

ADAPTATION TO EMOUCHURE AS A FUNCTION OF DENTOFACIAL COMPLEX*

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MEMBERS of the orthodontic profession have long known that irregularities of the teeth and their supporting structures interfere with many and diverse functions for which these parts are utilized in the process of ordinary living. For this reason, the profession systematically has altered dentofacial irregularities in such a way as to obtain a greater adequacy of function. It is not important here to depart into a technical discussion of the many kinds of irregularities that are found, nor to discuss the several functions with which they interfere. It is sufficient to recognize that wind-instrument playing is one of the group of functions that depend, at least in part, upon the teeth and their supporting structures.

To date, so far as the literature reveals, orthodontics has paid little formal attention to the dentofacial problems of the musician. Yet, problems of this nature require attention if we are to provide service for this group of individuals. The number of wind-instrument players is sufficiently large to warrant a consideration of problems potentially peculiar to this group.

The jaws, the teeth, the lips, and associated structures are used continuously in the playing of wind instruments. For this reason, it is important to the musician to be able to use these structures at their best functioning level in order to fulfill adequately the varied and often difficult musical requirements. These dentofacial features, as well as the mouthpieces of wind instruments, are not fixed in form. Rather, they both differ widely from individual to individual. Their functions are also likely to be different, at times permitting easy adaptation to the instrumental mouthpiece, and at other times making this adaptation very difficult. This presentation is concerned with the adaptation of different structural types to embouchure. It proposes to estimate the dentofacial requirements for wind-instrument musicianship.

EMBOUCHURE

Embouchure is a technique of using the lips, teeth, jaws, and related structures against the mouthpiece of a musical instrument to produce a tone. In this activity, physical adaptation is dependent both on the dentofacial form and on the shape of the mouthpiece of the instrument used. In view of our knowledge

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about the differences in facial form, it is reasonable to expect that some individuals will make better adjustment than others. This assumption also holds when we consider the varied shapes of mouthpieces within and between groups of wind instruments.

For purposes of this study, musical instruments are classified as brass and wood wind. In general, brass instruments can further be designated as small and large. The small instruments have small cup-shaped mouthpieces and include trumpet, bugle, French horn, and alto horn. The large instruments have large cup-shaped mouthpieces and include trombone, baritone, bass horn, and tuba. Wood-wind instruments are considered herein as a group, but may be classified as: (1) instruments having a single reed clamped to a mouthpiece, (2) instruments having a double reed for a mouthpiece, and (3) instruments having an aperture in the head of the instrument serving as a mouthpiece.

Fig. 1. A.

Fig. 1. B.



The adaptation to small brass embouchure is shown in Fig. 1, A. During adaptation, the lips are drawn back into a smiling position and the mouthpiece is placed lightly against both upper and lower lips. To assist in this accommodation, the lower jaw is shifted downward and forward with the upper and lower incisors slightly apart to permit the flow of the air stream between them. Ideally, the incisors support the upper and lower lips with equal pressures.

The adaptation to the larger trombone mouthpiece is like that of the trumpet and is shown in Fig. 1, *B*. Fig. 1, *C* shows adjustment to the tuba mouthpiece.

Adaptation of the dentofacial structures to the wood-wind instruments depends somewhat upon the type of instrument used. For the single-reed instrument, as shown in Fig. 2, *A*, the lower lip is drawn slightly over the lower teeth and about one-half of the mouthpiece is placed between the lips. In this position

Fig. 2, *A*.Fig. 2, *B*.Fig. 2, *C*.

the reed rests against the lower lip and the upper teeth rest upon the mouthpiece. The lips are then drawn back and closed firmly around the mouthpiece so that no air can escape. Here again, the lower jaw is thrust downward and slightly forward to support the lip and the instrumental mouthpiece.

Both lips are drawn slightly inward to cover the teeth during adjustment to the double reed. This relationship is shown in Fig. 2, *C*. About one-eighth

to one-quarter of the reed is placed in the mouth and rests firmly on the lower lip. Both lips are then closed to prevent air escape. Again, the teeth support the lips and the mandible moves slightly downward and forward during adjustment. For instruments with an aperture in the head of the instrument, less precision in jaw movement is required. As shown in Fig. 2, *B*, the lower lip is drawn slightly inward and the lips are closed, allowing only a very small opening in the center of the mouth over the aperture.

From the foregoing discussion, it is apparent that there is considerable variation in the shapes of instrumental mouthpieces, as well as of the jaws, teeth, lips, and associated structures. All of these variations must be considered when studying the role of the dentofacial complex in the development of embouchure.

