is in the primary dentition. During eruption of the primary incisors, an open bite is a normal developmental stage and the vertical changes that may be expected to take place without treatment can be predicted by evaluating the relative interaction of overall genetic growth influences and local influences.

This temporary open bite in the presence of an average vertical growth pattern can be expected during eruption of teeth and will eventually close unless the teeth are prevented from erupting. This impedance to tooth eruption is in most cases the result of thumb or finger sucking. At this developmental stage evidence relating an impedance to the tongue is not obvious except in the neurologically impaired child. If the impedance to eruption, such as thumb or pacifier, is prevented from interfering, the teeth usually erupt normally (Fig. 4, 5).

Whether to interfere with the thumb habit by introducing treatment procedures at this time is debatable. The decision rests on the wishes of the parent and patient after consideration of the age of the patient and the likelihood that they will stop the habit unaided. If treatment is elected, the reliable procedures are the crib-type appliances recommended by Graber and others (5). In most patients with a favorable skeletal pattern the dental open bite will be self-correcting if the patient stops thumb sucking while eruption potential and vertical alveolar growth potential are still present. Subtelny and Sakuda (15) report that in the presence of both thumb sucking and protrusive tongue activity, cessation of the thumb sucking, results in consequent eruption of the teeth and spontaneous change in protrusive tongue activity.



Figure 4. A two-year-old child with anterior open bite associated with use of pacifier.

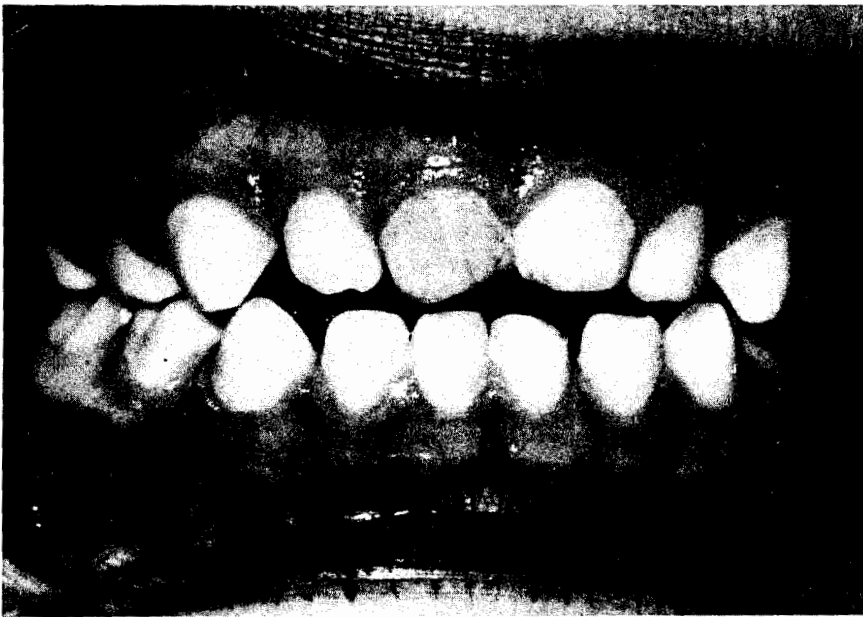


Figure 5. The same child 12 months later. Use of the pacifier has ceased and morphology is returning to normal. Tongue thrusting activity has ceased spontaneously.

These observations in the primary dentition can also be made in the early transitional dentition as the permanent incisors replace their predecessors at approximately six to eight years of age (Fig. 6, 7).



Figure 6. A seven-year-old child with an anterior open bite and tongue thrust as a normal developmental stage.



Figure 7. The same child 18 months later. As incisors erupt normally, open bite closes and muscular activity spontaneously becomes normal.

Many investigators report a high incidence of so-called unusual tongue activity at ages six to eight years with an expected spontaneous decrease at age 10 or 11 years (3, 8, 16, 18). If there is evidence that the tongue activity is compensatory for the morphology, one should be cautious about directing treatment at the tongue while the morphology is changing normally (Fig. 8, 9, 10).

