DENTAL PROBLEMS IN WIND INSTRUMENT PLAYING

1.—Dental Aspects of Embouchure

DENTAL complications connected with the playing of wind instruments may be more prevalent and more important than is at first apparent. Consider the large number of players of wind instruments: in addition to the many professional wind musicians there are students at music colleges, children in school orchestras, the large number of adults in brass bands and amateur orchestras, semi-professionals in dance bands and those who play in their homes for personal pleasure. Other than wind instrument players, it would be difficult to find such a large number of potential patients who put their mouths, lips, jaws, teeth, tongues and faces to a use which is so different from the normal functions of eating, speaking and expression. It is obvious, therefore, that there is a clear need for an understanding of the dental requirements of players of wind instruments.

The problems which may arise for the dental surgeon who is treating the player of a wind instrument are due mainly to the very exacting functional demands on the lips, mouth, jaws and tongue during blowing. Herein lies the dental surgeon's greatest difficulty. For, whereas during eating and speaking it may not matter so much whether the patient chews on the one side of his mouth or the other, or whether he speaks in this or in that manner, it matters very much indeed what sound a musician produces and how and when he produces it while playing a musical passage.

The way in which the lips and mouth are applied in the blowing of a wind instrument is known as the 'embouchure' (Grove, 1954). It varies with the different classes of instrument (Plate I) and, since no two mouths are alike, it varies in detail with each player. There are, broadly, four classes of wind instruments and these may be based, for the convenience of the dental surgeon, on the types of mouthpieces. During playing, in each of two classes the mouthpiece is applied intra-orally, and in each of the other two it is applied extra-orally. They are:

Intra-oral Mouthpieces

(1) *Single-reed instruments.* These have a single reed (of cane or plastic) ligatured to the under-surface (or lay) of the mouthpiece; e.g. clarinet, saxophone (fig. 1).

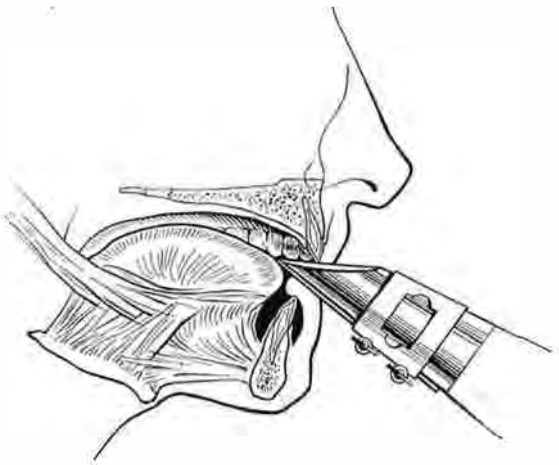


FIG. 1.—Clarinet (and Saxophone). The single reed of the mouthpiece resting on lower lip which covers lower incisors is allowed to vibrate. The top teeth usually are on the sloping top of the mouthpiece. *Note:* (1) Tendency to move upper incisors upwards and forwards. (2) Tendency to move lower incisors and lower jaw backwards. (3) Tendency for lower incisors to cut into lower lip. (4) Some clarinet players draw upper lip under upper incisors (double-lip embouchure) and tend to cut upper lip as well as lower lip.

(2) *Double-reed instruments.* In these, the double reed constitutes the mouthpiece; e.g. oboe, bassoon (fig. 2).

Extra-oral Mouthpieces

(3) *Flute and piccolo.* These have a hole at the head of the instrument across which air is blown (fig. 3).

(4) *Brass instruments.* All of these have cup-shaped mouthpieces of varying sizes and shapes; e.g. cornet (or trumpet), horn, trombone, tuba (figs. 4 and 5).

Of these, 1, 2, and 3 comprise the 'woodwind' instruments.

In addition to the above, mention should be made of the recorder, which is a woodwind instrument related to the flute in fingering and in tone,

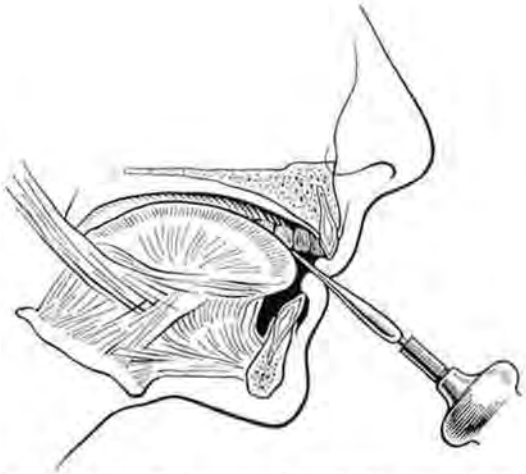


FIG. 2.—Oboe or Bassoon. The double reed of oboe inserted between lips drawn inwards, i.e. 'double-lip' embouchure. (Larger mouthpiece of bassoon requires detailed difference in embouchure due to much larger double reed.) *Note:* (1) Tendency for incisors to be tilted slightly backwards. (2) Tendency for central incisors to cut slightly into lips.

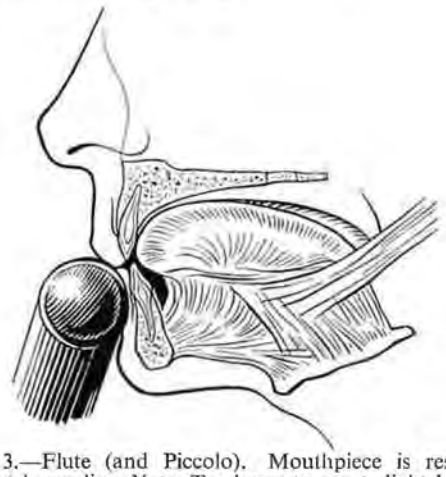


FIG. 3.—Flute (and Piccolo). Mouthpiece is resting against lower lip. *Note:* Tendency to exert slight backward pressure on lower incisors.

and somewhat to the clarinet in appearance and mode of blowing. It is a much simplified version of both and is widely used in schools as an introduction to music and music-making. Many children proceed later to the more advanced wind instruments. The mouthpiece is applied intra-orally. Tone is very easily produced and lip pressure very light. Nevertheless, since it is generally played during the years of rapid bone growth, its influence on the development of the lips, jaws and teeth may be of some significance to the orthodontist because of the treatment he may need to provide for these young patients.

Although the saxophone, flute and sometimes the clarinet may be constructed in metal they are, nevertheless, regarded as 'woodwind' because their design is that of the classical woodwind instrument: i.e. they have holes and keys to produce different tones. The brass have pistons or slides for fingering the various notes.

Brass instruments differ from woodwind in basic functional demands, since the lips perform the dual purpose of washer (preventing escape of air) and reed (being allowed to vibrate as a double reed

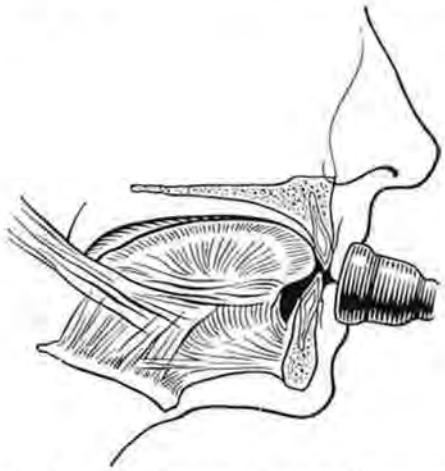


FIG. 4.—Cornet or Trumpet. The cup of mouthpiece is half on upper lip and half on lower lip. Portion of lips within cup vibrate. Portion of lips on rim acts as washer preventing escape of air. *Note:* (1) Tendency to press upper and lower incisors equally backwards. (2) Protruding tooth or corner would disturb lip.

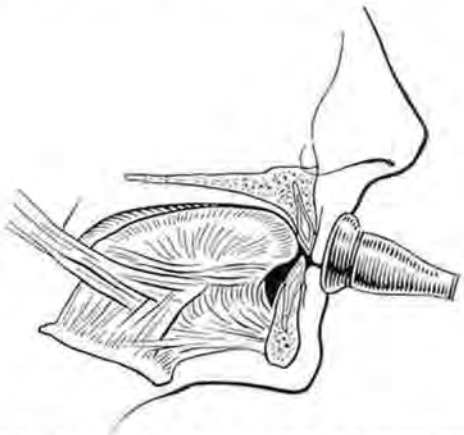


FIG. 5.—Horn. The cup of mouthpiece is approximately two-thirds on upper lip and one-third on lower lip (still more on upper lip with larger mouthpiece, e.g. trombone, tuba). *Note:* (1) Tendency to exert unequal backward pressure on upper and lower incisors. (2) Protruding tooth or corner would disturb lip.

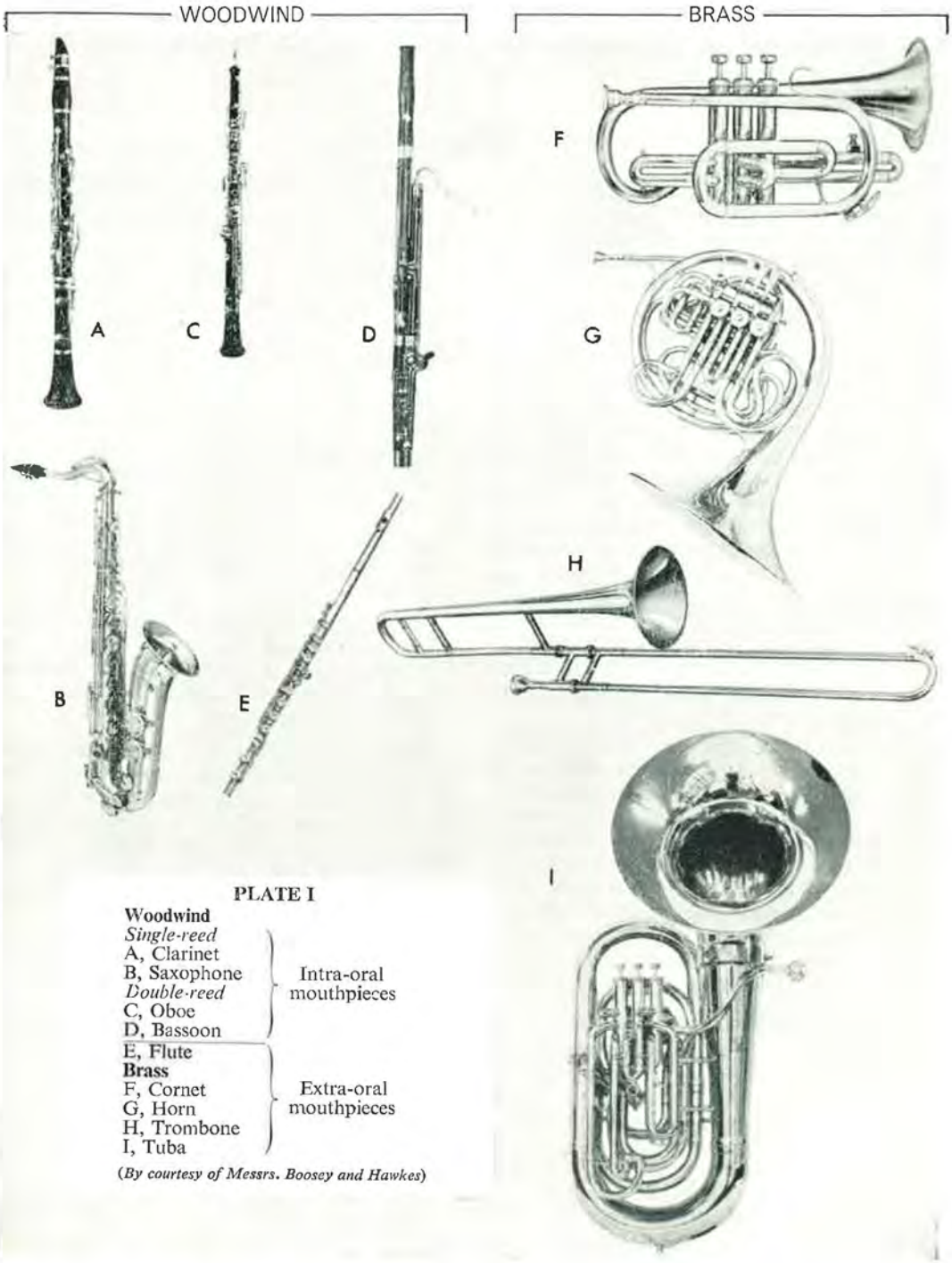


PLATE I

Woodwind

Single-reed
A, Clarinet
B, Saxophone

Double-reed
C, Oboe
D, Bassoon

Intra-oral mouthpieces

E, Flute

Brass
F, Cornet
G, Horn
H, Trombone
I, Tuba

Extra-oral mouthpieces

(By courtesy of Messrs. Boosey and Hawkes)

within the cup of the mouthpiece to produce tone).

In woodwind the lips form a washer-like sphincter around the mouthpiece in single- and double-reed instruments, while in the flute (and piccolo) the lips direct the exhaled air column across the hole at the head of the instrument.

Relationship between Teeth and Embouchure

When learning to play, the embouchure is deliberately developed in a very precise manner which becomes habitual (Porter, 1967). It should, therefore, not be surprising that any sudden disturbance to this habit, such as an alteration in the oral environment, may upset playing.

The embouchure is determined by the suitability of the lips. The suitability of the lips is dependent mainly on the position and form of the teeth (natural or artificial), the bony or artificial structure supporting them, and the jaw relationship. In addition, injuries to the teeth and the restoration of the size and shape of anterior teeth may affect the efficiency of the embouchure. Occasionally a student chooses a wind instrument for which his lips, mouth and teeth are unsuited, although they are healthy and within the bounds of anatomical normality, and his chances of reaching a high standard as a musician are consequently impaired. An example of this is that the upper lip may be too short in relation to the upper front teeth, for playing a double-reed instrument, so that it is too difficult to stretch it downwards under the incisors and backwards into the mouth (fig. 2).

For embouchure comfort and efficiency during playing, it is necessary that the lips shall not be hampered by the presence of rotated, elongated or misplaced teeth (Lamp and Epley, 1935) or proud fillings. The tongue should be free to articulate against the back of the upper incisors, palate, or lips in brass instruments, against the back of the incisors or palate in the flute, or against the reed or palate in the single-reed and double-reed instruments. The dorsum of the tongue is cramped by the presence of an artificial palate.

Adverse Dental Conditions

Dental conditions inimical to performance on wind instruments are numerous. Nearly all are dental defects, but one or two occur in mouths which in all other respects would be regarded as normal. An example of the latter is the choice by the student of a double-reed instrument, referred to earlier, when the upper lip is too short. The disadvantages of the former can be best appreciated by visualising each of the following examples and relating them to figures 1, 2, 3, 4 and 5, which illustrate embouchures in the different classes of orchestral wind instruments.

(1) A protruding tooth or corner in a horizontal direction could disturb brass embouchures.

(2) A vertically projecting tooth or corner could disturb single- and double-reed embouchures.

(3) Sharp, even, incisors could disturb single- or double-reed embouchures by cutting into one or both lips.

(4) Spaces between central incisors could trap the lip and disturb single- and double-reed players.

(5) Painful or loose incisors could disturb players of all wind instruments.

(6) Labial ulcers or inflammatory gum conditions could disturb all players of wind instruments.

(7) Outstanding canines could disturb flute players and those of double-reed instruments.