THE DATA

An opportunity was provided to appraise some of the interferences that dental irregularities impose upon wind-instrument playing. An experiment was set up for this purpose. It was designed to estimate the role of the teeth, lips, jaws, and related structures in the development of embouchure and to study the adjustment of these parts to embouchure. Material for study was obtained by examining one hundred wind instrumentalists, selected from members of the University of Michigan bands, students in the University School of

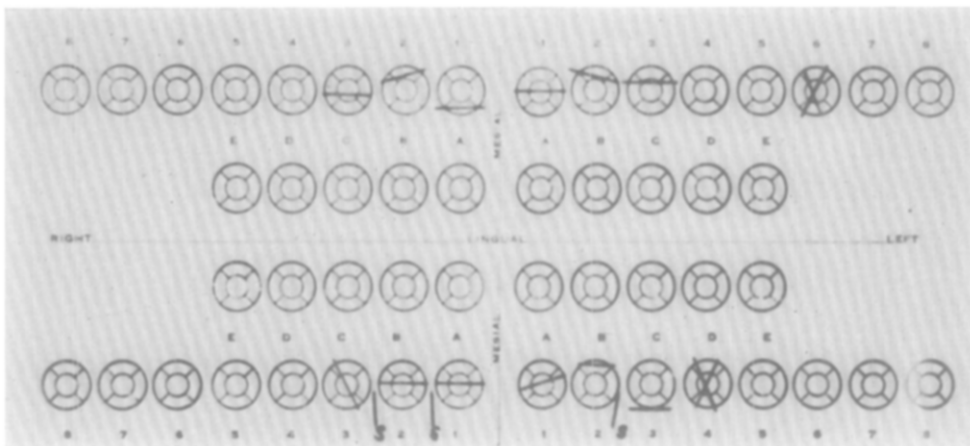


Fig. 3.—Oral examination record form.

Music, and music teachers in Ann Arbor during the academic year of 1943-1944. The selection of individuals for examination was based on musicianship and the types of instruments played. Although variable degrees of musical ability were represented, the aggregate was of a semiprofessional nature.

Two sets of observations were obtained on each individual. The first of these is illustrated in Chart I. Here the attention is centered upon the major features of the dentofacial complex. Although the inclusion of other details about occlusion would be warranted, the ones shown appear most pertinent to the immediate problem.

Fig. 3 is a section of the systematic oral examination record form used in the Orthodontic Clinic at the University of Michigan. It enables the recording of many details of the dentition itself, too extensive and varied in nature to be allocated reasonably into the systematic form of Chart I. Rotation of individual teeth, spacing, mutilation, maxillary protrusion, and retrusion were recorded in

CHART I. DENTOFACIAL EXAMINATION

Name		Sex	Age
Address			Date
OCCLUSION			
Normal		Irregularities	
Class I (Angle)		1. Mutilation	Anterior Posterior
Class II (Angle)	Degree in Cusps	2. Anterior Crowding	Maxillary Mandibular
1. Division 1 Bilateral		3. Anterior spacing	
2. Division 1 Unilateral		4. Maxillary protrusion	
3. Division 2 Bilateral		5. Cross-bite	Anterior Posterior
4. Division 2 Unilateral		6. Overbite	Shallow Medium Deep
Class III (Angle)	Degree in Cusps	7. Maxillary retrusion	Impinging
1. Bilateral		8. Open-bite	Mild Medium Extreme
2. Unilateral			
OTHER OBSERVATIONS			
Lip Form			Tapering
Length	Short Medium Long	Arch Form	Ovoid Square
Thickness	Thin Medium Thick	Tooth length	Short Medium Long

CHART II. EVALUATION OF EMBOUCHURE

Name:	
Address:	
Age:	Sex:
1. Instruments which you play. 2. Instrument which you major in. 3. Have you ever had any orthodontic treatment? If so, why? 4. If no treatment, would orthodontic correction have helped? 5. Are you aware of any pain or discomfort in/or around the teeth while playing a wind instrument? (i.e., pain in/or around the teeth, tiring of the oral supporting structures, or pain to the lips.) a. What instrument caused the pain or discomfort? b. Is the discomfort immediate, or does it occur after a considerable amount of playing? c. Does difficult music (difficult for you, or generally considered difficult) hasten the onset of discomfort? 6. Discussion of embouchure difficulties which you cannot account for (if any). 7. Are there any difficulties which you cannot account for?	

this manner. Correct alignment of an incisor was expressed by drawing a line through the mesiodistal center of the circle. Rotations were recorded by placing lines at an angle comparable to the positions of the teeth observed. Placement of the line to the lingual indicated retrusion. Placement of the line to the labial indicated protrusion.

The evaluation of embouchure was examined as shown in Chart II. Questions relating to orthodontic care were included to detect opinion about the value of this service to musicians. Item 5 served to uncover difficulties in adjustment to embouchure. The instrument to which the musician adjusted poorly was recorded under *a*. Items 6 and 7 presented the history of embouchure adaptation.

ANALYSIS

The detailed distribution of instrumentalists is shown in Table I. Thirty-six small brass, twenty-six large brass, and thirty-eight wood-wind players were examined. They include twelve individuals with normal dentitions, thirty-eight with Class I malocclusion, twenty-eight with Class II malocclusion and twenty-two with Class III malocclusion. Twenty-six musicians adjust poorly to embouchure.