Anterior open bites in the presence of extreme skeletal variations, especially in the vertical plane of space, are a more difficult problem. In these cases, the open bite is probably an expected characteristic of the overall skeletal growth pattern. The role that local influences play are secondary and treatment, such as the use of a crib, is not likely to result in complete spontaneous closing of the bite. The open bite may close partially as the contribution from local influences is removed, but the skeletal component can only be affected by influencing the overall facial growth pattern.

Patients exhibiting an open bite as an expected component of the overall skeletal growth pattern may be candidates for efforts to redirect skeletal growth. Usually these efforts should be delayed until the patient is ready to start active orthodontic treatment unless the skeletal pattern is extremely severe or the patients and/or parents present particularly compelling reasons.

Efforts to influence overall facial growth in the primary dentition or in the early transitional dentition are often inappropriate for several reasons. The patient is growing at a slow rate. The patient may be too young to cooperate satisfactorily. The availability of teeth necessary to apply the force system is often unsatisfactory. The total treatment may be unduly prolonged since the patient's natural growth tendency must be countered throughout the total growth period. Failure to control facial growth for this total growth period is likely to result in relapse as the original growth pattern reasserts itself.

The prognosis for changing overall skeletal growth by orthodontic means is limited. Some efforts have been made to impede posterior alveolar growth while condylar growth remains unimpeded in order to change the mandibular growth to a more horizontal direction. A typical treatment plan attempting to influence facial growth is as follows:

- 1) Primary teeth are extracted, if necessary, to speed eruption of their successors if the permanent teeth are not available when the pubertal growth spurt approaches. Permanent teeth are extracted, if necessary, to gain arch space, usually first bicuspids just as they are beginning to erupt or before the cuspids have been forced into unfavorable eruption paths.
- 2) Occipital headgear is applied to the first molars before the second molars or second bicuspids have erupted. The objective is to stop or reduce the vertical development of the first molars. As the second bicuspid and second molar become available, they should be banded and archwires placed to prevent their vertical development. At the same time the incisors are able to assume a more vertical axial inclination with an increase in vertical overlap.

The open bite is now closed by a forward rotation of the mandible and increased superior vertical positioning of the incisal edges of the anterior teeth. With proper timing the patient should be able to receive any other tooth positional changes required as the teeth become available, resulting in a smooth continuous transition to the fully completed treatment.

The effectiveness of such attempts to change growth direction are dependent on the patient's growth potential plus ability and willingness to cooperate with headgear therapy. The prognosis for maintenance of any correction is primarily dependent on the patient's post-treatment growth potential in direction and amount.



Figure 8. A nine-year-old child with finger sucking and tongue thrusting associated with anterior open bite.

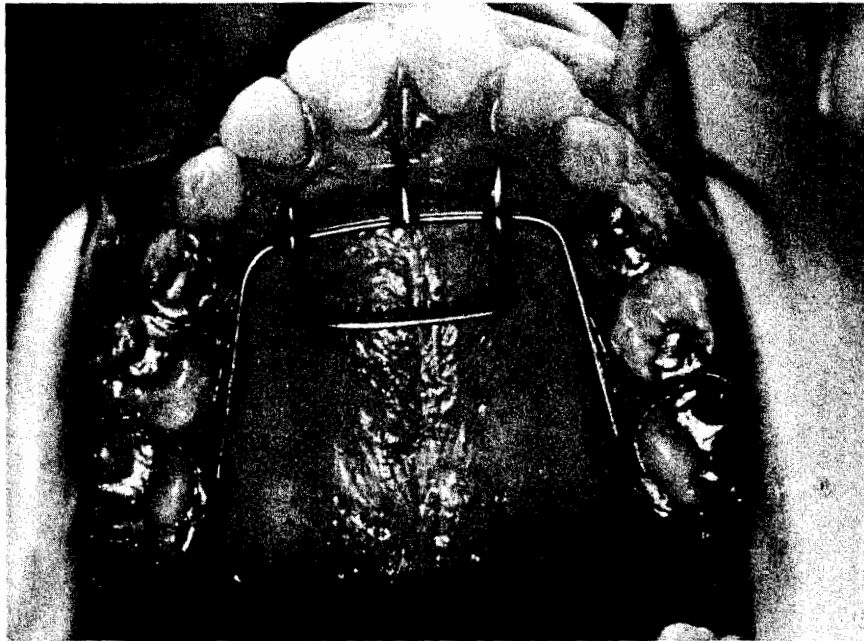


Figure 9. Crib used to help patient stop finger sucking, appliance was worn for two months.