(8) Dentures, by being dislodged or tilted, would prevent the playing of any wind instrument.

(9) Orthodontic appliances, when impinging on lips or tongue, could cause much discomfort to, or prevent, playing.

(10) Any condition that results in 'open-bite' could prevent lip support in players of certain instruments.

(11) Excessive overbite of anterior teeth could predispose to periapical or periodontal problems of those teeth in players of instruments that require an intra-oral application of the mouthpiece.

Since in playing brass instruments the lips (behaving as a double reed) are required to vibrate at a meticulously regular frequency for each note played, it will be found that the dental problems in these players are usually more difficult than those of woodwind players.

The relationship between the playing of wind instruments and dentistry can be placed into three categories: (1) dental defects affecting playing; (2) dental treatment affecting playing; (3) playing affecting the dentition or dental treatment. When the requirements of the wind instrument player are understood, the first two of these can be dealt with by the dental surgeon and the third averted (figs. 1, 2, 3, 4 and 5). Bearing in mind that the professional player is dependent upon his dentition for the maintenance of his employment, his treatment should always be regarded as urgent.

REFERENCES

Grove, Sir George (1954) Grove's Dictionary of Music and Musicians, 5th ed., vol. II, p. 938. Edit. E. Blom. Macmillan, London.

Lamp, C. J., and Epley, F. W. (1935) *J. Amer. dent. Ass.*, **22**, 1232.

Porter, M. M. (1967) *The Embouchure*, **12**, 129. Boosey & Hawkes, London.

2.—Single-reed Instruments—the Lip Shield

A PATIENT with a normal dentition and normal jaw relationship usually has a fair amount of attrition of the anterior teeth from the age of about 30 years onwards. The resulting sharp, chisel-like edges of the enamel of the incisors—lingually in the lower and labially in the upper (fig. 6)—tend to cut into the lips in players of these instruments. Often, there is a linear impression on the mucous membrane, caused by the teeth, which can be quite painful and may hinder playing (fig. 7).

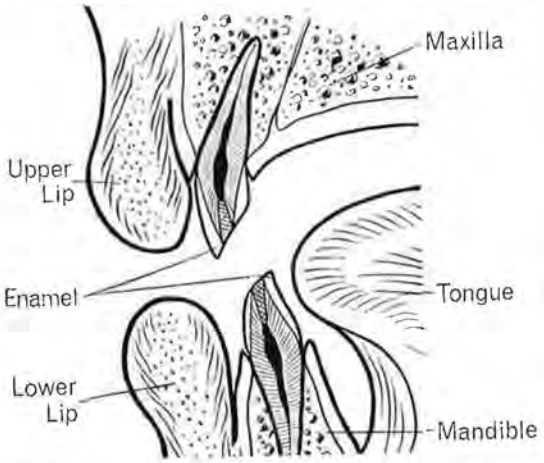


FIG. 6.—To show attrition in maxillary and mandibular incisors in adult of about 30 years or more. *Note:* Chisel-like edges of enamel, labially in maxillary incisor and lingually in mandibular incisor.

FIG. 7.—Linear impression in lower lip due to cutting effect of mandibular incisor teeth of one of foremost clarinet soloists. Dentition is normal and incisor teeth are very regularly positioned.

In the so-called 'single-lip' embouchure (i.e. lower lip over edges of lower incisors) of players of clarinet or saxophone (fig. 8), simple selective grinding and smoothing might suffice to render comfort during playing. A similar procedure could be appropriate in players of the clarinet who use a 'double-lip' embouchure—upper lip curled inwards under upper incisors, as well as lower lip curled inwards over lower incisors (fig. 9); players with long upper lips often prefer the double-lip embouchure. Should the result not be sufficiently satisfactory, a simple lip shield covering the sharp enamel of the offending teeth could solve the problem.

Construction

An improvised shield could be constructed in the mouth using a convenient material such as gutta-percha. It should be made as thin as possible, covering the incisors, canines, and, possibly part of the first premolars. Other materials, such as silicone rubber have also been used, but much patience

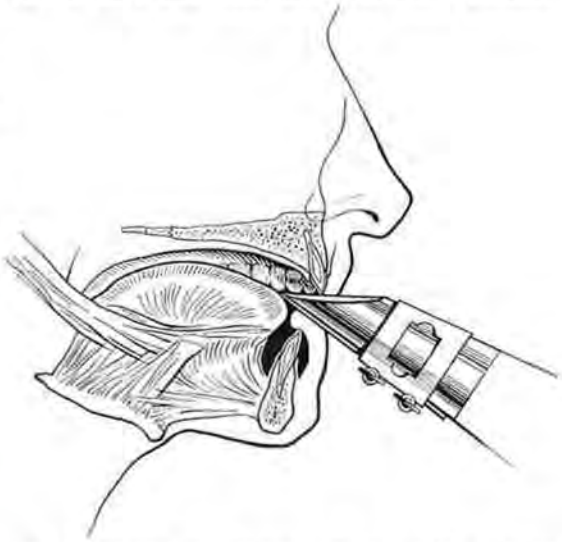


FIG. 8.—'Single-lip' embouchure in clarinet playing where dentition is normal. In saxophone playing, embouchure is somewhat similar. *Note:* Cutting effect of mandibular incisors on lower lip.

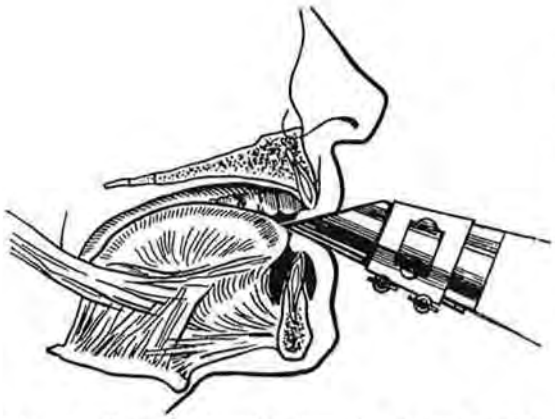


FIG. 9.—'Double-lip' embouchure in clarinet playing, where dentition is normal. *Note:* Cutting effect of maxillary and mandibular incisors on upper and lower lips.

is required in moulding the shield to embouchure requirements (with the mouthpiece in the mouth as in playing) before the material has set. A more permanent shield may be made on an artificial stone model in the laboratory, either in plastic (figs. 10 and 11) or metal.

FIG. 10.—Model of malpositioned mandibular incisor teeth of a saxophonist and lip shield made in laboratory.

FIG. 11.—Lip shield in clear acrylic resin, made in laboratory, fitted to fit model in figure 12.

The author, after many years of experience, prefers the more porous quick-curing acrylic resins to the denser slow-processing acrylics and the much heavier metals. Metal shields present a number of distinct disadvantages. Unless the fit is accurate in the extreme, difficulty will be encountered and time involved in locating proud points on the tooth-bearing surface or in adjusting when too tight. Should the shield be somewhat loose, some material, such as plastic, must be added to make a tighter fit. Metal was also found to cause unpleasant thermal effects in some mouths during cold weather. Furthermore, in some other mouths vibrating and possibly resonating effects disturbed the player; this was also true in a few cases where slow processing acrylics were used. The author also prefers to make acrylic shields directly in the mouth, with the mouthpiece in position from time to time, as in playing, using the following technique.

Direct Method (i)

A thin tin foil sheet (No. 40 gauge Amal. Dent. Co. 0·04 mm.) of suitable size is hand-swaged over the teeth and gum of the field to about $\frac{1}{4}$ inch beyond the intended limit of the shield. Fingers are first used, followed by a soft wood periodontal stimulator (e.g. Inter-dens) or a pencil type rubber eraser (e.g. Olivetti) to ensure swaging sufficiently into interdental spaces without piercing the foil (fig. 12). This sheet of foil is left in place in the

FIG. 12.—Swaging thin tin foil sheet over mandibular incisors and canines as in 'direct' lip shield technique.

mouth. A somewhat smaller sheet of tin foil, four or five times the thickness of the first is now carefully moulded over the first layer so that the incisal area (top) is blunt and rounded. The patient's lip can be drawn over this thicker sheet to ensure that it presents a smooth surface to the labial mucous membrane. Owing to the curvature of the dental arch and in order to prevent or minimise creasing or buckling, the thicker foil may be allowed to stand away a little on the lingual aspect, while conforming

more closely on the labial aspect of the teeth. The top, thick, sheet of foil is removed from the mouth, dried on the inside, where it is smoothed if necessary with a blunt plastic instrument to create an even trough; then it is trimmed with crown scissors to form a modified impression tray.

The trough is now about half-filled with quick-setting clear acrylic resin and when just beginning to set is re-inserted in the mouth and pressed lightly over the swaged first sheet. The patient carefully inserts the mouthpiece into his mouth as in playing high and low notes but with gentle pressure at first; as hardening proceeds pressure may be increased slightly. Care should be taken that the acrylic does not extend to the soft tissues.

When the acrylic has almost set, the whole shield with both layers of foil is removed and replaced. The purpose is that the shield does not become fixed in the mouth by too much compression into undercuts. It is once again removed from the mouth when set. The top foil may now be peeled off the plastic with ease. The thinner foil is carefully removed from the inner, dental, surface. Should it tear, an excavator will facilitate removal of the remainder. The shield is now trimmed and on re-insertion should be found to fit the teeth adequately. The lip should be drawn over the shield to locate any proud edges or bumps. Final light stoning, burnishing with abrasive rubber cups or wheels and polishing, might be necessary. Heavier stoning may be required on the outside of the lingual aspect, where the thicker foil was allowed to stand away from the teeth to minimise buckling.

Direct Method (ii)

An alternative method is to use an artificial stone model cast from an alginate impression taken at an earlier visit, and to carry out the procedure with the thin and thick foils as above, but doing most of the work on the model. During the process the shield with foils may be tried in the mouth before the acrylic has set, and tested with the player's mouthpiece.

It will be found that the above methods are likely to be more successful than when the shields are made on models in the laboratory. In the latter case the technician is left to guess the thickness and the labial contour necessary for the patient's embouchure requirements, but on the other hand the dental surgeon can stone the acrylic as necessary in the mouth. Should such a method result in the shield being too loose, careful addition of a little quick-setting acrylic in selected areas can improve the retention.

In all cases the patient is advised to clean the shields carefully and regularly after use and to keep plastic ones damp, to avoid or minimise shrinkage.

Many such lip shields have been known to last for years.

3.—Single-reed Instruments—Restorative Dentistry

Dental Pressure on Lips

MOST players of these instruments use the 'single-lip' embouchure, i.e. lower lip curled over the incisal edges of the lower teeth to support the single reed, while the upper anterior teeth are on the upper surface of the mouthpiece. Should the teeth be regularly positioned, a 'linear pressure' mark, which is sometimes painful, often occurs on the mucous membrane of the lower lip. Where there is irregularity or rotation of one or more lower incisors sharp 'point pressure' on the lower lip is a frequent result, with consequent pain during playing. The object of any treatment is to eliminate the tendency of the incisors to cut into the lip, in order to give maximum comfort during playing.

When the rotation is slight, selective grinding and polishing of the protruding corners of the tooth is often all that is necessary to ease the condition. Where the player uses a 'double-lip' embouchure, i.e. upper lip curled inwards under the incisal edges of the upper incisors as well as the lower lip curled inwards over the lower incisors, a similar procedure would be appropriate to an upper tooth.

Where the rotation of the tooth or teeth is greater, grinding and polishing are not likely to be sufficiently effective to remedy the discomfort during playing. In such cases, a lip shield would probably solve the problem and its effectiveness may be tried by first constructing an improvised one from, say, gutta-percha, made as thin as possible.

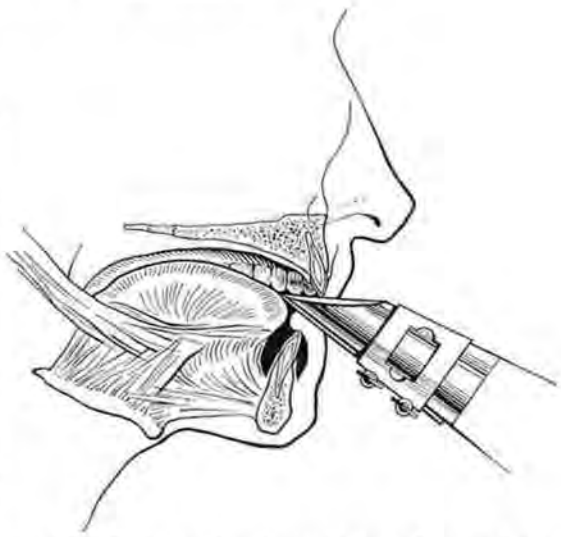


FIG. 13.—Clarinet embouchure with lower lip completely covering incisal edges of mandibular incisors. This often results in a disturbing 'linear pressure' mark on lower lip.

Labial Pressure on Lower Incisor

Most players of single-reed instruments (e.g. clarinet, saxophone) are taught to cover the lower incisors with the lower lip (fig. 13). A comparatively smaller number are taught to contract the lower lip against the labial surfaces of the lower anterior teeth (fig. 14), presumably to avoid either 'linear pressure' or 'point pressure' on the mucous membrane of the lower lip (fig. 15). The result of the latter method of embouchure adaptation is 'surface pressure' against the lower incisors (fig. 16) often with adverse periodontal effects (Porter, 1953). Another reason for this method sometimes being taught is that the teacher, himself having a short

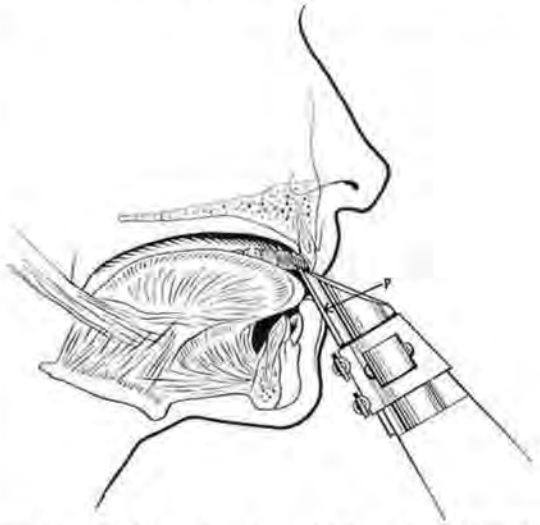


FIG. 14.—Clarinet embouchure with lower lip contracted against labial surfaces of mandibular incisors. Sharp edges or corners of lower incisors are avoided by the lip, but labial 'surface pressure' (P) against the teeth is largely increased.

lower lip in relation to the length of the lower incisors, finds it less comfortable to stretch his lower lip over the incisors.

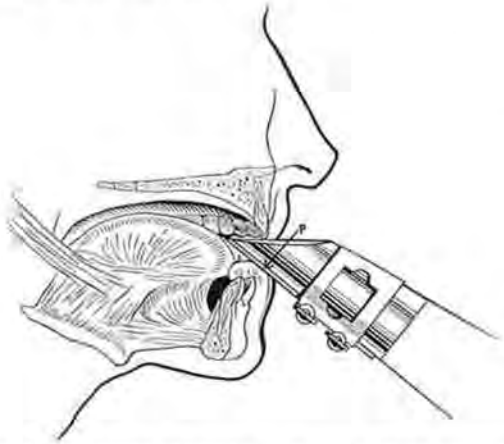


FIG. 15.—Clarinet embouchure, showing 'point pressure' (P) on lower lip as a result of rotated mandibular incisors.