TABLE I. DISTRIBUTION

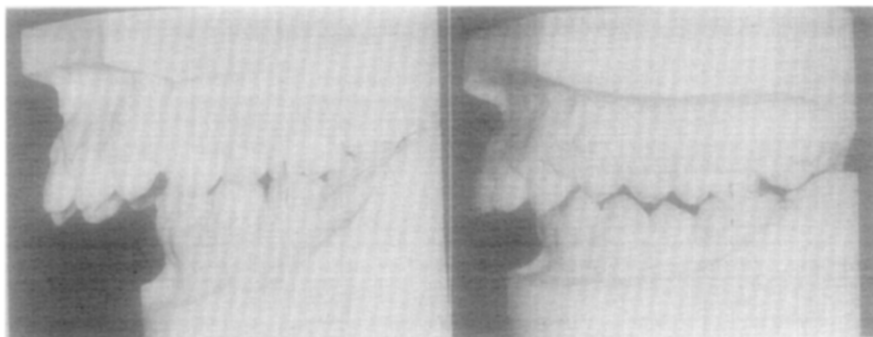
	ADJUST POORLY TO EMOUCHURE			ADJUST WELL TO EMOUCHURE			TOTAL
	BRASS		WOOD WIND	BRASS		WOOD WIND	
	SMALL	LARGE		SMALL	LARGE		
Normal	0	0	0	4	2	6	12
Class I	4	0	0	10	10	14	38
Class II	11	4	1	3	2	7	28
Class III	2	3	1	2	5	9	22
Total	17	7	2	19	19	36	100

Difficulties in adaptation occur most frequently among small brass instrumentalists (47.2 per cent), less frequently among large brass instrumentalists (26.9 per cent), and infrequently among wood-wind musicians (5.2 per cent). Embouchure difficulties attain the greatest frequency among small brass instrumentalists with Class II malocclusion. Among individuals with Class III malocclusion, difficulties are distributed evenly. With the Class I grouping, only small brass instrumentalists adjust poorly. In contrast, all players with normal dentitions adapt well to embouchure.

Explanation of the partial negations within Class I and Class III malocclusion (Table I) seems to be dependent on structural differences between basic types of facial deformities. Apparently the addition of dental irregularities to the Class II type accounts for the marked decrease in adjustment within this group. For purposes of obtaining a brief overview of these influences, it is now desirable to consider the effects of malocclusion upon adaptation to embouchure.

The manner in which various dentofacial irregularities affect the adjustment to embouchure is best seen by examining the various types in function. The analysis reveals that a Class II arch relationship is most undesirable for brass embouchure. This fact is clearly brought out in Table I where approximately three-fifths of all musicians with distocclusion who were examined in this study

adjusted poorly to embouchure. In general, difficulties in adjusting are proportional to the degree of malocclusion present. Usually, the extreme distocclusion, as shown in Fig. 4, *A*, creates an adjustment problem for the brass player. Small brass players with this deformity adjust less readily than do larger brass players, and bilateral discrepancies are less efficient than unilateral ones. Here the posterior relationship of the mandible is not in harmony with the anatomic requirements for function. The amount of forward movement of the lower jaw needed to position the lower incisors and lip directly below and even with the upper incisors and lip during adjustment is often too great for satisfactory function. On the other hand, mild distocclusion, as shown in Fig. 4, *B*, interferes less with musical ability. For individuals with a distocclusion of one-half cusp or less, the adaptation problems are more likely to result from irregularities of the teeth and lips. In addition, as shown in this study, distocclusion in itself does not interfere with the clarinet or other types of wood-wind embouchures.

Fig. 4, *A*.Fig. 4, *B*.Fig. 4, *C*.

Mesioclusion provides a somewhat different problem from distocclusion. Only mild discrepancies in Class III arch relationships, as shown in Fig. 4, *C*, were observed in this study. Difficulties distribute among all types of instrumentalists and most especially among wood-wind players. Here the protruded

lower jaw carries the front lower teeth to a position too far forward for the lower lip to fold easily over them during playing. Often mesial relationships of the mandible associated with lower anterior irregularity are disturbing to both large and small mouthpiece brass players. Although extreme mesioclusion was not encountered, there is little doubt, on the basis of the present finding, that the interference would be so great as to make wood-wind playing practically impossible and brass instrument playing very difficult.

Few musicians with Class I malocclusion experienced embouchure problems. For these individuals, adjustment problems were due to irregularities of the teeth and/or lips.

In addition to functional inefficiencies arising from basic jaw discrepancies, there are many problems associated with irregularities of the teeth and lips. In general, tooth and lip irregularity increases the difficulty of adjustment for the musician when arch discrepancies are present. At times, these conditions are disturbing in themselves. This assumption does not hold true in all cases, however. For this reason, each irregularity must be examined during function for its probable effect upon the adjustment to embouchure.

Fig. 5, A.

Fig. 5, B.