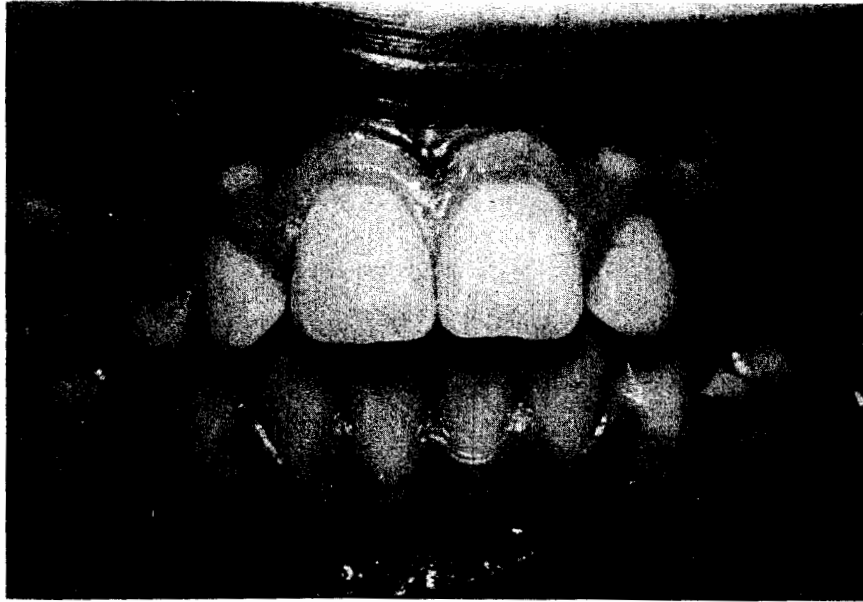


Figure 10. The same patient 12 months later illustrating spontaneous closure of anterior open bite after cessation of finger sucking.

The most stable results are achieved in those patients whose treatment finishes at the same time as their growth ceases. The most unstable results occur when the patient experiences large amounts of post-orthodontic treatment growth. When the original growth pattern manifests itself after the orthodontist has no way to control this growth, such as after orthodontic appliances have been removed, the patient may outgrow the previously achieved results (Fig. 11, 12, 13, 14). This situation is common but erroneously interpreted as relapse of dental changes. Evaluation of serial cephalometric x-rays of treated patients reveals continued vertical movement of the molars and incisors but inadequate vertical growth of the ramus to compensate for the alveolar growth; a return to and continuation of the original pretreatment growth pattern. Since males, especially late maturing males may grow considerably beyond the normal age and duration for orthodontic care, their results are notoriously unstable.

It should be noted that in cases of severe skeletal discrepancies clearly requiring surgical management, attempts to significantly influence jaw growth by orthodontic means are futile and should not be attempted. Surgical corrections are usually made after the patient has ceased growth.

Permanent Dentition

The presence of an anterior open bite in the permanent dentition associated with a favorable vertical skeletal growth pattern is extremely rare. In such a case if the unerupted teeth are due to an impedance to eruption, such as a thumb or tongue habit, cessation of the deleterious activity will usually result in eruption if vertical alveolar growth potential is present. In a non-growing adult the prognosis for self-correction is poor.