FIG. 16.—Illustrating effect of labial 'surface pressure' on lower incisor using embouchure as in figure 14. The result of the pressure (P) is intentionally exaggerated.

The objective is to find adequate means of resisting the labial pressure during playing, but a lip shield is not always suitable. Its labial bulk, however slight, may at first discourage some players because the additional stretching of the lower lip imposes an appreciable alteration to the habitual embouchure. Nevertheless, since in a few cases the shield is, in fact, tolerated and does reduce the pressure on the teeth during playing, it is worthy of trial in the first instance. The object of the shield in these cases is to take the strain of labial 'surface pressure' off the incisors by spreading the load over several teeth (fig. 17). Since the canines with their longer roots are usually firmer than the incisors, the shield should extend at least to their distal portions.

Periodontal Treatment and Playing

When a player already is undergoing periodontal treatment, it is essential for the dental surgeon to be aware of the fact that the effects of playing can interfere with the treatment. Nevertheless, treatment may be necessary in order to prevent the possible loss of the teeth due to the forces exerted during playing. Means of resisting lingual movement of the lower incisors during playing may be indicated, such as periodontal splinting by either removable or fixed appliances. Periodontal splints that incorporate incisal onlays may have edges to which the lip is sensitive, particularly during playing; it is important that these edges are eliminated. For this reason, horizontal pin splints (Sanell and Feldman, 1962) may be indicated.

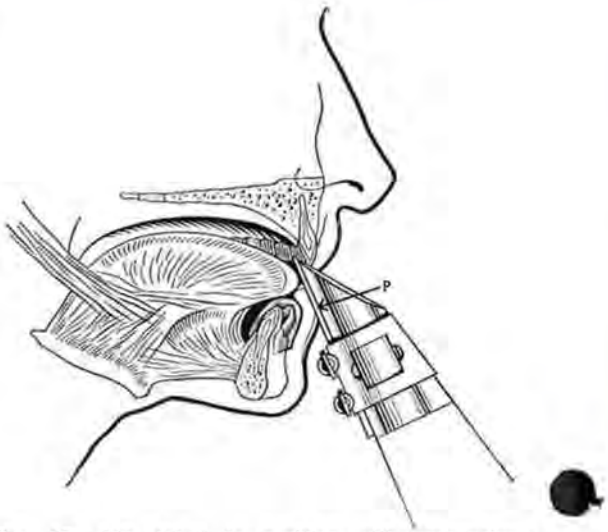


FIG. 17.—Lip shield in position with embouchure adopted as in figure 14. Loosening of incisors is prevented by spreading the pressure (P) over several teeth.

In the single-lip embouchure, the upper incisors rest on the inclined plane of the upper surface of the mouthpiece during playing and the mouth is therefore slightly open. Due to the more powerful elevators of the mandible slowly overcoming the weaker depressors, there is an unintentional tendency for the teeth to close on the mouthpiece which may in time loosen them. To overcome this, inlay splinting, or horizontal pin splitting, may be required. In some cases removable periodontal splints reinforced with adequate flattened palatal bars would suffice. Missing posterior teeth could of course be included where necessary.

Restorative Treatment and Playing

In carrying out routine restorative treatment, it should be mentioned that large approximal fillings in upper anterior teeth could render incisal corners particularly vulnerable to fracture where the upper incisors rest on the mouthpiece. Should fractures occur, adequate reinforcement of the incisal edges of facings in inlays is especially indicated. Three-

quarter crowns are to be preferred because they are more resistant than keyed inlays or pinlays, the last being more likely to result in fracture of the tooth mesially or distally along the direction of the pins.

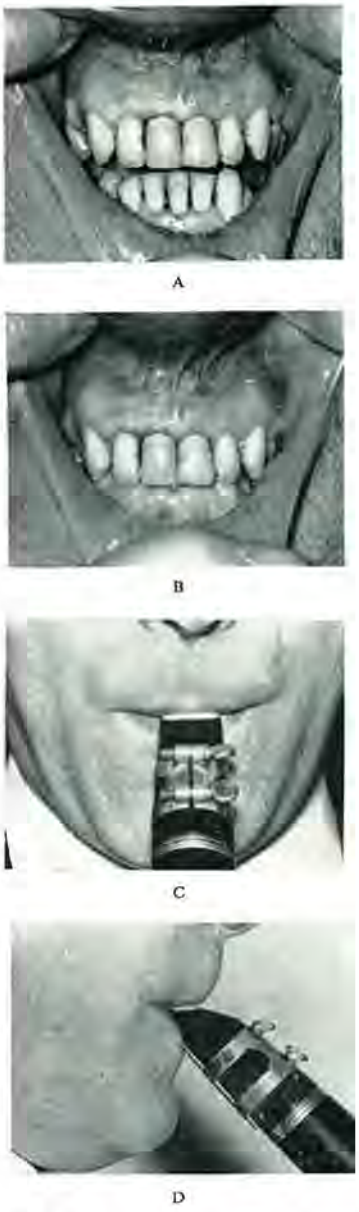
Porcelain or plastic jacket crowns are also liable to be dislodged or fractured if the incisal edges are too proud when resting on the sloping and laterally curved upper surface of the intra-oral mouthpiece of this class of instrument. In constructing these restorations it would be advisable to use a small hard wax bite-block against which the upper surface of the mouthpiece has been adapted as in playing. This will record the lateral curvature of the mouthpiece of the instrument as well as the inclined plane and may be reproduced in the finished crown. Metal-backed and tipped crowns, such as in gold-porcelain bonded or plastic-faced crowns, would probably resist fracture better although, except for its appearance, a complete metal crown would be most suitable.

In some of the cases mentioned a lip shield could be constructed over the upper incisors and canines in order to relieve pressure on particularly vulnerable restorations, which should be slightly reduced in length to accommodate the shield. In this way the load is spread over the remaining sound incisors and canines. Not all players, however, are able to accustom their playing to the extra bulk, however thin, particularly the player with a very short upper lip, since the lip is prevented from performing the function of an efficient washer and is unable to prevent escape of air.

Problems arising from Endodontic Treatment

Upper incisors which have undergone endodontic treatment present special problems, particularly where apicectomy has been performed. Unless the dentist knows that he is dealing with the player of a wind instrument, the treatment may be jeopardised, especially where professional musicians are concerned. Such teeth should be adequately protected from pressure in the apical regions, but instead of this they are probably being subjected to excessive pressure for several hours daily. When post crowns are being fitted, it is advisable to construct them rather shorter incisally than usual, particularly where there is an excessive overbite and where the anterior teeth rest on the top of the mouthpiece.

The 'lip' shield (in this instance the 'tooth' shield) once again is a means of preventing loss of the affected teeth, by distributing the pressure over a number of neighbouring teeth. Allowance is made for adequate, although minimal thickness of the shield which at the same time can be relieved where it would touch the tips of the affected incisors. This will prevent undue pressure in the apical region.



A, B, C, D

FIG. 18.—Endodontic treatment, apicectomy and temporary crowning of $\underline{1}|\underline{1}$ in a professional player. A, Mouth slightly open. Temporary post-crowns on $\underline{1}|\underline{1}$; subgingival calculus visible at $\underline{1}|$. *Note:* Incisal edge on plastic $|\underline{1}$ shaped to curvature of upper surface of mouthpiece. B, Teeth in centric occlusion. *Note:* Excessive overbite creates undue pressure on $\underline{1}|\underline{1}$ in playing intra-oral instrument, such as clarinet or saxophone. C, Mouthpiece slightly to left of centre, corresponding to facet on $|\underline{1}$. This is player's habitual embouchure of comfort. He has applied Elastoplast to the upper surface of the mouthpiece to prevent it sliding. D, Pressure of upper incisors on wedge-shaped mouthpiece as single-lip embouchure is used. Shield is in position on $\underline{321}|\underline{123}$.

In the event of loss of such teeth, a permanent prosthetic appliance, either fixed or removable, can be resorted to later. Meantime, should one or two incisors suffer removal, the shield which was in use prior to their loss may still be sufficiently serviceable for playing. The missing tooth or teeth may be replaced within the shield by an immediate artificial tooth or teeth; or some tooth-coloured plastic or even gutta-percha may be added as a temporary measure during the resorption period.

A

B

C

D

E

F

G

FIG. 19.—Endodontic treatment in $\underline{2}\underline{1}|\underline{1}$ with apicectomy and crowning of $\underline{1}|\underline{1}$ in professional player. A, Models after $\underline{1}|\underline{1}$ crowns were shortened by author on 12.11.62. B, After removal of $|\underline{1}$ on 22.6.67. Mouth slightly open. C, In centric occlusion, showing degree of overbite. D, Original shield in position with gutta-percha replacing missing $|\underline{1}$. E, Immediate denture replacing $|\underline{1}$ temporarily for æsthetic purposes when not playing. F, Playing with shield in position. Mouthpiece slightly to right of centre. G, Profile when playing with shield in position. *Note:* Position of upper surface of wedge-shaped mouthpiece in relation to area of $\underline{1}|\underline{1}$. Single-lip embouchure is used.

By this means the player, particularly if he is a professional, need not discontinue playing while awaiting a more permanent replacement. An immediate temporary denture may be fitted, in addition, for æsthetic purposes.

Illustrative Cases

The two following cases illustrate the need for the special care required in treating players of these wind instruments. Each was helped by the use of a lip shield, here behaving as a 'tooth shield'.

In the first case (fig. 18), endodontic treatment with apicectomy and temporary plastic crowning of $\underline{1}|\underline{1}$ was carried out in a professional clarinet and saxophone player. The patient was unable to earn his livelihood for several months after the treatment due to the periapical pain during playing. He was referred to the author following the above treatment; permanent crowning and periodontal treatment of the lower jaw was to follow later at a teaching hospital, with whom the writer was in close co-operation. The crowns at $\underline{1}|\underline{1}$ were shortened and $|\underline{1}$ shaped incisally to accommodate better the upper surface of the mouthpiece and a plastic shield, which was made to transfer pressure to $\underline{3}\ \underline{2}|\underline{2}\ \underline{3}$. This enabled the musician to resume playing after a few weeks. The permanent crowns were to be fitted later to imitate the reshaped plastic ones.

In the second case (fig. 19), endodontic treatment of $\underline{2}\ \underline{1}|\underline{1}$, with apicectomy and crowning of $\underline{1}|\underline{1}$, was carried out at a teaching hospital on a professional music teacher, who is a talented clarinet player. Playing was disturbed, uncomfortable and frequently painful. When first seen by the writer on 12.11.62, periapical irritation was evident over $\underline{1}|\underline{1}$. These teeth were retained by reduction in length of the crowns and the use of a shield which transferred the pressure to $\underline{3}\ \underline{2}|\underline{2}\ \underline{3}$. Subacute inflammation supervened over $|\underline{1}$, which had to be removed on 22.6.67. Nevertheless, the patient is able to continue playing with the use of the same shield. Gutta-percha replaces $|\underline{1}$ in the shield during the initial resorption period. A temporary denture replaces $|\underline{1}$ for æsthetic purposes when the patient is not playing. Later, a chrome-cobalt embouchure denture will be constructed to normal and embouchure requirements. A bridge is not considered advisable at present.

REFERENCES

Porter, M. M. (1953) *Brit. dent. J.*, **95**, 153.
Sanell, C., and Feldman, A. J. (1962) *J. prosth. Dent.*, **12**, 138.

4.—Single-reed Instruments—Partial Dentures

IN the playing of single-reed wind instruments, e.g. clarinet or saxophone, the lips are intended to act mainly as a washer, preventing the escape of air. Where the 'single-lip' embouchure is used, that is the sole purpose of the upper lip. The lower lip, besides acting as part of the sphincter-like washer, also supports the reed and helps to control the series of its regular vibrations which are required to generate a musical sound. In addition it acts as a buffer between the reed and the lower anterior teeth. With the clarinet the lower lip is curled more lingually, while with the saxophone it is usually pursed more forward (figs. 20 and 21). Where a 'double-lip' embouchure is used, the upper lip, being curled inwards under the incisal edges of the upper incisors, also acts as a buffer, but between the upper incisors and the top of the mouthpiece. Moreover, much of the pressure to which the upper incisors are exposed in the single-lip embouchure, is absorbed by the upper lip in the double-lip embouchure. When the pressure is excessive, the pain felt in the lip acts as a warning sign. This probably accounts for loss of $\underline{1}|\underline{1}$, or other dental trouble with those teeth, being unknown to the author in players who use the double-lip embouchure in single-reed instruments.

FIG. 20.—Example of clarinet embouchure. Lower lip curled backwards over lower teeth.

FIG. 21.—Example of saxophone embouchure. Lower lip pursed more forwards than in figure 20.

Partial Denture Prosthesis

Overcoming Tilting Forces

In players of these instruments upper partial dentures are frequently subjected to definite tilting forces by the wedge-shaped intra-oral mouthpiece, especially in the case of the single-lip embouchure when the artificial upper anterior teeth resting on the inclined plane of the mouthpiece tend to be forced upwards and forwards, displacing the back of the denture. Adequate clasping of suitable natural teeth helps to prevent such movement, but alone is not altogether satisfactory. The forces working during playing, while probably not noticeable to the player, are now transferred in part or in whole to the clasped teeth, which may subsequently become loose.

The loosening would be mitigated, no doubt, by spreading the load and clasping several teeth, but it is doubtful whether sinking into the gum would be adequately prevented by this means alone. A much more efficient means to prevent such sinking would be the inclusion of sufficient incisal and occlusal onlays. Wherever possible incisors and canines should have metal onlays in addition to those which may be indicated for posterior teeth. Where the bite is very close, selective grinding of opposing teeth should be considered to allow for the provision of the onlays. Should the bite be so extraordinarily close that under other circumstances onlays in the upper front teeth would not be included or may be even contra-indicated, it may be advisable to provide a special separate denture, constructed exclusively to individual embouchure requirements, to be worn only for the purpose of

playing the instrument (fig. 22). With this special denture the problem of the very close bite would not arise and the incisal onlays may be included, as the mouth is open during playing. During rest periods in the music the opposing teeth will, no doubt, occlude occasionally and the bite will feel raised, but if the bite is evenly distributed and not unduly raised, it could be reasonably tolerated at each music session.

Construction of Special Upper Denture

Although during construction of the special partial denture the impression may be taken and the jaw relationship recorded in the usual way, it would be advisable to make some provision for alining the anterior teeth in the 'setting-up' stage to conform somewhat to the upper surface of the wedge-shaped and laterally convex mouthpiece. This may be done by trimming a small, specially prepared wax bite-block in the incisor region to conform with the convexity and inclined plane of the upper surface of the mouthpiece of the instrument, which is adapted to the mouth as in playing. At the same time, the labial surface of the wax block should conform with the mucous surface of the upper lip, which is manœuvred as in playing.

A

B

C

D

E

F

FIG. 22.—Special partial prosthesis for clarinet player. A, Mouth slightly open. *Note:* Length of $|\overline{23}$. B, Mouth closed. *Note:* Excessive overbite. $|\overline{23}$ are in contact with palatal gingivæ of $|\underline{12}$. C, Temporary plastic denture for appearance. D, Special denture for playing. *Note:* Incisal and occlusal onlays; absence of artificial palate. E, Playing with special denture. *Note:* Mouth is open and raised bite of onlays is of no consequence. F, Same player as in E. Single-lip embouchure used.