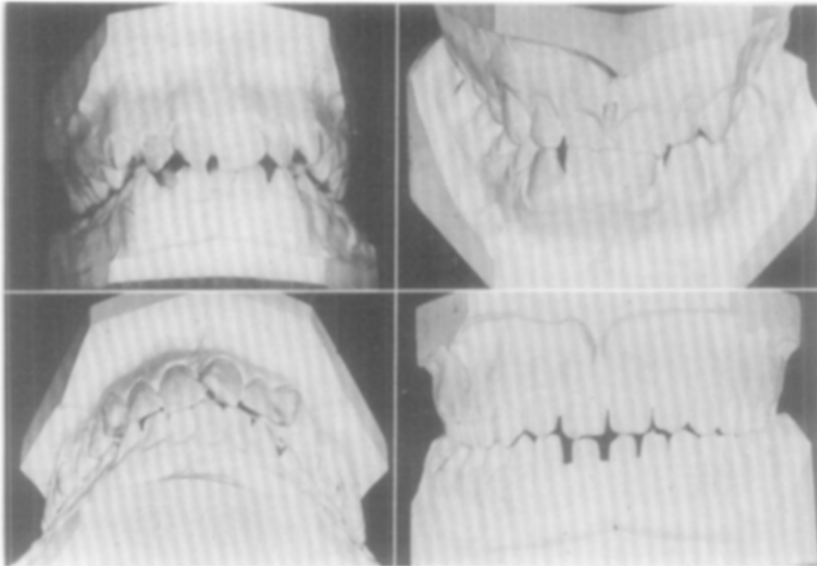


Fig. 5, C.

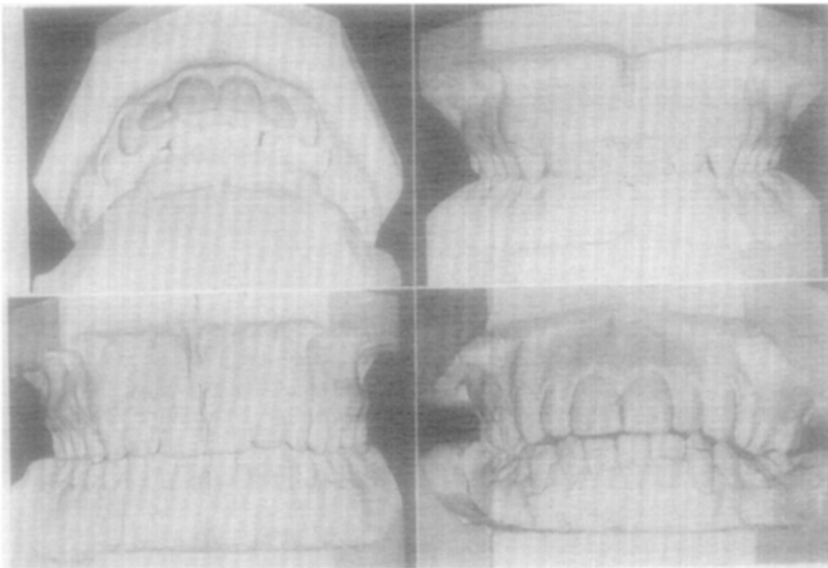
Fig. 5, D.

Crowding and/or rotation of anterior teeth is one of the dental irregularities considered undesirable for wind instrument playing. Conditions similar to those in Fig. 5, A, B, and C, were observed in fully one-third of all individuals examined. These occurred among all types of instrumentalists and were disturbing to both the brass and wood-wind players. The effects upon musicianship appear to vary in accordance with the type of arch relationship associated with the irregularity. Maxillary anterior crowding accompanying distocclusion (Fig. 5, A) was troublesome for over one-half of the brass instrumentalists. Similarly,

maxillary crowding in a Class III malocclusion (Fig. 5, *B*) was disturbing, and all brass players with this irregularity experienced embouchure difficulties. Crowding in Class I malocclusion (Fig. 5, *C*) was troublesome to a lesser number of the small brass players who exhibited it.

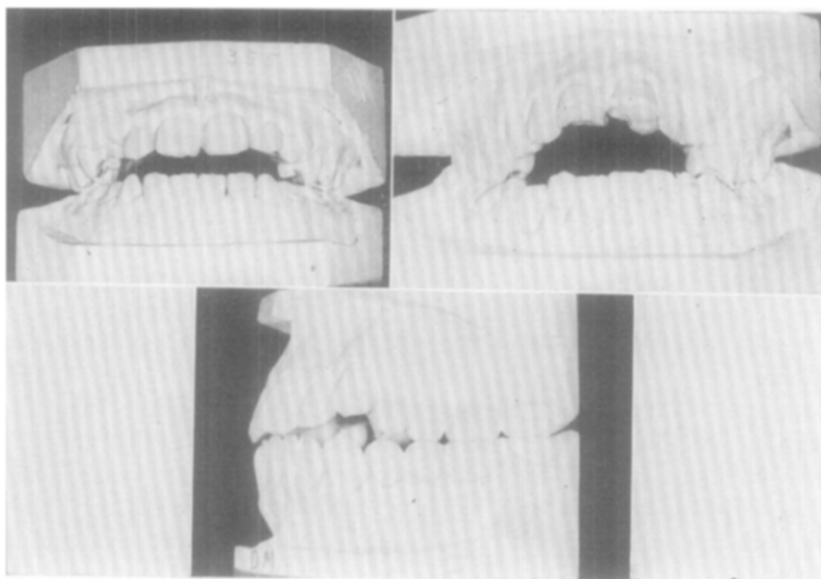
Fig. 5, *A*, *B*, and *C* also show several types of lower anterior crowding. Occasionally, this condition disturbs brass instrumentalists. The lips are irritated by the sharp corners of the rotated teeth when they are shifted forward to assist in support of the instrumental mouthpiece. Here again, in mandibular, as in maxillary crowding, difficulties occur more often when associated with mesioclusion or distoclusion than when these arch discrepancies are absent.