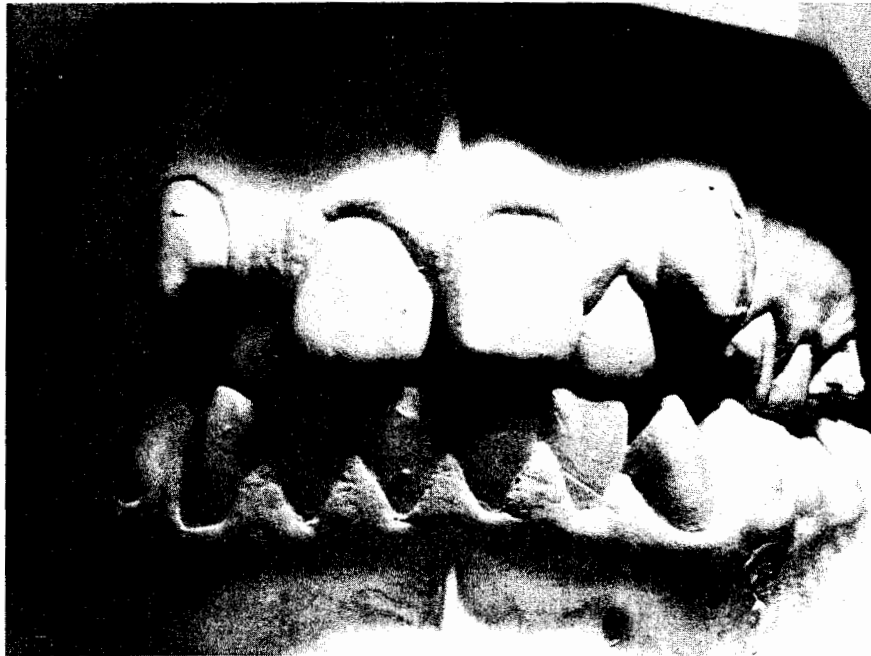


Figure 11. Pretreatment model illustrating anterior open bite associated with crowding and an unfavorable skeletal growth pattern.

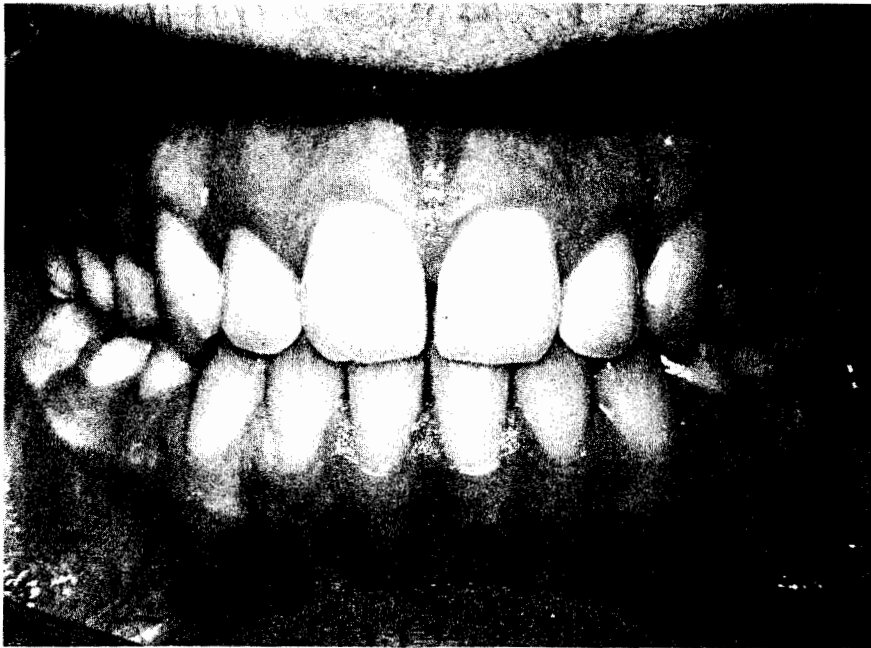


Figure 12. Finished result after two years of orthodontic treatment.