The alinement to the upper surface of the mouthpiece would be more appropriate to the single-lip embouchure, since the anterior teeth, especially the centrals, rest directly on that surface with increasing pressure during long sessions of playing. In order to prevent any disturbing sliding effect along the polished upper surface of the inclined plane of the mouthpiece, the incisal edges of the upper teeth need not be too blunt or too polished. Also, where possible, the gum-bearing surface of the cervical edges of the artificial incisors should be blunt and

rather domed and not sharp (*see* fig. 23B). Moreover, it should be mentioned that, since some players of these instruments find control of the air column during blowing hampered by the presence of an artificial palate, special dentures should be constructed without a palate, wherever this is possible (*see* fig. 22). Other players, including a celebrated teacher of the saxophone (fig. 23), tolerate a flattened palatal bar in the upper denture very well. This player wished to retain the characteristics of his natural dentition and is able to tolerate the reproduction of a linguo-inclined $|\bar{1}$ in his lower denture, probably because his lower lip purses forward in front of, rather than over, his lower incisors. With the double-lip embouchure, the upper lip is interposed between the teeth and the mouthpiece, acting as a buffer to the teeth, and moulding itself to any differences in length between the incisors. However, in order to prevent any discomfort to the lip, the incisors and canines should be blunt, smooth, not too long and regularly alined, so that they do not cut into the lip.

A

B

C

D

E

F

FIG. 23.—Saxophone Player: same as in figure 21. A, $\underline{21}|\underline{12}$ and $\underline{2\bar{1}}|\underline{\bar{1}2}$ missing. B, Upper and lower dentures with adequate onlays constructed to normal and embouchure requirements. C, Dentures in centric occlusion, front view. *Note:* Incisal concavity on $|\underline{1}$; and lingually placed $|\bar{1}$ conforming to earlier habitual embouchure. D, Same as C in profile. E, To show lower denture in position. *Note:* Lower anterior teeth are in the position of the natural teeth. The patient had developed an embouchure of accommodation to this irregularity; and an established satisfactory embouchure should seldom be disturbed. F, Player's embouchure, front view. *Note:* Mouthpiece slightly to left of centre. The profile of this player is shown in figure 21.

Construction of Special Lower Denture

In lower partial dentures, the anterior teeth should be usually regular in alinement and rather blunt and smooth on the incisal edges in order not to cut into the lower lip, unless an irregularity, to which the embouchure has long been accustomed, is definitely required (fig. 23, E and F). While onlays on remaining natural incisors offer much advantage in preventing sinking into the gum during playing, care is necessary to ensure there are no minute proud or sharp edges encroaching on a lip which is curled over them. Clasps should conform as near as possible to the anatomical form of the tooth to be comfortable to the lip. Roach clasps, if used, should

also not interfere with the comfort of the lip. The lips are sensitive to sharp edges or protrusions on dentures much more acutely during the playing of a wind instrument than under other circumstances.

Bridge Work

When constructing bridges for such musicians a compromise is necessary between the normal requirements of eating and speaking and those of the individual embouchure. For example, while alining the upper anterior teeth to the top of the mouthpiece and to the lip for comfort in playing they should also conform to occlusal requirements for eating. Where a single pontic is to replace a missing tooth, abutments and abutment teeth would need more than the usual strength to withstand the eccentric forces consequent on the playing of this class of instrument. For example, a full crown abutment on one side of a pontic and no abutment at all on the other side, or a threequarter crown on one side and an inlay spur on the other, are likely to be slowly or suddenly loosened or dislodged. Full crowns on abutment teeth on each side of the pontic are advisable.

Long-span bridges (e.g. to replace missing $\frac{21}{12}$ by full crowns on $\frac{3}{3}$) would need adequate strength and length of abutment teeth or some additional reinforcement. Long or short palatal armed bridges (e.g. spring cantelever) would probably be contra-indicated unless some means of preventing excessive sinking into the soft tissues during playing is included. In the single-lip embouchure such sinking and possible distortion of the bridge is more likely to occur than with the double-lip embouchure, where the upper lip affords some protection to the bridge.

Protective Value of Lip Shield

In any of the cases mentioned a lip shield might still be used to much advantage, and the possibility of its use should be taken into account in designing the particular bridge, e.g. whether length of pontics could be reduced to allow for the overlying bulk, however thin, of the shield. Where labial surfaces of crowns are to be in porcelain or plastic it would be advisable, where possible, to make a superimposed shield to be used while playing. Where inlay bridges are constructed the use of a shield should be invariably explored to prevent dislodgment or distortion and to protect facings.

With lower anterior bridges there is likely to be more than the usual downward and backward pressure during long sessions of playing. Full crowns on abutment teeth are advisable and, in cases of doubtful firmness of such teeth, re-inforcement by means of a shield or special removable lingual periodontal splint support might be necessary.

The Professional Player

When a bridge has been constructed for a wind instrument player, particularly if he is a professional musician, it is necessary to examine his mouth clinically and radiographically (unless contra-indicated because of possible over-exposure to x-rays) about every four months. During the blowing of wind instruments there is an excessive salivary secretion which accumulates at the front of the mouth (Huszar and Gondor, 1949) and this requires a more frequent removal of calculus. It is also advantageous to take impressions annually so that successive models of the teeth and jaws can be used to ascertain whether or not there have been any alterations in the teeth or the jaw relationship. Such models also act as records in case of accident.

So far as the *professional* wind musician is concerned, it cannot be stressed too strongly that even a slight mishap resulting in difficulty of embouchure adaptation could immediately prevent playing, so that the patient is out of commission as a musician and is deprived of his livelihood. Owing to the intense competition in the field of orchestral music no player, however good, is indispensable and his concern with the possibility of losing his place in an orchestral team is, unfortunately, well justified.

Moreover, it would behove the anæsthetist and oral surgeon as well as the dental surgeon, to exercise extreme care during the administration of a general anæsthetic in order to prevent damage, however slight, to the anterior teeth in a player of a wind instrument. In one unfortunate case, the author was served with a subpœna to give professional evidence in the High Court in an action brought by a wind instrument player against a hospital, following an operation for the removal of a nasal polypus. Thereafter the patient was unable to play his instrument, although only the mesial corners of $\frac{1}{1}$ were chipped. In this case, it was proved to the satisfaction of the judge that the damage was caused by the patient biting the edge of a spittoon on recovering from the anæsthetic. The verdict of the judge was in favour of the hospital.

REFERENCE

Huszar, G., and Gondor, L. (1949) *Dent. Items*, 71, 929.

5.—Single-reed Instruments—Full Dentures

THE problems of full denture prosthesis assume a unique character where the playing of wind instruments is concerned. In the single-reed instrument, the reed, which rests on the lower lip and is the sound generator of these instruments, must be allowed to undergo a series of regular vibrations to produce a musical tone. This necessitates absolute control of the column of expired air entering the mouthpiece.

An artificial denture, bearing an artificial palate and the replacement of alveolar bone as well as teeth, is already hampering such control and as it partly surrounds the air column, the player requires patience and tolerance to overcome the problem. The control is far more complicated when retention of the denture is short of being practically rigid, as the air column in the mouth is then altered and stability of the flow and pressure of air is difficult to maintain.

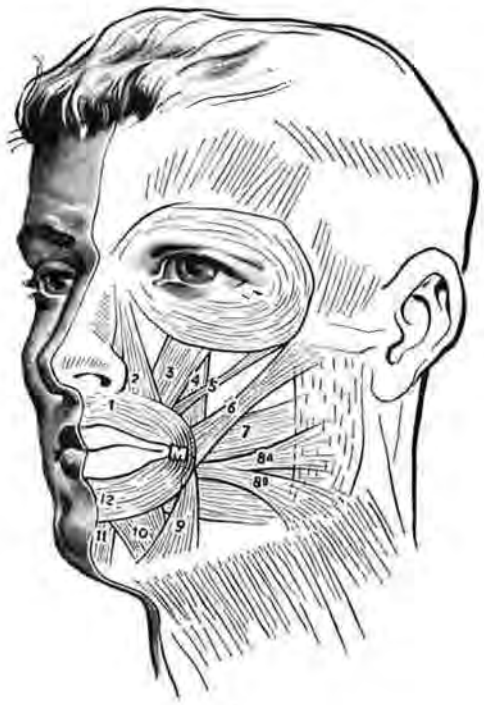
Full Denture Requirements

The objective, therefore, is to construct for these players full dentures which will not hinder the lower lip in allowing the reed to vibrate; the artificial palate and the teeth should not hamper the player's control of the air column; and, perhaps most important of all, the retention of the denture should be as rigid as possible. Rigid retention is necessary to resist the dislodging forces imposed by the wedge-shaped mouthpiece and the individual embouchure adaptation thereto. In this last respect, it is recommended that, when the denture is being constructed, advantage should be taken of the contraction of certain muscles of the embouchure which will help retain the dentures in position during blowing. Notable among these muscles are the modiolus (Fish, 1948), the buccinator and the risorius (fig. 24 A and B). The dentures should be carefully designed to accommodate an exaggerated buccal muscular pad in the premolar and molar regions bilaterally. The form of the premolars and the molars should be extremely narrow buccolingually and the dentures should be flanged so that the buccal pad created inside the cheek by the contracting modiolus, buccinator, and risorius, occupies an artificial fossa in the dentures (i.e. an 'embouchure fossa').

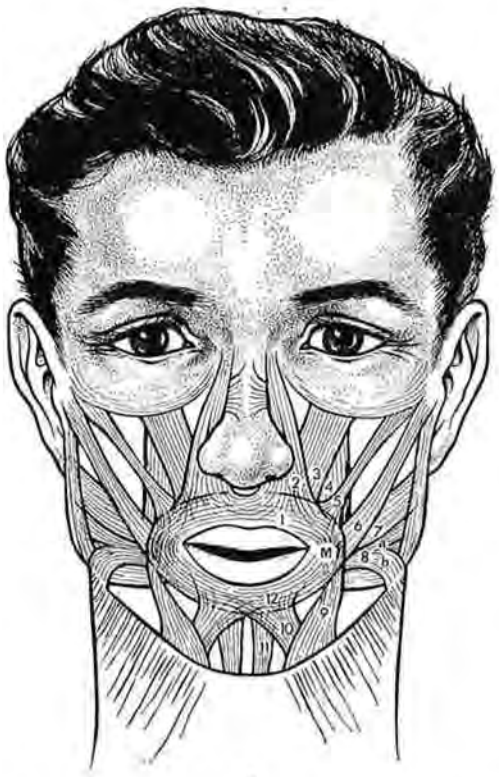
The upper anterior teeth should be designed and arranged to help accommodate the mouthpiece and the lips to give maximum playing comfort and minimum tilting effect.

Helpful Data on Embouchure

Where loss of remaining teeth is imminent, impressions should be taken with any partial dentures in position and when centric occlusion is not obvious the bite should be recorded. It is an advantage to have photographs taken of the player, if possible in profile and full face, with his instrument as in playing and without his instrument with his teeth in centric occlusion. The models will show the height, arrangement and form of the upper and lower anterior teeth and will be a guide, together with the photographs, in relating these to the length



A



B

FIG. 24.—Scheme of musculature of embouchure. A, lateral view. M, modiolus. 1, orbicularis oris (upper lip portion). 2, levator labii sup. alæque nasi. 3, levator labii superioris. 4, levator anguli oris. 5, zygomaticus minor. 6, zygomaticus major. 7, buccinator. 8a, risorius (masseteric strand). 8b, risorius (platysma strand). 9, depressor anguli oris. 10, depressor labii inferioris. 11, mentalis. 12, orbicularis oris (lower lip portion). B, front view. M, modiolus. 1, orbicularis oris (upper lip portion). 2, levator labii sup. alæque nasi. 3, levator labii superioris. 4, levator anguli oris. 5, zygomaticus minor. 6, zygomaticus major. 7, buccinator. 8a, risorius (masseteric strand). 8b, risorius (platysma strand). 9, depressor anguli oris. 10, depressor labii inferioris. 11, mentalis. 12, orbicularis oris (lower lip portion).

of the upper and lower lips. The photographs will also show the degree of opening of the mouth, the extent of insertion of the mouthpiece into the mouth, and the angle at which the mouthpiece is held in relation to the lower lip and chin. Extra-oral radiographs with the mouthpiece in place are also a help.

Without such preliminary data, the dental surgeon not acquainted with the playing of wind instruments or with dealing with such patients is left to guess the construction of the denture to individual embouchure requirements; the result could easily be unsuccessful so far as the patient's playing is concerned. When the teeth are extracted it is helpful to retain the anterior teeth in order to copy the form, particularly of the central incisors.

Methods of Construction

In taking impressions, it is essential to use special trays and in manœuvring the lips and tongue for muscle recording a narrow short block of wax or composition can with advantage be included in the incisal area of the special tray. The purpose of the wax or composition is to assist the mouthpiece of the instrument to be held in the mouth as in playing while taking the impressions, so that any eccentric positions of the lips, tongue and cheeks can be recorded on the impression. It is assumed that the alveolar bone has been fully prepared for dentures, by removal of sharp interstitial spicules and edges of alveolar bone.

Wax bite-blocks on base plates should be trimmed to a height and bulk that, when in centric occlusion, give a facial contour which, in the judgment of the operator, corresponds with the appearance in the photographs (those taken in centric occlusion without the instrument). The bite should also correspond as near as possible with that of the pre-extraction models. Next, the incisal area of wax in the upper should be lightly and carefully trimmed to conform reasonably to the top of the mouthpiece, which has been placed in the mouth as in playing.

With both upper and lower bite-blocks and the mouthpiece in position, as in playing, the facial contour is compared with that shown in the photograph which includes the mouthpiece. Allowance should be made in the vertical dimension for impression paste to be used. Impressions are taken with the paste in one of the special trays; the other tray is inserted without the paste and, having corrected centric occlusion, the patient adapts the mouthpiece as though he were playing high notes and low notes so that the lips and cheeks are well manœuvred to those functions. When the impression paste has hardened, excess and overflow on to the wax may be removed where necessary.

The process is repeated with the opposing special tray bearing paste. Centric occlusion is again adjusted by softening or trimming one of the bite-blocks if necessary. The mouthpiece is again adapted as in playing. Frequent reference is made to the pre-extraction models and photographs as a guide to the vertical dimensions and lip form and position.

At the setting-up stage, the technician, having been provided with the cleaned extracted anterior teeth, chooses a pattern as near as possible to them and sets them in the upper to conform with the height and labial surface of the wax block. He thereby reproduces their alinement to the upper surface of the mouthpiece and the lip. Should a 'single-lip'

A

B

FIG. 25.—Full upper denture prosthesis in a leading saxophone player. A, Taking the impression and recording embouchure bite, front view. *Note:* Wax block trimmed to upper surface of mouthpiece. B, Taking the impression and recording embouchure bite, lateral view. *Note:* Wax has been trimmed to upper lip requirements.

embouchure be used by the player, the upper anterior teeth need not be too smooth or blunt to minimise sliding on the inclined plane of the mouthpiece but the lower anterior teeth should be blunt and smooth. With a 'double-lip' embouchure the same teeth should be set slightly higher and should be smooth and blunt to prevent cutting into the lip.