A few cases of extreme anterior spacing of the maxillary and mandibular incisors were encountered. An example is shown in Fig. 5, *D*. Although the data are limited, it appears significant that all instrumentalists with this condition experienced difficulties with embouchure. All complained of discomfort and early tiring of the supporting alveolar bone during playing. On the other hand, the presence of mild spacing is apparently of little consequence.

Fig. 6, *A*.Fig. 6, *B*.Fig. 6, *C*.Fig. 6, *D*.

An overbite relationship was observed in nearly all of the one hundred individuals examined. Twenty-six per cent of the Individuals adjusted poorly to embouchure. Although depth of bite does not directly affect adaptation, it appears to be a good measure of adjustment or nonadjustment. The degrees of overbite encountered ranged from deep impinging conditions to shallow end-to-end relationships. Most deep impinging overbites, similar to that shown in Fig. 6, *A*, were associated with extreme distoclusion. Here the lower jaw must be shifted downward as well as forward when adapting to the instrumental

mouthpiece. The detailed data show that for instrumentalists with a Class II malocclusion, the deeper the overbite, the greater the tendency for embouchure difficulties. In extreme cases, satisfactory embouchure is often impossible. In the deep (Fig. 6, *B*) to normal one-third overbites (Fig. 6, *C*), usually associated with Class I arch relationships, the musician has only to adjust vertically when adapting the lips, teeth, and jaws to the mouthpiece. In this group, a majority of the Class I brass players adjusting poorly had deep bites. Most shallow to end-to-end bites (Fig. 6, *D*) examined were associated with protrusive tendencies of the mandible. Mild or extreme crowding of the lower anterior teeth was often observed. As was pointed out in the discussion about crowding and/or rotation of anterior teeth, the combination of a shallow protrusive overbite with irregular incisors often interferes with both brass and wood-wind embouchures.

Fig. 7, *A*.Fig. 7, *B*.

An open-bite relationship of the maxillary incisors to the mandibular incisors was observed in five of the musicians examined. Although the data are limited, the effect of this condition on those exhibiting it is sufficient to provide general information. Mild open-bites, as shown in Fig. 7, *A*, are not troublesome for brass instrumentalists. The extreme types, however (Fig. 7, *B*), seriously interfere with brass embouchure. All musicians with extreme open-bites failed to make the adjustments necessary to support the instrumental mouthpiece in a satisfactory manner. On the other hand, with one exception, open-bite appears to be of little concern to the wood-wind player. The one exception was observed in several individuals having shallow overbites. In these dentitions, the maxillary canines and lateral incisors have failed to erupt completely to the plane of occlusion. As a result, a type of partial anterior openbite occurred opposite the

corner of the mouth. A similar condition is shown in Fig. 7, *C*. The shift of the mandible forward and downward during the adjustment to embouchure served to increase the open-bite at these points. The condition was particularly disturbing to wood-wind instrumentalists. These individuals experienced difficulty in preventing the escape of air through the corners of the mouth during instrumental activity.

Eleven of the one hundred musicians had a maxillary protrusion similar to the type shown in Fig. 8, *A*. Six of the instrumentalists with protruded maxillary incisors were brass players, and five played wood-wind instruments. A majority of the brass instrumentalists adjusted poorly to embouchure. Here again, the data, although limited, suggest how this condition influences adaptation to embouchure. Maxillary protrusion was troublesome to all brass players who exhibited it. The labial inclination of the upper incisors interfered with the lip placement and increased the amount of jaw movement needed to place the teeth in a supporting position. The general absence of this deformity among brass players suggests in a negative manner that the condition is undesirable for brass embouchure. Wood-wind instrumentalists had no difficulty with maxillary protrusion.

Retrusion of all upper incisors is shown in Fig. 8, *B*. In no case did this condition present a problem for the wind instrumentalist. Rather, when a Class II arch relationship exists, it is of advantage to the brass player. Here, the amount of jaw movement needed to make the adjustment is greatly reduced. However, central incisor retrusion associated with crowding, rotation, and mild protrusion of adjacent teeth gives brass players a great deal of trouble. Malocclusions of this type were recorded under crowding and will be discussed in this category.

Twenty-two individuals exhibited a cross-bite relationship of the maxillary teeth to the mandibular teeth. When a single maxillary central or lateral incisor was in linguoversion to its opponent in the mandibular arch, as shown in Fig. 9, *A*, adjustment of the small brass mouthpiece against the lip labial to the crossed tooth was often difficult. When all upper incisors were lingual to well-aligned lower incisors (Fig. 9, *B*), embouchure problems did not arise. On the other hand, when anterior cross-bite relationships appeared in association with crowding, the wood-wind players experienced lower lip irritation.

Only a few of the individuals examined exhibited mutilations involving the anterior portion of the dentition. None were disturbed by this condition. There is every reason to believe, however, that the loss of a single tooth could affect embouchure in the same manner as the cross-bite of a single incisor. In all of the cases examined here, drifting of adjacent teeth reduced the edentulous space to a width of one-half tooth or less. The complete absence of this condition among all individuals examined serves further to point out the vital role of the dentition in adjustment to embouchure.