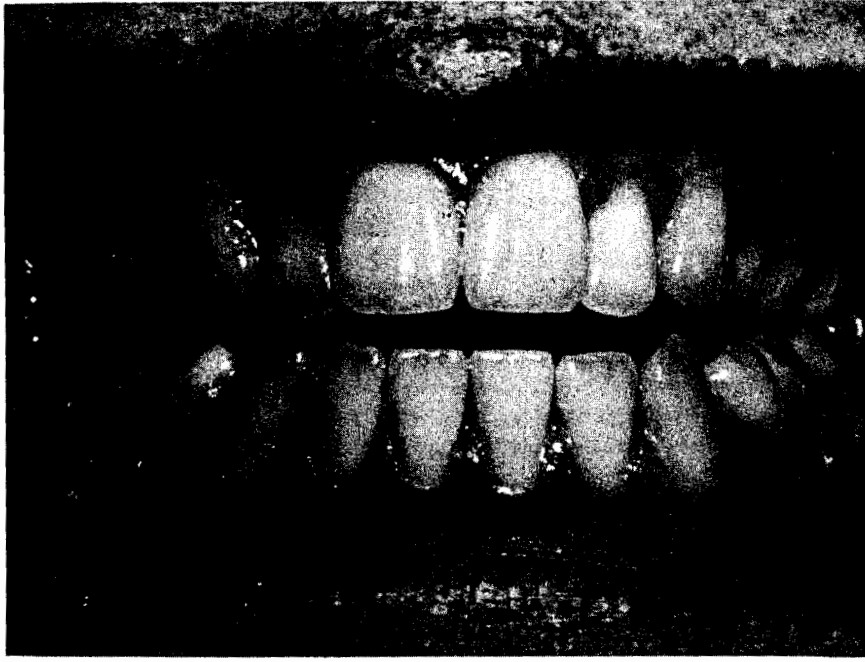


Figure 13. Return of anterior open bite 21 months after removal of fixed appliances.

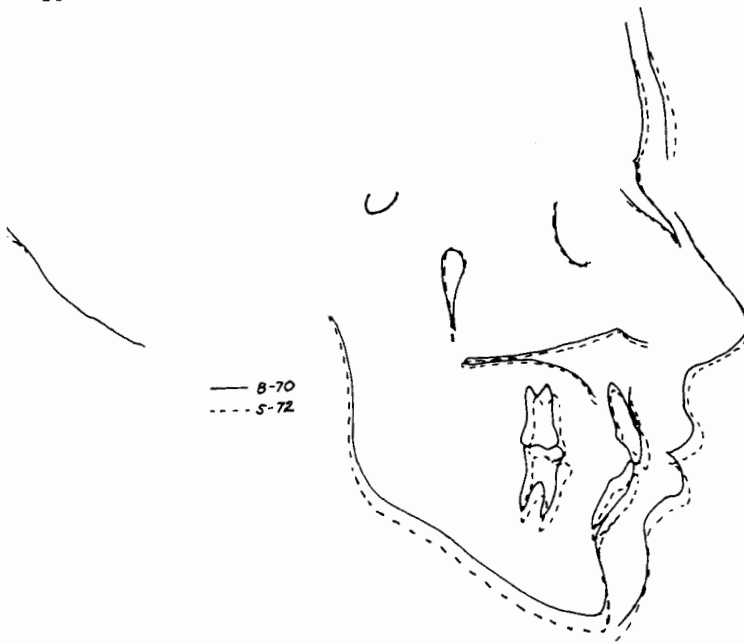


Figure 14. Superimposed cephalometric tracings illustrating disproportionate post-treatment vertical growth. Dentition is remarkably stable, but open bite results from skeletal growth changes beyond orthodontists control.

In the permanent dentition, the most common anterior open bite is associated with an unfavorable vertical facial growth pattern. Successful treatment is closely related to the orthodontist's ability to favorably influence jaw growth. In a growing individual, the most ideal treatment is to change the growth pattern, as in the transitional dentition patient described above. Only modest changes can be achieved with this technique. In severe cases one should plan on a future surgical change to close the open bite.

One can effectively change a severe open bite with surgery in the growing patient but the results may be unstable. There are, however, exceptions where the benefits gained by esthetic or functional improvement may outweigh the risk of potential instability.

In a non-growing individual, all correction must be made by dental compensation or surgically changing the facial pattern. Dental compensation usually involves extruding the incisors with vertical elastics or tipping the occlusal plane. Such treatment objectives must be undertaken with a great deal of caution and judgment. The resulting tooth positions may be unstable, periodontally unhealthy or esthetically unsatisfactory. It is important that the patient and parent have realistic objectives and an understanding of the poor prognosis for dental corrections which compensate for severe skeletal growth discrepancy. Post-treatment instability cannot be blamed on intractable muscular dysfunction.