A tough, high quality wax should be used, as during the try-in stage careful embouchure adaptation should be tried by the patient as in playing. The base plate and wax should extend to the periphery and contour of the model, which should show the distinct outline of the impression. Should the try-in be satisfactory, relieving of hard areas, such as a torus palatinus or alveolar bone, if not already recorded on the model, should be recorded now. The denture may then be finished, with instructions to the technician that the palate should be as thin as practicable.

On fitting the dentures, reference should again be made to photographs and models, with and without the instrument in the mouth, when, if possible, minor adjustments to teeth and bulk can still be made. As with the more usual full dentures, those for the wind musician will require some time to be fully tolerated by him and to be comfortable. In his case, patient practice with his instrument will be necessary.

The Single Full Denture

Where the patient presents with, say, an edentulous upper jaw and is already wearing a full upper denture which has become too loose or too uncomfortable for playing, the above procedure in the construction of a new denture may be modified. Impressions and bite are taken with the mouthpiece in position as in playing (as outlined above) (fig. 25). Centric occlusion is also recorded in the usual way, but the technician should endeavour to reproduce faithfully the incisal, labial and buccal contour of the wax block which has been fashioned to register embouchure requirements (fig. 26). In this case, the posterior teeth of the denture should correspond in size and shape with those of the opposing natural teeth.

A

B

FIG. 26.—The finished denture. A, Incisors lightly contoured to mouthpiece, front view. B, Incisors lightly contoured to mouthpiece, lateral view. *Note:* Single lip embouchure used. Lower lip projects more forwards in saxophone than in clarinet.

Aids to Retention

Where the scope for retention is particularly unfavourable due to such problems as lack of alveolar ridges and where in spite of the above technique the denture is still not rigid enough during playing, additional devices may be used. Such embouchure denture aids may also be used where the patient is already edentulous and is wearing well-fitting dentures which are completely satisfactory for the requirements of eating and speaking and almost fulfil embouchure requirements.

The first and simplest is one of preventing the wedge-shaped mouthpiece from tilting the upper denture upwards and forwards. A short single or double strip of Elastoplast may be applied to the upper surface of the mouthpiece so that it acts as a 'stop' to the front of the incisal edges of the central incisors. This forces the denture upwards and backwards instead of upwards and forwards.

The second is a device (Patterson, 1963) which could be particularly useful where otherwise suitable dentures are already worn. It consists of two small removable blocks of acrylic resin on each side fitted over $\bar{7}\bar{6}\bar{5}|$ and $|\bar{5}\bar{6}\bar{7}$ which hold a wrought gold wire (18 or 19 gauge) which emerges from the back of each block. The wire curves backwards, upwards and forwards and has attached to it a smaller pad of acrylic resin which engages the opposing teeth in the upper denture, thus preventing the downward dislodgment of the upper denture by the mouthpiece during playing. This device suggests that the spiral springs used several years ago in ridgeless edentulous cases could be used as embouchure denture aids.

The third is a special embouchure full upper and lower denture, bearing a system of inclined planes and made especially for playing only, where the bone support is extremely poor. This will be described later.

Lastly, it should be emphasised that, while, in the writer's experience at any rate, full denture prosthesis for wind instrument players is very seldom called for, it may well be due to the fact that many of these players assume they cannot be helped by dentists and reluctantly find other means of occupation. While this assumption may not be entirely well-founded it is certainly true that a good deal of specialised research and training is required in the dental schools, since each case presents a formidable challenge to the dental surgeon's ability, ingenuity and attention to the minutest detail of individual embouchure requirements.

REFERENCES

Fish, E. W. (1948) Principles of Full Denture Prosthesis, p. 37. Staples, London.
Patterson, N. (1963) *J. Amer. dent. Ass.*, 67, 102, 862.

6.—Single-reed Instruments—The Embouchure Denture

THIS is the name given to a denture (Porter, 1953) constructed exclusively for the purpose of playing a wind instrument where the patient is edentulous and where the retention of any other denture, at best, is poor for the embouchure requirements of the player. It should be mentioned, however, that in the author's experience of dealing with wind musicians, requests for such a denture have been extremely rare. This does not mean that the need rarely exists; for, besides a large number of erstwhile professional wind musicians who have probably ceased playing as a means of livelihood because they have lost all of their teeth, there are a still larger number of amateurs who are edentulous. Most, if not all, would wish to possess such a denture if it were to enable them to continue the playing which gives them so much pleasure. Many believe, some from experience, that dentistry is unable to help them. It has, for example, been publicised that 'it is impossible to use a huntsman's horn with artificial teeth'! Perhaps dentistry can prove otherwise; but it is evident that specialised research in the dental schools is required before the knowledge of the availability of embouchure dentures creates a substantial demand for them. Hitherto, the successful construction of full dentures for wind instrument players has proved extremely difficult, more so in those with extra-oral mouthpieces than those with intra-oral ones.

Dislodging Effects of Playing

The dislodging forces during playing are unique and vary not only with the general embouchure requirements of the different classes of wind instruments, but also with the detailed individual requirements of each player of any one class of instrument.

So far as the single-reed instruments are concerned, the intra-oral wedge-shaped mouthpiece tends to force the upper anterior teeth upwards and forward, dislodging the back of the denture; the lower anterior teeth tend to be pushed downwards and backwards and the back of the denture upwards. Adequate means are necessary therefore to oppose these dislodging forces applied at the front by the mouthpiece and the logical way would be to prevent the back of the upper denture from moving downwards and the back of the lower denture from moving upwards.

Use of Inclined Planes

In the region of the posterior teeth of the denture a system of inclined planes could be included between upper and lower dentures which would allow for differences in vertical and horizontal relationships between the two, and yet permit contact between them during playing which will prevent either from being dislodged (fig. 27). With the

FIG. 27.—Embouchure denture. Tilting of upper and lower resisted by inclined planes.

clarinet, the difference in embouchure adjustment during playing between high and low notes is slight and much more constant and the excursions forwards of the lower jaw far less than is the case with the saxophone. Therefore the inclined planes should be more gradual and less steep in the latter than in the former (figs. 28 and 29).

Aids to Design and Construction

Where extraction of remaining teeth has not yet been carried out, certain aids to the design and construction of the embouchure denture can be used to advantage. These are:

(1) Models of both jaws with any partial dentures in position.

(2) Bite-blocks, to register centric occlusion and free-way space where these are not obvious.

FIG. 28.—Inclined planes of denture. Steep planes for clarinet to allow for very limited forward movements of mandible.

FIG. 29.—Inclined planes of denture. Shallower planes for saxophone to allow for forward excursions of mandible.

(3) Extra-oral radiographs with mouthpiece in position as in playing highest note and lowest note.

(4) Photographs of patient (without instrument) in profile and full-face; and further ones, in same aspects, with mouthpiece as in playing lowest note and highest note.

(5) Calliper measurement of distance from incisal edges of lower central incisors to lower border of mental protuberance of mandible; similar measurement from incisal edges of upper centrals to fixed point, say, where top of philtrum of upper lip meets lower border of the septal cartilage of the nose. Overall measurement in occlusion from the top of philtrum to bottom of the mental protuberance will also help.

Following their removal, the anterior teeth, particularly the central incisors, should be retained for copying or matching by the technician. Where the patient is already edentulous, models, with and without dentures in place, will be required.

In the light of several years' experience, but of only a few cases, the following technique is suggested.

Cutting the Inclined Planes

Having taken suitable impressions, bite-blocks are mounted on well-fitting base plates, and the bite is registered in the usual way. The lower block is then cut short of the retro-molar region on each side so that it presents a downward and backward steep inclined plane of about 5 to 10 mm. (varying with the amount of alveolar room). Another cut is made sloping more gradually downwards and forwards for about $\frac{1}{2}$ inch, then a third cut (about 4 mm.) is made parallel with the first; a fourth inclined plane is cut in the wax parallel with the second. The wax of the upper block is now built to interdigitate with the lower inclined planes. These planes appear from the side as two inverted V's with short steep posterior arms and long more gradually sloping anterior arms.

The labial surfaces of the blocks in centric occlusion should compare favourably with the models taken earlier, mounted in an articulator, and the free-way space should be reasonably copied. Reference should also be made to the photographs (those without the mouthpiece) to check labial and cheek form, contour and vertical dimension. In this last respect the calliper measurement from top of philtrum to lower border of mental protuberance should be checked.

The anterior portion of the lower wax block is carefully trimmed down to correspond with the calliper reading, as in the finished denture the lower lip will be curled inwards to support the reed and it is important that the artificial anterior teeth should allow the lip to cover them. The incisal area of the upper block should also be trimmed to correspond with the calliper reading. Some allowance should be made in the calliper measurements for thin layers of impression paste to be used under the special trays, so that the measurements should be less than when first recorded. The central incisor area of the upper wax should be trimmed to correspond slightly with the convexity from side to side of the upper surface of the mouthpiece and with its inclined plane labio-palatally.

Adjustments to the Inclined Planes

Where high notes are difficult to register, the wax blocks, including the inclined planes, may be trimmed down until the notes may be satisfactorily

produced. Where low notes are not reasonably obtainable, the wax blocks may be built up a little at the back or the incisal portions of the wax may be reduced slightly. Generally, high notes require a smaller intra-oral volume of air than do low notes. The rigidity of the dentures may be helped by the contracting muscles behind the angles of the mouth, i.e. the buccinator, risorius and the modiolus. These form a firm buccal pad on the oral side of the cheek during playing and much advantage is obtained by creating a shallow buccal depression or fossa in the premolar and molar regions, which is continued into shallow buccal flanges in the molar region of both dentures and which will accommodate the pad.

Functional Impressions

With one base plate in position, a paste impression is now taken with the other and with the mouthpiece of the instrument inserted in the mouth as in playing. The lips, jaws, mouth and tongue are manœuvred as in playing the highest and lowest notes and into any such positions as the patient is accustomed to when playing. When the impression paste has hardened, the procedure is repeated with the paste in the other base plate with the mouthpiece in position. Any excess paste is removed from the wax and the base plate so that the contracting muscles, i.e. buccinator, risorius, and modiolus, are able to function without discomfort. Reference is made to photographs and radiographs and the patient is questioned regarding rigidity and any difficulty in producing high or low notes.

Setting Up

At the setting-up stage, it is necessary for the technician to mount teeth which simulate the labial, buccal, lingual and palatal, as well as the occlusal, contour of the wax blocks. Teeth may be included up to about the first molars (although figures 27, 28 and 29 include only the anterior teeth), but they should conform to the outline occlusally and in other respects to the inclined planes. Posterior teeth should be very narrow bucco-lingually. The denture may then be processed and finished.

It is again emphasised that the embouchure denture is not meant to be used when eating; it is intended to be used only for playing. Its construction demands much patience and a good deal of ingenuity by the dental surgeon. Furthermore, it is quite likely that a first attempt at making such a denture may not be completely successful and this need not be due entirely to the dental surgeon's efforts.

Co-operation between Patient and Practitioner

In the author's opinion, formidable psychological problems are often involved with players of wind instruments, particularly in cases of professional players. The treatment may be protracted and costly and they may be impatiently awaiting satisfactory results in order to resume their livelihood.

It would, therefore, be extremely unwise to promise a satisfactory result, however confident one may be of achieving it in a particular case. An all important reason for this is that the patient must play his own part in re-adjustment of his embouchure and this may require time and patient practice. Success is more likely to be achieved with the woodwind players than with brass players, as in the latter the lips function as a double reed as well as a washer and still further complications are involved in the construction of the denture.

Much specialised clinical and laboratory research is necessary to help wind musicians, particularly the edentulous professional ones, whose livelihood depends, probably more than in any other category of patients, solely on their dentitions.

Obviously, postgraduate schools and undergraduate schools with postgraduate facilities would be preferable to the ordinary private practice in carrying out such work, although much, if not most, of the pioneer work and research seems to have been carried out in a few private practices.

The above account by the author of an embouchure denture is but one contribution of an applied idea. There may well be many others, perhaps simpler and possibly more effective and it should not be beyond the scope of modern dentistry to produce them.

REFERENCE

Porter, M. M. (1953) *Brit. dent. J.*, **95**, 158.

7.—Double-reed Instruments and Flute

THERE are several double-reed instruments, e.g. the oboe, the oboe d'amore, the cor anglais, the bassoon and the contra-bassoon. The most important of these used in orchestras are the oboe and the bassoon (*see* Part 1, plate I, C and D). They may differ in size of instrument, size of double reed (which constitutes the mouthpiece), the key system and basic characteristic sound.

In each of them the 'double lip' embouchure is essential; that is, the lower lip is curled backwards over the lower incisors, whilst the upper lip is curled backwards under the upper incisors (fig. 30). The

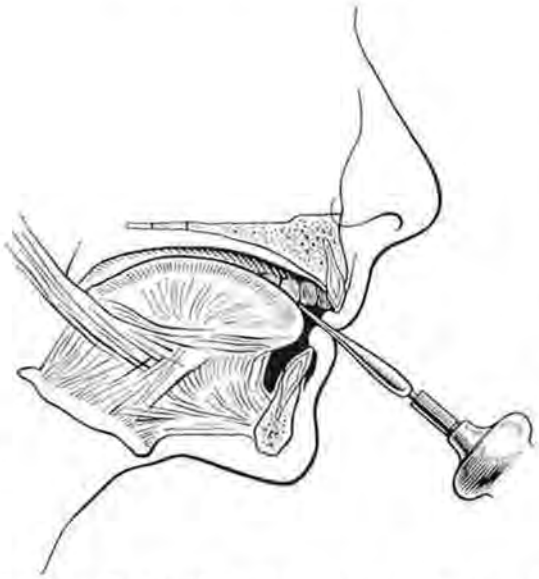


FIG. 30.—The double-lip embouchure of double-reed instrument. *Note:* Above is example of oboe embouchure. There is difference in detail between oboe and bassoon. Bassoon mouthpiece is much larger and requires different pressure of lips on reed and air column.

double-reed mouthpiece is inserted between the lips to the extent of about half an inch and the contraction of the facial muscles converging into the modiolus of each side, just behind the angle of the mouth, creates a sphincter-like washer to prevent the escape of air. Whereas with the single-reed instruments the lips function practically solely as a washer, with the double-reed instruments the lips have the additional function of assisting the vibrations of the two blades of the mouthpiece or double reed.

Control of Labial Pressure

While the pressure of the lips on the double reed should be sufficient to prevent the escape of breath during playing, it must not be so much as to prevent the column of expired air from entering the aperture between the reeds. The pressure of the teeth on the lips is less than with single reed instruments. Careful control of the size of the aperture between the reeds is maintained by a co-ordination between lip pressure, on the one hand, which tends to approximate the reed blades, and expiratory air pressure, on the other hand, which tends to separate them.

Unlike the single-reed instruments where the mouthpiece is wedge-shaped and has a hard sloping upper surface on which the upper incisors usually rest, the double-reed instrument has two flexible, almost parallel, single reeds bound together forming a very flattened tube (fig. 31). With a single-reed instrument, excessive pressure would be transferred to the upper incisors and their attachments when a single lip embouchure is used, or to the mucosa of the upper lip when a double lip embouchure is used. Excessive pressure with the double-reed instrument would occlude the aperture between the reeds, stop them from vibrating and prevent the generation of the musical sound. It would follow, therefore, that the dental surgeon may expect far fewer problems associated with the teeth or lips in players of double-reed instruments. Nevertheless, bearing in mind that a certain amount of lip tension is essential, as with all wind instruments, some dental conditions can be a hindrance to playing and the muscular effects arising from lip tension during playing can interfere with certain forms of dental treatment.