Tooth length varies a great deal and can be studied in all figures illustrating this discussion. Although extremes are rarely encountered, definite differences in length are observable. It will be noticed that tooth length is a relative relationship, dependent upon the over-all size of the tooth and the surrounding

structures. In spite of the abundance of data, the only general conclusion available is that short incisors appear among a majority of the brass instrumentalists adjusting poorly.

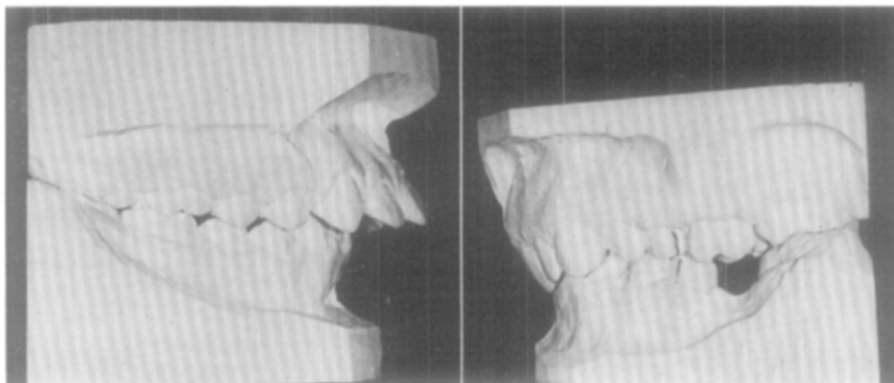


Fig. 8, A.

Fig. 8, B.

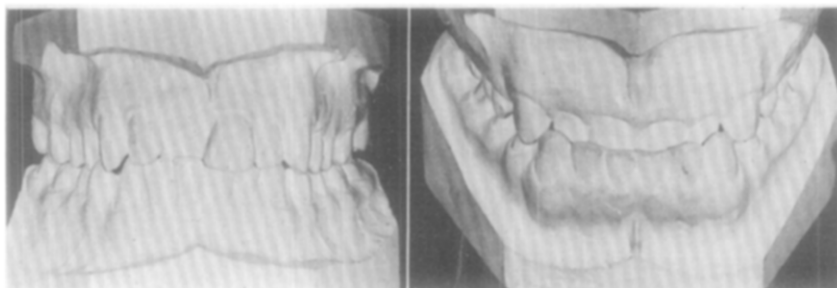


Fig. 9, A.

Fig. 9, B.

The investigation of the role of the lips in the playing of wind instruments revealed some information of a general nature. Thick lips were observed in a majority of Class II brass players adjusting poorly. Thin lip form appeared among many Class III brass players with adaptation difficulties. In addition, a tendency for a short upper lip was noticed among the Class I brass instrumentalists with embouchure problems. Also, the poorly adjusted Class I brass players had longer lip form. However, the data are not clear-cut, and it is difficult to estimate the role of lip size in adjustment to embouchure. It appears more important to consider these parts important as they combine with other variations of the teeth and jaws during function. There is little evidence to show variation in lip form, by itself, as highly influential in the production of a satisfactory or exceptional wind instrument-embouchure.

DISCUSSION

Throughout the analysis, discussion about adaptation to embouchure has proceeded with only occasional reference to the complaints offered by the instrumentalists who adjusted poorly. The nature of these complaints varies a great

deal, and each is individually peculiar. However, for purposes of discussion, they have been grouped into six categories and are listed in Table II. They will be discussed in the order of the frequency with which they occur.

Six musicians complained of "tiring of the supporting structures during playing." They also complained of pain and fatigue in the supporting structures and teeth after relatively short periods of instrumental activity. Occasionally there was pain and fatigue in the muscles of the lip and in the floor of the mouth. As shown in Table II, one of the large brass players had a Class III malocclusion and the other two had mild distocclusions. All had marked spacing of the anterior teeth. Marked anterior spacing was also found in one of the two wood-wind players and the other had retruded lower incisors associated with a Class II malocclusion. For all of these individuals, the adaptation problems centered around discomfort and pain of the teeth and supporting bone and/or early fatigue and pain of the muscles of the floor of the mouth. This distress usually occurred after a short period of instrumental activity. For some, the discomfort reduced the musical efficiency; for others actual playing was prevented for varying amounts of time. The one individual with a Class I malocclusion had extreme anterior spacing, but complained of early tiring of the lips during playing.

TABLE II. NATURE OF COMPLAINT

NATURE OF COMPLAINT	OCCLUSION				TOTAL
	NORMAL	CLASS I	CLASS II	CLASS III	
Tiring of supporting structures	0	1	2	3	6
Have to bring mandible forward	0	0	6	0	6
Cause unknown	0	0	5	1	6
Irregular, rotated, or protruding incisors	0	1	3	1	5
Lip form	0	2	0	0	2
Open-bite	0	0	0	1	1
Total	0	4	16	6	26

In considering the dental conditions associated with this type of complaint, it is apparent, with one exception, that marked spacing of the anterior teeth is common to all. The exception is found in the wood-wind player whose lower incisors tip sharply backward. In addition, with the exception of the small brass instrumentalist, the difficulties are associated with large brass and wood-wind mouthpieces which often subject heavier pressures against the lips and teeth during playing. In view of these circumstances, it is evident that most of the complaints of this group are associated with instability of the incisor teeth as they function in support of the lips during playing. The lack of contact of adjacent teeth or the retruded position of the lower incisors allows the pressure from the mouthpiece to be transmitted directly to the supporting structures instead of being dispersed to closely contacting adjacent teeth in the anterior part of the dental arch. As a result of this pressure, it is probable that low-grade inflammatory processes are set up, similar to the initial changes during orthodontic treatment, and result in pain and discomfort of varying intensities.