Patients whose jaw discrepancies cannot be satisfactorily compensated for by dental changes are candidates for a combined orthodontic and surgical approach to treatment. Quite frequently desired changes in the patient's overall facial esthetics also suggest consideration of this approach.

Post-treatment Changes

When anterior open bite problems are properly diagnosed and treated, one can have a predictable prognosis. If the problem is primarily a tooth position or dental problem, the prognosis for a successful, stable correction is good. If the dental problem is associated with unfavorable facial growth, one can predict a less successful correction and a likelihood of post-treatment instability.

The problem with correction of anterior open bite is that in most cases, one is dealing with unfavorable facial growth. Since the orthodontist does not have direct access to controlling growth, most treatment is an attempt to compensate for the cause of the problem rather than deal directly with the cause.

Thus, post-treatment changes may occur which are beyond the control of the orthodontist, for example, continuation of unfavorable facial growth, or postsurgical instability. Certain local tooth positional changes may be beyond the control of conventional retention techniques. In some cases, the cause of post-treatment change may be unknown.

It has been suggested that tongue habits may induce post-treatment changes (14.) There is no evidence supporting this idea. In our experience, efforts to alter tongue function by crib or myotherapy have not made significant contributions to post-treatment stability.

While the orthodontist might prefer to have a myofunctional therapist responsible for his own shortcomings; in all fairness, he must accept the responsibility himself. Similarly, while the patient might prefer to have a myofunctional therapist responsible for his genetically influenced growth pattern, he must recognize the fact that altering oral facial muscular functions does not change overall facial growth.

The Role of the Speech Clinician in Treatment of Dental Problems

The role of the speech clinician in treatment of anterior open bite can be defined from several perspectives. You have professional obligations relative to your sphere of expertise, in this case communication skills. It is common and completely appropriate for a speech clinician to work with dentists in the case of a patient who has a suspected communication problem. Speech clinicians have the responsibility for determining whether or not a communication problem exists, for deciding an appropriate therapy and evaluating the results of therapeutic procedures.

In the case of most orthodontic patients, efforts are focused in helping the patient communicate with normal function for a normal morphology or communicate with function adaptive for an abnormal morphology. The speech clinician is not generally expected to alter the morphology from abnormal to normal.

The speech clinician's role may be defined by external influences such as the dentist's requests or the patient's expectations. In the case of the dentist's requests for therapy you must decide if the request is for therapy within your sphere of expertise. The American Speech and Hearing Association's "Position Statement of Tongue Thrust" makes it clear that speech clinicians who attempt to alter functional patterns of deglutition are doing so in the face of evidence which is unsupportive of the validity of tongue thrust as a clinical entity.

A dentist may request tongue thrust therapy to permit an orthodontic correction to be achieved or to maintain the stability of a correction. In the case of an anterior open bite present as a normal temporary developmental stage of course no therapy is justified.

In the case of an anterior open bite requiring orthodontic therapy, provision of tongue thrust therapy to permit correction of the open bite or to maintain stability of a corrected open bite is essentially accepting responsibility for the patient's orthodontic result. Most speech clinicians would not acknowledge responsibility for orthodontic results as within their professional responsibilities.

Patients may consult the speech clinician with a request for therapy to prevent or correct an anterior open bite. Your course of action should be governed by your professional knowledge and ethics rather than simply complying with the patient's requests.

As noted in the body of the paper, appropriate advice to the patient is dependent on your ability to appraise the patient's overall facial growth pattern, evaluate the dental developmental stage, appraise the contribution of local factors impeding the eruption of teeth, predict naturally occurring changes as the patient matures and estimate the importance of factors beyond the clinician's control.

These decisions require a high degree of sophistication and are a responsibility you may wish to share with the orthodontist.