Dental Conditions Affecting Playing

Where dental conditions are normal and the incisors form practically perfect arches in the front of the jaws, the most common factor disturbing playing is the sharp chisel-like edges of the enamel of the incisors, due to attrition. The sharp edges

FIG. 31.—The double-reed. *Front view.* A, Large broad reed of bassoon (bound end is attached to instrument). B, Narrow small reed of oboe (cork end is attached to instrument). *Lateral view.* C, Broad flattened tube of bassoon reed. Aperture between reeds is larger than in oboe. D, Narrow flattened tube of oboe reed. Aperture between reeds is smaller than in bassoon.

usually border the lingual surfaces of the lower incisors and the labial surfaces of the upper incisors. Varying with the degree of sharpness, pain may be caused while playing by the lips being stretched inwards against these edges. Further factors influencing comfort while playing are the labial inclination of the upper incisors, their length in relation to the length of the lips stretched over them, and the presence of what would normally be regarded as 'natural spaces' between the incisors. The free corners exposed by such spaces tend to irritate the lips. Where a space is substantially wider, such as between upper central incisors, there is a tendency sometimes for the upper lip to become trapped during playing.

To ensure comfort during playing, therefore, treatment should be directed towards removal of sharp edges or corners and to eliminating spaces which disturb the lips. However, the author can recall only very few players of any of the double-reed instruments who, *having a normal dentition* required incisal edges to be stoned and polished and none at all needing the elimination of a disturbing space. Should a case of this kind present, the dentist should bear in mind the possibility of constructing either a lip shield if the length of the upper lip permits this procedure, or, alternatively, the crowning of the incisors to eliminate the space between them if the upper lip is too short. In a professional player, however, crowning should not be undertaken lightly.

Where the dentition is outside the bounds of normality each case must be treated on its merits and success depends chiefly on the ingenuity of the dental surgeon. It should be emphasised, however, that 'normality', so far as embouchure requirements in the playing of wind instruments is concerned, has a somewhat different meaning from that of the usual anatomical one. For example, slight rotation or elongation of a single incisor may have a troublesome effect on a wind instrument player's embouchure comfort, whereas in other patients the presence of such conditions may be of no practical importance so long as such major factors as occlusion are normal.

Suggestions for Treatment

In view of the above considerations and in order to prevent or minimise any interference with the playing of these instruments which may occur after dental treatment, the following suggestions are offered:

Conservation Treatment

Fillings and inlays should be finished in such a way as to present smooth polished surfaces to the mucosa of the lips; incisal edges should be blunt, smooth and not too thin.

Crowns and bridges, similarly, should present smooth blunt surfaces or edges to the lips; their length and bulk should be carefully assessed to enable the lips to overlap them adequately during playing. Crowns should not be so long as to require the lips to be overstretched; when post crowns are fitted to roots on which apicectomy has been carried out they should be shorter still.

Periodontal Treatment

Minor periodontal treatment is seldom likely to interfere with the playing of these instruments except in players whose anterior teeth have extremely sensitive dentine which has been exposed by procedures such as removal of subgingival calculus, root planing, or gingivectomy. During playing, frequent rapid deep inspirations are necessary, and unless sensitive dentine is suitably treated, pain may become a hindrance.

Periodontal packs, if too bulky, may interfere with the embouchure, as may also the suturing of flaps.

Where the more radical periodontal operations are involved, it would be advisable to arrange for the treatment to be carried out at a time when the patient, particularly if he is a professional, will not be playing for an adequate number of days subsequently.

Orthodontic Treatment

Orthodontic appliances bearing labial or lingual bows, springs, or clasps, may hamper playing to the extent of tempting the young player to remove them for long periods during the day. It is suggested that removable appliances worn at night might solve this problem.

Some types of fixed appliances could prevent the playing of a wind instrument altogether. At the initial examination, therefore, it would be advisable to inquire about the interests and hobbies of the young patient and to record the fact that a wind instrument is being played, the type of instrument being played and the time devoted daily to such playing.

Partial Denture Prosthesis

Partial dentures should be constructed for preference in metal and, where possible, should be of the skeleton type and bear adequate occlusal and incisal onlays free from any protruding or sharp edges. The upper denture may be entirely toothborne, with the palatal bar excluded.

The artificial teeth should be regularly alined and they should present smooth blunt surfaces and edges to the labial mucosa. Clasps should be rather broader than usual and should present rounded smooth surfaces to the lips.

All these measures will enhance embouchure comfort and will minimise interference with playing.

Full Denture Prosthesis

Full dentures should allow adequate provision in the incisor region for the lips to be curled backwards into the mouth to support the double reed. The anterior teeth should be set regularly, i.e. without protrusion of individual incisors. Any overbite of the upper incisors over the lower ones should be minimal.

Where dentures are to be fitted following extraction of the remaining teeth, models of such teeth with any previous partial dentures in position should be made for reproducing the original conditions as closely as possible in the new dentures. Photographs will help to show the original labial contour and the length of the anterior teeth relative to the lips.

During playing, the embouchure musculature, and particularly the buccinator and modiolus, is contracted in an unusual way, so that the reproduction of an 'embouchure fossa' in the dentures, as explained in an earlier article, in which the accentuated buccal pad can lie, will help to retain the dentures in position.

In taking the impressions it is an advantage to allow the patient to manipulate his lips, cheeks and tongue as in playing, preferably with the mouthpiece in position. The special trays should have short wax or composition blocks mounted on them in order to support the lips and to enable a double reed to be held between them.

When registering the bite, besides recording correct centric occlusion, the wax should be trimmed to labial and buccal contour and to such relative verticle dimension between lip line and incisal line in each jaw as will permit comfort while playing. Calliper measurement of the overall vertical dimension from the base of the septal cartilage of the nose to the bottom of the mental protruberance will also help. Reference to clinical photographs will be a valuable guide in all these respects.

The technician should set and aline the teeth to conform to all these requirements. Incisal edges of artificial teeth should be blunt and smooth in order not to irritate the lips which will be stretched over them.

Initial Examination with Instrument

In order that the playing of wind instruments shall not interfere with any dental treatment, it is necessary to understand that playing, particularly when the patient is a professional, may go on continually for several hours daily with the lips and cheeks contracted in an unusual fashion. It would, therefore, be advisable to have the patient bring his instrument with him at the initial examination in order to assess the possible effects on any treatment. For example, progress following periodontal treatment may be hampered by the labial pressure during playing. Therefore, some means of resisting this, say by removable periodontal appliances to be worn while playing, may be considered advisable. Similarly, the orthodontist might consider the provision of special appliances in order to resist the forces exerted on the teeth during playing which run counter to those

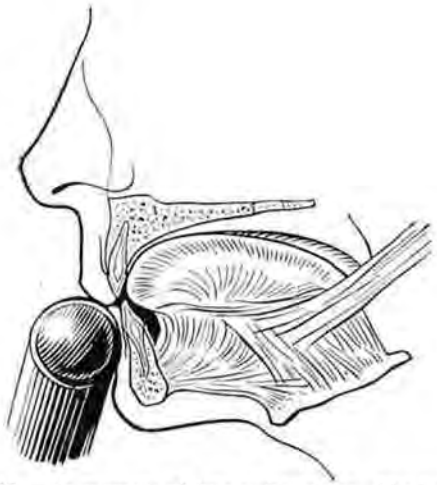


FIG. 32.—An example of flute embouchure. The head of the instrument rests on or below the lower lip. Exhaled air is directed across hole (not seen here).

intended by the treatment. On the other hand, his treatment may be undesirably accelerated by the forces exerted during playing.

After oral surgery involving flap operations and suturing, the wound may be interfered with if playing is allowed during the initial healing process.

The Flute

The flute (*see* Part 1, plate I, E) (and piccolo, which is a much smaller version of the same instrument) requires an embouchure quite different from the reed instruments or brass. While it is of the wood-wind variety, like the single and double-reed instruments, the mouthpiece is applied extra-orally, but in a different way from the brass instruments.

The embouchure of the brass provides an outer lip seal on the mouthpiece, to prevent escape of air, and an inner double lip reed which is allowed to vibrate. The flute embouchure (fig. 32) permits the projection of a column of exhaled air from the lip aperture, which is comparatively remote from the hole at the head of the instrument, at which it is aimed and the edge of which vibrates. To accomplish this, an extremely delicate control of the contraction of the embouchure musculature (particularly the risorius and the modiolus) is essential to produce an optimum volume of air at an appropriate pressure.

Meanwhile, the head of the instrument rests in a suitable position on, or just below, the lower lip with little labial pressure on the lower anterior teeth. Labial and buccal tension, however, which must be maintained during playing may be disturbed by a number of dental conditions, especially outstanding highly placed canines in the upper jaw, or excessively irregular anterior teeth in the lower jaw.

Apart from these considerations, much of what has been outlined in connexion with players of the double-reed instruments may be taken to apply to those of the flute, albeit to a less extent. However, in the author's experience, far fewer dental problems have presented in connexion with flute players than among players of any of the other wind instruments. A reason for this may be that there are, possibly, fewer players of the flute than of other classes of wind instruments.

8.—Brass Instruments

IN many respects the dental problems associated with players of brass instruments are more difficult to solve than those of players of other wind instruments. The reason for this is the fact that, unlike the woodwind where the lips act mainly as a washer and the 'generator' of the musical sound is within the mouthpiece of the instrument, in brass playing the lips function as a washer and as a double reed: the lips, in fact, constitute the sound generator. If dental problems of brass instrument players are to be recognised and solved, an appreciation of such delicate functions of the lips during playing is essential.

The Sound 'Generator' and Tone 'Resonator'

All wind instruments—and among these may be included the mechanism of the human voice—require a 'generator' the vibration of which gives rise to the sound (Langwill, 1965). In the clarinet and oboe, it is the reed which vibrates; in the flute it is the edge of the hole across which the breath is directed which causes the vibration. With the brass instruments it is the free edges of the lips within the cup of the mouthpiece immediately surrounding the column of air blown into it.

The brass player's lips, having initiated the sound, communicate their vibrations to the column of air within the instrument (the resonator) which now dominates. The musical sound produced depends on the frequency of vibration of this column of air which may be changed by altering its effective length. In the case of brass instruments, this is done by fingering the pistons (or valves) or by using the slide. Variations in lip pressure and in jaw relationship are carried out simultaneously where necessary and play a very important part in all brass instruments in emitting the exact musical tone (fig. 33).

FIG. 33.—Playing a brass instrument (cornet). *Note:* (1) Sound is generated by free edges of lips within cup of mouthpiece. (2) Musical tones are resonated by: (*a*) operation of pistons by fingers; (*b*) pressure of mouthpiece rim against lips; (*c*) size of aperture between lips; (*d*) jaw relationship.

Resemblance of Lips to Vocal Cords

The vibration of the brass player's lips somewhat resemble the vibration of the vocal cords of the larynx (Farkas, 1962*a*). Exhaled air, passing up

FIG. 34.—Scheme of Laryngeal cleft (rima glottidis) (as seen from above by laryngoscope under different conditions). 1, tongue; 2, epiglottis; 3, vocal folds ('true' vocal cords); 4, rima glottidis; 5, arytenoideus; 6, vestibular folds ('false' vocal cords); 7, corniculate cartilage; 8, cuneiform cartilage.

A

B

FIG. 35.—Cornet or trumpet embouchure. A, While resonating high tone. *Note:* (1) Distance of mouthpiece from upper and lower incisor teeth. (2) Separation between upper and lower jaws. (3) Antero-posterior relationship between upper and lower jaws, especially in incisor regions. (4) Hyoid bone tucked under mandible to constrict intra-oral volume. B, While resonating low tone. *Note:* (1) Distance of mouthpiece from upper incisors much increased; only slight increased distance from lower incisors. (2) Increased separation between upper and lower jaws. (3) Lower jaw thrust more forward. (4) Hyoid bone now clearly visible. (5) Increased intra-oral volume to produce lower tone.

through the larynx is intercepted by the vocal cords. When the cords are at certain degrees of tension and this air is forced past them, they will vibrate, causing *phonation*. When the cords are sufficiently relaxed and the opening sufficiently wide, phonation ceases and air passes through freely. During vibration, a little of the air column is forced between the cords so that the edges are separated by virtue of their elasticity to a varying degree, depending on the required pressure of exhaled air and their tension. The edges are again approximated so that the flow of air is interrupted temporarily. When this process is repeated at a rapid enough rate rhythmically, as in singing (Rose, 1962), phonation occurs. The sound emitted (high or low tone) depends on the tension and the degree of separation of the cords (fig. 34), the force of upward thrust of breath, and the resonance within the air passages and air cavities beyond the cords. One may well appreciate how easily such a delicate mechanism may be disturbed by numerous conditions, e.g. the presence of a foreign body, or an inflammatory condition, in or near the cords.

The wind player who is attempting to animate his instrument, i.e. to make it 'speak' or 'sing', is at once made aware of similar disturbances to the vibration of his 'cords' or sound generator, whether they be the reeds of his mouthpiece or his own lips. Just as the quality and condition of the reeds of the reed instrument player are very important, so also are the quality and condition of the brass player's lips. In fact the brass player's lips are much more important since, obviously, they are the only ones he possesses.

When, with continual practice, his embouchure has developed to a certain degree, the brass player is able to produce instinctively and almost instantaneously an exact musical tone by permitting a meticulous series of rhythmic vibrations of his lips. The application of his mouthpiece helps him to do this. The similarity of the embouchure's function in playing to that of the larynx in singing is such that the student is often told to 'imagine you are singing when playing.'

Fallacy of 'Non-pressure' System

While a certain amount of pressure of the brass mouthpiece against the lips is necessary, many players will persist in speaking of using a 'non-pressure system'. This method presumes that the higher musical tones are produced by pursing the lips together tighter, thereby constricting the aperture between them and *not* pressing the mouthpiece tighter against the lips. Figure 35, illustrating the embouchure of one of the foremost cornet players who had been an advocate of such a non-pressure system, clearly shows the different pressures of the mouthpiece against the lips in playing high and low

notes. A more accurate description would be a 'minimum pressure system' or 'light pressure system'. Several years of playing will often disclose an obvious change in appearance of the cutaneous portion of the lips corresponding to the rim of the cup of the mouthpiece which has been pressed against them; it is particularly noticeable where that part of the lip overlies a protruding incisor tooth (fig. 36). A case is on record of perforation of the lip of a brass player (Reichenbach and Brückl, 1936) due to excessive pressure.

FIG. 36.—Effect of 'light-pressure' system in cornet player. Appearance indicative of obvious labial cutaneous change over many years in one of Britain's finest soloists.

It will now be appreciated, no doubt, that to produce a musical tone accurately at any point within the compass of a brass instrument, the lips, just as the reed of a reed instrument, must be set into a series of regular vibrations of appropriate strength, and to play a musical passage well enough requires considerable practice of embouchure control, as well as the fingering of the instrument. A mature professional wind musician may have spent at least ten years to become an orchestral player of reasonable standard. It will also be appreciated that the peculiar use to which the lips are put, often for several hours daily, in order to produce a well-developed embouchure, may be easily upset by numerous and what may be otherwise considered from a purely dental point of view, trivial factors. Not all factors are, however, trivial—for example, an abscess. Nevertheless such factors, trivial or otherwise, may be enough either to hinder the player seriously or to prevent his playing.