Although only mild discrepancies in arch relationship were observed among these individuals, it was noticeable that even the slightest shift in jaw positioning required during adjustment embouchure increased the problem of placing the mouthpiece without increasing the pressure against the supporting lips and teeth. For this group then, closure of the anterior spacing or support of the spaced teeth is indicated in order to give better function for the individual during adjustment to embouchure.

Six musicians complained of "inability to shift the lower jaw forward." All players, with one exception, were brass instrumentalists, and the majority played the small brass instruments. Here, as was pointed out in the analysis, difficulties in adjustment appear in proportion to the amount of distocclusion. Class II arch relationships of one cusp or more were much more troublesome than when a discrepancy of one-half cusp or less was present. The extreme distocclusion is not in harmony with the anatomic requirements for brass embouchure. The instrumentalist must shift his lower jaw forward to place the lower incisors directly below the upper incisors and thereby obtain the proper position to support the mouthpiece equally against both upper and lower lips. For individuals in this group, the jaw shift, when added to the ordinary manipulations necessary during instrumental activity, rendered adaptation highly unsatisfactory, and at times impossible. The adaptation of an extreme distocclusion to a small brass mouthpiece requires a great deal of precision in jaw movement. The trombonist, for example, has a great deal more opportunity to adapt a retruded lower jaw to a medium-sized mouthpiece than does a cornettist adjusting a similar condition to a small mouthpiece.

Here again, orthodontic correction, as an aid to function, is indicated. Distocclusion in its various degrees is generally well handled by the orthodontist. The establishing of functional harmony between the dental arches by creating a balanced occlusal relationship and a one-third to one-half incisor overbite would reduce much or all of the necessary jaw shift needed by the individual with a Class II arch relationship. The possibilities of these changes should be pointed out to music teachers and instrumentalists troubled by such conditions.

The complaints headed "unsatisfactory adjustment—reason unknown" are highly significant when the case histories are examined. Six musicians complained of unsatisfactory adaptation to embouchure, but were unable to point out the cause of poor adjustment. Five were brass instrumentalists and one played a clarinet. Examination of the dentofacial relationships of these individuals revealed, with one exception, that all brass players had extreme distocclusions. Here again, the available information emphasizes how unsatisfactory mandibular retrusion is for brass playing, and especially for the small mouthpiece brass instrumentalists.

A Class II arch relationship of one-half cusp and a short upper lip was observed in the other brass player of this group. He also had mildly protruding maxillary incisors. The presence of the protruding incisors usually increases the amount of jaw movement needed during adjustment for this type of instrumentalist. For this reason, the combination of distocclusion, short lip, and protruding maxillary incisors is often inefficient for brass instrument playing. It

may have been the cause in this case. The clarinetist who complained of poor adjustment also had a mandibular retrusion and some incisor irregularity. As has been pointed out in the analysis, incisor irregularity appearing in the mandible is often troublesome for wood-wind playing. Again the evidence serves to point out the effect of dentofacial irregularity upon wind instrument musicianship, and further demonstrates the value of orthodontic services to individuals who are troubled by this irregularity.

The complaint, "difficulty in adjustment of the instrumental mouthpiece to the front teeth," came from individuals having one of three types of dental irregularity. These included crowding and rotation of the anterior teeth, protrusion of the incisors in the upper jaw, and irregularity associated with cross-bite of one or more of the anterior teeth.

The instrumentalists troubled by crowding and/or rotation of anterior teeth complained that the sharp corners of the rotated crowns irritated the lips as they supported the instrumental mouthpiece. However, it is difficult to determine when the condition will be disturbing to embouchure. This fact is brought out by reviewing all cases of crowding relative to adjustment and non-adjustment. Of thirty-six individuals with upper crowding, fourteen adjusted poorly; only five complained of the irregularity as the direct cause. Out of forty individuals who showed mandibular crowding, twelve adjusted poorly; only three complained of the irregularity as the direct cause. It appears, then, that although anterior crowding and rotation is associated with disturbances in embouchure, it will be the direct cause of poor adaptation for only a small number of individuals who display it.

Two individuals with protruding maxillary incisors complained of this irregularity as the immediate cause of their difficulty. They were brass instrumentalists. Both had slightly less than a one-half cusp distocclusion along with the protrusion. In one case, the lateral incisors protruded sharply alongside normally inclined central incisors. For this individual, the protruded lateral incisors irritated the lip when the mouthpiece was placed against it. In the other case, all incisors jutted outward and the amount of jaw shift needed to bring the lower jaw and teeth forward resulted in an uncomfortable position not satisfactory for long periods of playing. Although the number of complaints examined here is limited, the information definitely points out the disadvantages of maxillary incisor protrusion for the brass instrumentalist.