SUMMARY

In commenting on the concept of tongue thrust and its relation to malocclusion, the authors have chosen to survey recent reviews of the literature, describe current orthodontic strategies in the treatment of malocclusion, particularly anterior open bite, and comment upon the role of the speech clinician in relation to dental problems. Extensive reviews of the literature show no conclusive relationship between tongue function and anterior open bite. Anterior open bite is the result of overall facial growth disharmony or some local interference to dental development, such as a thumb habit. Patients exhibiting a variation in

facial growth known as high mandibular plane growth pattern frequently show the presence of so-called abnormal muscular activity or tongue thrust behaviors which are merely compensatory for the existing structure. Treatment of anterior open bite involves recognition of the patient's overall skeletal growth pattern, evaluation of the dental developmental stage, appraisal of the contribution of local factors impeding eruption of teeth, prediction of the naturally occurring changes as the patient matures, and estimation of the importance of factors which are beyond the control of the orthodontist, such as continuation of unfavorable growth patterns post-treatment. The use of tongue thrust or myofunctional therapy to permit correction of an open bite or to maintain stability of a corrected open bite is seldom, if ever, needed and involves accepting responsibility for a patient's orthodontic result. This responsibility should lie with the dental professional.

Reprint requests should be mailed to:

Clark Starr, Speech Pathology and Audiology, Speech and Hearing Clinic
University of Minnesota, MINNEAPOLIS, Minnesota 55455, U.S.A.

BIBLIOGRAPHY

1. Biewald, K.H.: A comparative evaluation of certain soft and hard tissue dimensions of length and width in vertically diverse facial types, unpublished Master's Thesis, University of Minnesota, 1973.
2. Droel, R.J., and Isaacson, R.J.: Some relationships between glenoid fossa position and various skeletal discrepancies, *Am. J. Orthod.* 61:64-78, 1972.
3. Fletcher, S.G.: Tongue thrust swallow, speech articulation and age, *J. Speech Hear. Disord.* 26:201-208, 1961.
4. Fletcher S.G.: Processes and maturation of mastication and deglutition, *Speech and the Dentofacial Complex: The State of the Art: Proceedings of the Workshop: ASHA Reports 5*, Washington, D.C.: American Speech and Hearing Association, 92-105, 1970.
5. Graver, T.M: **Orthodontics: Principles and Practice**, Philadelphia: G.B. Saunders Co., 2nd edition, 1966.
6. Gundlach, K.K.H.: The relationship of craniofacial measurements and growth patterns to upper respiratory tract disorders, unpublished Master's Thesis, University of Minnesota, 1974.
7. Isaacson, J.R., et. al.: Extreme variations in vertical facial growth and associated variations in skeletal and dental relations, *Angle Orthod.* 41:219-229, 1971
8. Jann, G.R.: A longitudinal study of articulation, deglutition and malocclusion, *J. Speech Hear. Disord.* 29:424-435, 1964.
9. Mason, R.M. and Proffit, W.R.: The tongue thrust controversy: background and recommendations, *J. Speech Hear. Disord.* 39:115-132, 1974.
10. "Position statement of tongue thrust," Joint Committee on Dentistry and Speech Pathology-Audiology, American Association of Dental Schools and American Speech and Hearing Association, *ASHA* 17: no. 5, 331-337, 1975.
11. Proffit, W.R. and Norton, L.A.: The tongue and oral morphology: influences of activity during speech and swallowing, *Speech and the Dentofacial Complex: The State of the Art: Proceedings of the Workshop: ASHA Reports 5*, Washington, D.C., American Speech and Hearing Association, 106-115, 1970.
12. Sassouni, V. and Nanda, S.: Analysis of dentofacial vertical proportions, *Am. J. Orthod.* 50:801-823, 1964.
13. Straub, W.J.: Malfunction of the human tongue, Part I and Part II, *Am. J. Orthod.* 46:404-424, 1960.
14. Straub, W.J.: Malfunction of the Tongue. Part III, *Am. J. Orthod.* 48:486-503, 1962.
15. Subtelny, J.D. and Sakuda: Open-bite: diagnosis and treatment, *Am. J. Orthod.* 50:337-358, 1964.
16. Ward, M.M.: Articulation variations associated with visceral swallowing and malocclusion, *J. Speech Hear. Disord.* 26:334-341, 1961.
17. Weinberg B.: Deglutition: a review of selected topics, *Speech and the Dentofacial Complex: The State of the Art: Proceedings of the Workshop: ASHA Reports 5*, Washington, D.C., American Speech and Hearing Association, 116-131, 1970.
18. Worms, F.W., et.al.: Open-bite, *Am. J. Orthod.* 59:589-595, 1971.