Re-adaptation of Embouchure

Certain altered conditions and environment of the lips and mouth may require re-adaptation of the embouchure during playing, and considering its sensitivity and the several years that may have been spent to develop it, the necessity for this re-adaptation tends to come as a shock to the player. Since it takes him some time to readjust his mental as well as physical attitude, his confidence in playing is usually only slowly restored. This situation may often be frustrating to both the player, particularly the professional who expects to resume his playing immediately following dental treatment, and to the dental surgeon, who may have carried out otherwise excellent dental treatment. The professional musician, like the professional actor, is often fearful of losing his employment, since he is seldom indispensable, and any circumstances affecting his embouchure and therefore his playing tends to aggravate this fear.

Hence, in dealing with any dental condition which affects the embouchure of a wind instrument player, it would be unwise to promise that his playing will be restored immediately, however confident the dental surgeon may be of securing an excellent dental result.

It was stated at the beginning of this article that the dental problems of players of these instruments are often more difficult to solve than those of players of other wind instruments. They are also, in the author's experience, more frequently presented. The reason may be that there are probably more players of brass than of woodwind since there are numerous bands throughout Britain, mainly amateur, but also professional or semi-professional, which are devoted entirely to brass. In the past, a large proportion of these players, in the author's experience, have been shy of regular dental attention and several have been even neglectful of regular oral hygiene. Much of this apparent 'shyness' and neglect may have been due to a belief held in the past by many of these players that dental treatment (of almost any kind) was likely to interfere with their playing. While in general it has been unfounded, the writer is compelled to admit reluctantly that in a few players this belief has indeed been justified. More recently, however, a better appreciation has been apparent among them of regular dental attention as a means of preserving the valuable asset of a good embouchure. It would seem, therefore, that, as a precaution against possible interference with a player's embouchure, the dental surgeon should record at the initial examination, as the physician usually does, the occupation and the hobbies of his patient.

Mouthpiece Position

In diagnosing embouchure problems, the position of the mouthpiece on the lips is significant. The embouchures of brass instrument players vary generally with the size of the instrument mouthpieces but differ somewhat in detail with the individual anatomical form.

In some of the tutorial works on the playing of brass instruments, directions are given on the correct and incorrect positioning of the mouthpiece on the player's lips and recognised authorities are cited (Farkas, 1962*b*), some of whom appreciate the

anatomical differences among players and others who are quite dogmatic as to how the mouthpiece should be placed in almost all players.

In the author's experience, observation has shown that, in general, the following conditions prevail:

In cornet or trumpet playing, the mouthpiece is usually placed approximately half on upper lip and half on lower lip (fig. 37).

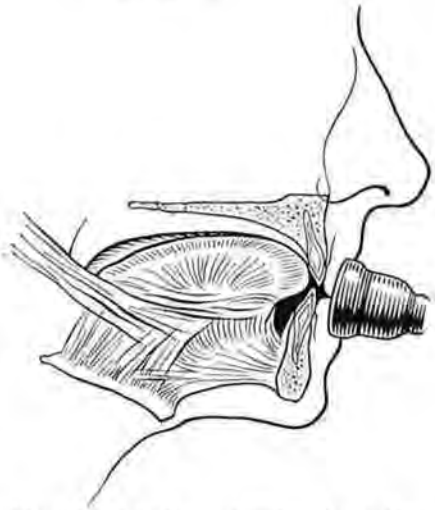


FIG. 37.—Cornet or trumpet embouchure. Distribution of mouthpiece approximately equal between upper and lower lips.

The horn player usually places the mouthpiece about two-thirds on the upper lip and one-third on his lower lip (fig. 38).

With players of the larger instruments with larger mouthpieces, e.g. trombone, tuba, the mouthpiece is usually placed between two-thirds to three-quarters on the upper lip, and one-quarter to one-third on the lower lip. Some authorities, however, state that certain players cover more lower lip than upper lip and that this embouchure might be due to the shape of the player's nose. Since the exact position is of some concern to the individual player and may be of equal concern to the dentist dealing with his embouchure problems, it may be an advantage to the dentist, during the course of routine treatment, to use some means of recording this position. It will be

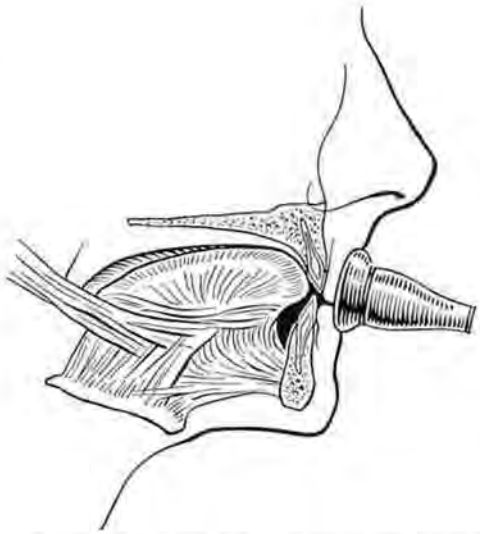


FIG. 38.—Horn embouchure. Example of mouthpiece applied to approximately two-thirds upper lip and one-third lower lip.

of great help in the event of injury or alteration to the embouchure following, say, certain forms of dental treatment. Experience has shown that, as well as models, photographs are extremely valuable. Should later treatment involve the more radical procedures on front teeth such as crowns, bridge work or extractions and dentures, which in some way interfere with the embouchure, the photographs may help to avoid any errors of judgment.

The photographs may be taken of full face, with the mouth open showing the anterior teeth, and with the mouth closed in centric occlusion. These are optional, since models will show similar conditions, although they will not include the lips; but the more helpful photographs will be those taken with the mouthpiece in position on the lips, in full face and in profile.

REFERENCES

Farkas, P. (1962*a*) The Art of Brass Playing, chap. 1, p.10. Brass Publications, Bloomington, Indiana, U.S.A.

—— (1962*b*) Ibid., chap. 3, pp. 32, 33 and 34.

Langwill, G. L. (1965) The Bassoon and Contrabassoon, chap. 9, p.44, (citing Prof. B. Hague). Ernest Benn, London.

Reichenbach, E., and Brückl, H. (1936) *Dtsch. Zahnärztl. Wchschr.*, 39, 213.

Rose, A. (1962) The Singer and The Voice. Ernest Benn, London.

IN the playing of brass instruments the manœuvrability and the condition of the lips are of the utmost importance for they have the delicate task of taking the place of the reed. Unlike the reed of the reed instruments of the woodwind, where replacements may be practically unlimited, the lips of the brass player are, obviously, not interchangeable or replaceable. While the brass player's lips provide part of the muscular superstructure of the embouchure apparatus meant to form an efficient washer, in his case they are also the vital part which constitutes the *generator* of the musical sound of his instrument. Moreover, in co-operation with the functional alterations in jaw relationship during playing, they constitute a significant part in *resonating* the musical tones.

Importance of Functional Jaw Relationship

Any factor interfering with such alterations in jaw relationship is likely to upset the efficient working of both the generator and the resonator. For example, certain conditions of the temporomandibular joint may limit the excursions of the mandible during the playing of musical passages and will hinder or prevent the required vibrations of the lips and the pressure of the mouthpiece against them in order to resonate those vibrations into definite musical tones. Furthermore, to maintain each musical tone for the required time of the music, each series of vibrations of the lips must be carried out rhythmically, otherwise bleated, disordered sounds, or noise is the result.

With each of the wind instruments the resonator is usually regarded as the vibrating column of air within the instrument and any change upwards or downwards in the musical sound is produced by altering its effective length. This may be demonstrated simply in the woodwind with the recorder. When all the holes in this instrument are closed by the fingers during playing, the vibrating column of air is in the whole length of the instrument. As each finger is raised, opening the holes from below upwards, the vibrating column is shortened, emitting a higher and higher musical sound. The much more sophisticated orchestral woodwind instruments have numerous holes and keys which serve a similar purpose.

Brass instruments such as the cornet (*see* Part 1, plate I, F) or trumpet however, have only three pistons with which to alter the effective length of the resonating column of air and these pistons may work singly, in various combinations of one another, or with none working at all. But the pistons are operated in close co-operation with changes in mouthpiece pressure against the lips, with alterations in size of lip aperture, with changes in tension of embouchure musculature and with changes in jaw relationship (fig. 39 A and B). As with all other wind instruments, 'supplementary resonance' (Porter, 1967) influencing individual tone character is furnished by the air vibrating in the cavities of the mouth, throat, head and even the chest (Langwill, 1962).

Position of Mouthpiece on Lips

While the rim of the mouthpiece may be applied to the lips so that it is distributed in certain proportions between them in the different brass instruments in a general and yet individual manner, the intention is to direct the column of expired air past the lips horizontally. This air, having set the lips into vibration, then continues horizontally through the instrument (Farkas, 1962*a*). Moreover, explicit instructions are given by this authority, perhaps one of the foremost on the teaching of brass instrument playing, that the upper and lower lips should be in a straight vertical line with the mouthpiece applied to them perpendicularly. However, having regard to the different classes of jaw relationship (e.g. Angle Classes I, II and III and their variations) it would seem that the player with a protruding lower jaw (Angle, Class III) would be at a distinct disadvantage. The inclination of his instrument upwards, or the bowing of his head downwards would not appear to fulfil the required condition unless either the rim of the mouthpiece is fashioned to accommodate the protruding lower jaw and lip, or his upper front teeth are rehabilitated artificially for the purpose. However, it should be stated that this same authority considers that 'persons with certain malformations of the jaw, teeth or lips would be ill-advised to study any brass

A

B

FIG. 39.—Trumpet embouchure. A, While resonating high tone. *Note:* (1) Distance of mouthpiece from upper and lower incisor teeth. (2) Separation between upper and lower jaws. (3) Antero-posterior relationship between upper and lower jaws, especially in incisal regions. (4) Hyoid bone tucked under mandible. B, While resonating low tone. *Note:* (1) Distance of mouthpiece from upper incisors much increased; only slightly increased distance from lower incisors. (2) Increased separation between upper and lower jaws. (3) Lower jaw thrust more forward. (4) Hyoid bone now clearly visible. (5) Increased intra-oral volume to produce lower tone.

instrument.' Nevertheless, it appears odd from a dental point of view that while the difficulties of the players with retruded lower jaws are discussed at some length and quite understandably where the retrusion is severe, no mention is made of the difficulty of the protruding lower lip, in a player with a severe or moderate Class III occlusion, being brought into a straight vertical line with the upper lip.

Functional Co-ordination of Embouchure Musculature

The superstructure of the embouchure apparatus consists mainly of the muscles of the lower part of the face which converge into the modiolus at each side of the mouth (fig. 40). All these muscles are co-

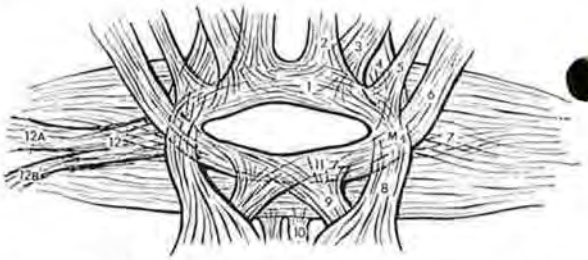


FIG. 40.—Scheme of embouchure musculature (region of lips). 1, orbicularis oris (upper lip portion); 2, levator labii superioris alaeque nasi; 3, levator labii superioris; 4, levator anguli oris; 5, zygomaticus minor; 6, zygomaticus major; 7, buccinator; 8, depressor anguli oris; 9, depressor labii inferioris; 10, mentalis; 11, orbicularis oris (lower lip portion); 12, risorius; 12A, risorius (masseteric strand); 12B, risorius (platysma strand); M, modiolus.

ordinated in function to give the lips the utmost assistance in behaving as a sensitive generator of the musical sounds, as an efficient washer to prevent escape of air and as a sensitive buffer able to select spontaneously the mouthpiece pressure required for each resonating tone. The underlying supporting structure consists of the jaws and teeth. Those teeth nearest the centre of the mouthpiece, usually the central incisors, support the sound-generating portion of the lips; those more laterally placed support the washer portion. Those still more laterally and posteriorly placed support the modiolus, the insertion into it of the rest of the embouchure muscles, and much of the buccinator muscle. The posterior teeth also act as a restraining hedge or barrier to the side of the tongue.

The absence of posterior teeth on one side only, tends to affect the support of the related modiolus or buccinator of that side and often allows the cheek to puff out, since there is inadequate resistance by the cheek alone to the pressure of the column of air. This is particularly noticeable following muscle

fatigue; indeed it may be a contributory factor to fatigue during playing. The missing girders (posterior teeth) which would support the contracting buccinator, if they were present, allow the cheek to puff out on that side, the air under high pressure causing a localised bulging of the cheek.

Should the player have somewhat narrow central incisors and a projecting mesial corner of a lateral incisor he will tend to engage this corner against the part of the lip within the cup of the mouthpiece rather than against the part of the lip bearing the pressure of the rim. In this way he avoids discomfort or pain. On close examination, his mouthpiece during playing will appear slightly to one side. Should both lateral incisors have projecting mesial corners, the player will instinctively allow the rim to rest on the one that offends least, i.e. on the one that allows more lip comfort.

Importance of Embouchure Comfort

The efficiency of the embouchure apparatus largely depends, therefore, on the architecture of the supporting scaffolding—the jaws and the position and form of the girders of the facial musculature, which are the teeth. With the brass instrumentalist considerably more of the musical mechanism is built into himself than is the case with the woodwind player because he provides the whole of the generator and much of the resonator, in addition to that which is common to all wind instrumentalists, the washer. Therefore an embouchure of at least reasonable comfort is a prime consideration for him, even more than for the woodwind player.

Frequently, when a certain condition is present which interferes with an embouchure of comfort (e.g. a sharp projecting corner of a tooth), the patient, well aware of the cause, will point this out to his dental surgeon, but sometimes he is inaccurate in identifying it, and the dental surgeon should diagnose and treat it with caution. For example, one or other or both of two adjacent rotated teeth may be the cause, and it is necessary to determine which of the teeth is being pressed against the lip by the rim of the mouthpiece. Examination of the cutaneous and mucous surfaces of the lip by means of a magnifying lens and observing the position of the rim of the mouthpiece during playing is helpful.

Mouthpiece Rim as Diagnostic Aid

Several modern brass instrument mouthpieces have removable threaded rims, some constructed of plastic. In order to ensure more accuracy in locating a tooth or teeth hindering an embouchure of comfort, the rim should be detached from the mouthpiece (fig. 41) and fixed temporarily in some way to a suitable holder by means of sealing wax, sticky wax, or oxyphosphate cement (fig. 42). The patient

FIG. 41.—Removable mouthpiece rim. Rim removed from threaded mouthpiece.

FIG. 42.—Removable mouthpiece rim. Rim attached to suitable handle. An old serrated hand instrument is attached to rim with oxyphosphate cement.

FIG. 43.—Rim adaptation to lips. Cornet player's embouchure with rim in position as in playing. *Note:* (1) Rim is to the right of centre. (2) Edges of lips vibrating within rim and to the right.

now adapts the mouthpiece rim to his mouth as in playing in the way he usually applies his whole instrument (fig. 43). On blowing, the vibrating portion of his lips will be clearly visible and the teeth on which the rim compresses his lips will be more easily located. Again, a magnifying lens is an aid.