All of the individuals troubled by an anterior cross-bite exhibited borderline Class III arch relationships. Two small brass and two wood-wind players adjusted poorly to embouchure. One brass instrumentalist had a single central incisor crossed and the other had a single lateral incisor crossed. Both complained that the lingually positioned single incisor removed support from the lip and forced them to replace the instrumental mouthpiece unevenly against the lip. Both wood-wind players complained that the irregularity resulting from the lingually posed incisors irritated the lower lip as it rested against these teeth during function.

In spite of the exceptions pointed out in the discussion about crowding and rotation, the removal of dental irregularities which result in difficult adjust-

ment of the mouthpiece to the incisors is often necessary. In most cases, the orthodontist can align crowded and rotated incisors, reposition protruded incisors for better function, and correct disturbing cross-bites. Again, he should be quick to point out the value of this service to the troubled instrumentalist or to the individual who contemplates wind instrument study.

Two individuals reported an "inability to attain adequate range and control in tone production" due to poor lip shape. Both were small brass instrumentalists and had short upper lips. They blamed the short lip for the inability to attain range and tone control with their instrument. Aside from these two cases, the information obtained in this study shows variation in lip form to be of little significance. However, in view of the importance placed upon lip form by some musicians, it is quite possible that other methods of examination may reveal findings not uncovered here. On the other hand, it should be pointed out that there are various and differing opinions among skilled wind instrumentalists as to the type of lip best suited to the various types of embouchure. Lip form differed considerably among the many excellent brass players examined in this study. In addition, it is possible that lip and muscle exercises may increase the flexibility of these parts and be of value to musicians who claim to have difficulty.

An "inability to support the mouthpiece and to control the air stream" interfered with the adaptation to embouchure of three individuals who had an open-bite relationship of the anterior teeth. One played the brass instruments and two the wood-winds. The brass instrumentalist exhibited an open-bite relationship of the front teeth by three-quarters to one inch. For three years he had attempted unsuccessfully to master the cornet. The teeth, due to the open-bite, were not in position to support the lips during instrumental activity and prevented satisfactory adjustment to the cornet embouchure. A similar result was experienced during efforts to adjust to the larger mouthpiece of a trombone. It is of further interest that this individual gave up the use of the brass instruments without knowing the reason for his failure to make the necessary adjustment for function. From this history it appears that individuals with extreme open-bites should not attempt to play the small brass instruments, nor can they expect to be highly successful in adjusting to the medium-sized brass mouthpiece.

The two clarinetists (they had been troubled also by anterior irregularity and are included in that group in Table II) complained of interference from open-bite relationships occurring opposite the corners of the mouth. At these points, the maxillary canines, and to some extent, the lateral incisors, were in infralabial relationship and there was an open-bite of one-quarter to one-half inch. As these individuals shifted their teeth apart and slightly forward during adjustment, the open-bite relationship at the canines increased. There was considerable difficulty in controlling the flow of the air stream into the aperture of the instrumental mouthpiece since the air tended to pass out through the open-bite areas. As a result, there was an unusual amount of pressure against the cheek tissues opposite the open-bite areas, and after only a short period of musical activity the air began to escape out of the corner of the mouth. As the musculature in these regions began to tire, the condition became almost uncontrollable. While this type of fatigue may be expected after long periods of in-

strumental activity, the individuals discussed here presented problems far more serious than are ordinarily encountered. Under certain conditions, then, partial open-bite relationships interfere with the adjustment to embouchure.

The difficulties encountered in dealing with extreme open-bites are well understood by the profession. For this reason, it seems best to advise against the use of brass instruments by prospective students who exhibit this condition. On the other hand, the lesser degrees of open-bite associated with crowding, protrusion, rotation, tipping, and other dental irregularities are often correctable. In many cases, it will be of advantage to the musician to have this condition corrected.

In conclusion, it is evident that there are many dentofacial irregularities which interfere with wind instrument musicianship. When confronted with these circumstances, the role of the orthodontist varies. In some cases, it will be adequate to advise the selection of instruments best suited to the occlusal variations of the individual. In others, orthodontic services will be needed to provide satisfactory functional relationships for the adaptation to embouchure.

REFERENCES

1. Dewey, M., and Anderson, G. M.: *Practical Orthodontia*, ed. 6, St. Louis, 1942, The C. V. Mosby Company.
2. Revelli, W. D., Rebmann, V. L., Righter, C. B., and Holmes, G. E.: *The World of Music Band Course, Cornet in Bb*, Boston, 1941, Ginn and Company.
3. Righter, C. B., Rebmann, V. L., Revelli, W. M., and Schmidt, A.: *The World of Music Orchestra Course, Clarinet in Bb*, Boston, 1941, Ginn and Company.
4. Righter, C. B., Rebmann, V. L., Revelli, W. M., and Schmidt, A.: *The World of Music Orchestra Course, Flute*, Boston, 1941, Ginn and Company.
5. Righter, C. B., Rebmann, V. L., Revelli, W. M., and Schmidt, A.: *The World of Music Orchestra Course, Oboe*, Boston, 1941, Ginn and Company.
6. Strayer, E. R.: *Musical Instruments as an Aid in the Treatment of Muscle Defects and Perversions*, *Angle Orthodontist* 9: 18-27, 1939.

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