Two Common Effects of Embouchure Disturbance

The patient suffering disturbance of the embouchure when playing a brass instrument may complain of pain in his upper lip and/or inability to generate sound.

(1) *Pain* is usually the result of the lip being pressed against a tooth by the mouthpiece rim. The tooth may have a projecting corner, a sharp edge or a faulty filling which hurts the lip; or it may have pulpitis, periapical inflammation or periodontal

inflammation, and so forth. In addition to these examples, other disturbing conditions such as labial or gingival ulcers may occur but these should be more readily apparent to the dentist. All of them, however, may be located more easily by observing the area of the lip being pressed by the rim and by examining the parts of the tooth surfaces against which this area of the lip is being pressed.

(2) *Inability to generate sound* signifies some disturbance to lip vibration and does not necessarily involve pain; in fact pain is usually absent. The extreme sensitivity of lips to any disturbance during vibration may be demonstrated in a number of ways: for example by allowing one's own lips to vibrate, as in whistling and very lightly tapping the upper or lower lip with the forefinger, while the air is being blown between them. This will interrupt vibration; maintaining the finger pressure on the lip, even very lightly, will prevent vibration. Any underlying dental cause preventing the lips from vibrating, may not be easily disclosed. The upper incisors may be too long in relation to length of lip to allow enough free labial edge to vibrate; on the other hand, they may be too short, so that there is insufficient support for the embouchure. In the latter case, the higher tones will be more difficult to produce than the lower tones; the higher tones require an air column of smaller diameter to pass through the lips than do the lower tones.

In teaching the playing of brass instruments, the use of mouthpiece rims on handles is sometimes advocated in order that the student may be able to study the development of his embouchure. Farkas (1962*b*) illustrates several of these and lists a number of suppliers in the U.S.A. Such rims could be of much advantage to the dental surgeon treating a brass instrument player, but still greater advantage would be the use, for diagnostic purposes, of either the player's own removable rim, or an accurate reproduction from the mouthpiece which is in constant use, where the rim is not detachable. A simple technique in constructing an acrylic reproduction of the rim of the player's own mouthpiece will be described.

REFERENCES

Farkas, P. (1962*a*) The Art of Brass Playing, chap. 1, pp. 8, 9. Brass Publications, Bloomington, Indiana.

—— (1962*b*) Ibid., chap. 1, pp. 6, 7.

Langwill, L. G. (1965) The Bassoon and Contra-Bassoon, chap. 9 (citing Professor B. Hague), pp. 144, 145. Ernest Benn Ltd., London.

Porter, M. M. (1967) The Embouchure, chap. IV, pp. 50, 51. Boosey & Hawkes, London.

10.—Brass Instruments *(continued)*

IN order to deal adequately with dental problems of the patient who plays a brass instrument, it would seem logical that the dental surgeon should be aware of certain stringent conditions under which the musical tones are produced on these instruments with the maximum ease and with the maximum of comfort to the lips. These conditions may be specified as follows:

Control of Air Column

The musician should be able to alter at will, the pressure, direction and volume of the air column entering the instrument. He should also be able to time it at will so that it may be stopped or maintained as the music demands. These requirements would involve such factors as the mechanical action of the respiratory muscles, the oral volume, and the size of the aperture between the lips together with the pressure and position of the mouthpiece against them.

While the mechanical action of the respiratory muscles may be excluded for the purposes of this series, it is of such importance in the playing of all wind instruments that mention should be made of the outstanding work by Campbell (1958) regarding the physiological and medical aspects. Consideration of the remaining factors, however, is within the scope of the practising dental surgeon trying to solve an embouchure problem in a brass player and, indeed, his help may be vital to the player.

Control of Lips

The lips should be allowed to vibrate as necessary by the teeth, jaws and mouthpiece; they should be allowed to withstand the necessary pressure of the mouthpiece required for the resonating of particular musical tones when working either alone or in co-operation with the pistons or slide of the instrument and they should be allowed to behave as an efficient washer by the supporting embouchure structure in order to prevent the escape of air.

Control of Jaw Relationship

During playing, the lower jaw should be free to form such a relationship between itself and the upper jaw and between the lower lip and the upper lip as will be required to produce any musical tone within the range of the instrument.

The Mouthpiece and its Management

The size, form, and material structure of the mouthpiece should in no way hinder the efficiency of the embouchure. This aspect together with its management will be discussed in greater detail.

Mouthpiece Position and Embouchure Comfort

The ideal dentition from the point of view of a brass player, would be one where there is a normal occlusion, 'normal' relationship between individual teeth, 'normal' tooth structure and 'normal' attachment of the teeth to the jaws. There would also be symmetry of the teeth of one side with those of the other side. A player with a dentition of this nature would be able to place the mouthpiece in a variety of positions, each of which would give him an embouchure of adequate comfort, even though he might favour one particular position. Such an ideal dentition, however, is rare.

Where the dentition deviates from this ideal, the mouthpiece is restricted usually to fewer positions which will give optimum or even adequate comfort during playing, depending on the extent of the deviation. For example, on opening the mouth slightly there may be more space between the incisal edges of $|\underline{1}\underline{2}$ and $|\overline{1}\overline{2}$ than between $\underline{2}\underline{1}|$ and $\overline{2}\overline{1}|$ (fig. 44). The player will then direct the air column instinctively so that it leaves his mouth between $|\underline{1}\underline{2}$ and $|\overline{1}\overline{2}$. Therefore when viewed from the front

FIG. 44.—Air column exit (dental). *Note:* Wider space between $|\underline{1}\underline{2}$ and $|\overline{1}\overline{2}$ than between $\underline{2}\underline{1}|$ and $\overline{2}\overline{1}|$ through which expiratory air column may pass to vibrate labial edges.

FIG. 45.—Air column exit (labial). *Note:* (1) Mouthpiece to left of centre and cup over |1̲2̲ and |1̄2̄ for expiratory and labial comfort. (2) Mouthpiece rim rather more on lower lip as coronal portion of lower incisors largely missing.

during playing, his mouthpiece will be placed slightly to the left of centre (fig. 45). Similarly where there is more space on opening the mouth, say, between 2̲1̲| and 2̄1̄| than between |1̲2̲ and |1̄2̄ (fig. 46), the position of the mouthpiece would appear to be to the right of centre, no doubt for optimum comfort of air expulsion (fig. 47).

FIG. 46.—Air column exit (dental). *Note:* Wider space between 2̲1̲| and 1̄2̄| than between |1̲2̲ and |1̄2̄ through which expiratory air column may pass to vibrate labial edges.

Such would be the case when other conditions permit. For instance, in the former example should |2̲ have a protruding sharp corner, the player would probably prefer to place his mouthpiece more to the centre or even to the right of centre, i.e. he would choose an embouchure which would be a compromise between lip comfort gained as a result of avoiding the sharp corner of |2̲ and maximum expiratory comfort and control which would now be more restricted. Similar compromises in embouchure

FIG. 47.—Air column exit (labial). *Note:* (1) Mouthpiece to right of centre and cup over 2̲1̲| and 2̄1̄| for expiratory and labial comfort. (2) Mouthpiece rim equally on upper lip and lower lip—on right side rim rests on 3̄|.

may be necessary where the player has, say, periodontal or periapical pain in a front tooth.

For example, the patient shown in figures 48, 49 and 50, is a well-known and very experienced trumpet player. In the embouchure he adopted for many years, the mouthpiece was centrally placed and was distributed evenly between upper and lower lips. Periodontal pain then supervened at 2̲| which was very loose; 1̄| had been removed many years earlier. After experiencing pain at 2̲| on pressure by the mouthpiece rim, he adopted an embouchure of comfort as shown in figure 50 in order to avoid the pain.

It will be noticed that the mouthpiece is now placed to the left of centre and that it covers more

FIG. 48.—Air column exit (dental). Mouth open. *Note:* (1) Teeth unevenly positioned and right maxillary teeth palatally inclined. Air column pathway approximately at centre. (2) Space between 1̲|1̲ and 2̲| was very loose. 1̄| missing leaving spaces between 3̄2̄|1̄2̄.

FIG. 49.—Air column exit (dental). Same case as figure 48, mouth closed. *Note:* (1) Crossbite on right. (2) Main exit for expiratory air column approximately centrally placed.

FIG. 50.—Air column exit (labial). Same player as figures 48 and 49. *Note:* (1) Mouthpiece to left of centre and rim leaning on left side and downwards, to avoid tender $\underline{2}|$ region. (2) Rim more on lower lip, to gain advantage of spaces between lower teeth. (3) Double-dome of upper lip bulge probably due to tension of labial frenum behind philtrum, which may be cause of separation between $\underline{1}|\underline{1}$ (*see* fig. 49).

lower lip than upper lip. The apparently excessive bulging of the lips is probably due to the pressure of the air column passing through the space between $\underline{1}|\underline{1}$ and through the space left by the missing $\bar{1}|$; i.e. he makes use of the existing spaces between his front teeth to enlarge the air cushion between his lips and teeth, which will buffer any excessive pressure on $\underline{2}|$.

Guide to Offending Tooth

Most brass players experiencing embouchure discomfort due to a dental defect are able to indicate the offending tooth to the dentist, but sometimes a player may be in some doubt as to which tooth is the cause. The dental surgeon may locate the tooth by closely examining the mucous surface of the lip with a magnifying lens or he may map out on the cutaneous surface the outline of the mouthpiece during blowing. Then, measuring the thickness of the mouthpiece rim, he can mark on the skin of the lips an inner circle corresponding to the inner margin of the mouthpiece rim. This is often a useful guide in identifying an offending tooth.

Use of Replica Mouthpiece Rim

It would facilitate matters, however, if the lips, vibrating within the cup of the mouthpiece, were clearly visible from the front. The use of mouthpiece rims will help in this respect. The previous article has shown how a removable mouthpiece rim may be assembled temporarily on a suitable handle for examination purposes. Where the mouthpiece rim is not removable, a replica may be constructed in acrylic resin either in the laboratory or in the surgery. The author has used the following technique in the surgery.

Construction of Replica Mouthpiece Rim

A sheet of tin foil about $2\frac{1}{4}$ in. square of suitable thickness (e.g. gauge 40 Amalgamated Dental Co.) is swaged carefully over the rim of the mouthpiece, extending over the whole of the outside depth of the rim but not reaching the outside of the cup, which is of a smaller diameter (fig. 51 A and B); it should be removable without distortion (i.e. it should not extend into undercuts). The well-fitted foil should be free from any creases and should stand away near the outside of the cup. A suitable hand instrument, or the rounded end of a wax knife, may be used for

A B

FIG. 51.—Mouthpiece of cornet. A, Rim is not detachable. B, During construction of replica of mouthpiece rim (*see* text).

the swaging. On the inside of the cup the foil is well swaged in its upper half and a hole of about $\frac{1}{4}$ in. diameter is cut in its centre (fig. 51 B).

Two or three sticks of hard composition (e.g. Kerr's green-stick or the harder red-stick) are softened in hot water and kneaded over the foil-covered rim to form, when hardened and removed, a tin-foiled impression of the mouthpiece rim. The composition should penetrate the hole in the foil at the inside of the cup. A strip of about $\frac{1}{4}$ in. wide may be cut out of the excess foil which, while being held in the composition, does not form part of the rim impression, but extends outwards from it. The composition is now cooled and trimmed, if necessary.

The serrated end of an old single-ended hand instrument is suitably heated and pressed carefully into the composition which is exposed where the foil strip has been cut out, so that it penetrates the rim impression, extending about half way between the outer and inner diameters and lies about $\frac{1}{8}$ in. from the deepest part of the rim impression (fig. 52). A

FIG. 52.—Tin-foiled impression of player's non-detachable mouthpiece rim. *Note:* Serrated handle of old hand-instrument penetrates impression about half-way to be attached to acrylic rim.

sufficient quantity of rapid curing clear acrylic resin is now mixed and agitated, vibrated, or poured into the rim portion of the impression, taking care that the handle is adequately embedded. Excess acrylic extending on to the domed impression of the cup may be removed while still plastic.

When the acrylic has polymerised, the composition may be warmed and removed together with the foil, leaving a mouthpiece rim replica with handle attached (fig. 53). Any acrylic excess extending on to the impression of the cup may be stoned away from the inside of the rim. The surface of the rim which was not processed against the foil may be stoned and polished; the other surface should not need further polishing.

FIG. 53.—Finished mouthpiece rim replica.

It is not essential that composition should be used as a supporting mould for the tin foil; plaster or alginate or silicone may be used, or, should the foil be sufficiently thick (e.g. tin-coated lead foil of a toothpaste tube), a replica acrylic rim may be made without any supporting mould. More care, however, is necessary to avoid distortion of the foil and in attaching a suitable handle.

The Study of Mouthpiece Suitability

Mouthpieces of brass instruments have been the subject of a good deal of detailed study over a substantial period of time, from both the academic and practical points of view and the literature is wide. So important is the subject considered in the fields of music and acoustics, that masters' degrees have been conferred in some universities for theses presented on it. The knowledge acquired over the years has shown an increasing appreciation of the value of dentistry in this connexion. From a dental point of view, suitability of the brass player's mouthpiece to his lips is an aspect of some importance when dealing with his embouchure problems.

Type and Individual Requirements

Since the playing of a brass instrument is incomplete without the provision of the player's own 'double-lip reed', considerable investigation has been carried out into the suitability of mouthpieces for the lips of players of different facial types and also into suitability to the lips of individual players. Some manufacturers have made exhaustive efforts to satisfy the need for suitable mouthpieces. V. Bach, for instance, formerly soloist in the Boston Philharmonic Orchestra is well known for his contributions and for the numerous designs of mouthpieces used throughout the world which bear his name, He is now consultant to a very large American manufacturing company producing wind instruments. The firm catalogues numerous mouthpieces of a single brass instrument to suit the various facial types and mouthpiece rims on handles for embouchure study by the student. These mouthpieces, and those of other firms however, are in standard patterns (Rohner, 1952).

In view of the occasional difficulty in satisfying the embouchure requirements of certain players, mouthpieces are sometimes built to individual requirements. Bate (1965) refers to a craftsman in the United States who, before the 1940's, regularly constructed mouthpieces for individual players of brass instruments, using plaster models of the teeth

for the purpose. Hunt (1950) of the Brigham Young University, Utah, U.S.A., in a study of cup mouthpieces in relation to dento-facial irregularities, discusses the use of plaster models as a means of building mouthpieces with offset rims to conform with different types of dental and jaw irregularities.

Dentist as Consultant during Construction

It would be in the best interests of the player if the manufacturer of a special mouthpiece were to consult with the player's dental adviser on the construction of it. For example, accurate models of the player's teeth and jaws could be provided by the dental surgeon who might also furnish a replica of the mouthpiece rim in hard wax or acrylic resin, offset to conform with any dental irregularity that required a specially constructed mouthpiece. The craftsman could then reproduce such a rim, accurately or modified, to be incorporated in a new mouthpiece. The production of such mouthpieces would no doubt be expensive but in view of the value they would have to those musicians who needed them there are, doubtless, many who would be prepared to meet the expense of acquiring such a valuable means of improving their embouchures.

Included among Hunt's references is the orthodontic aspect outlined by Cheyney and Hughes (1946). Cheyney had presented earlier a highly commended thesis on the relationship between orthodontics and wind instrument playing at the Ann Arbor University of Michigan, as part of a master's degree in orthodontics.

Orthodontic and Periodontal Supervision in Children and Adults

Cheyney (1949), in a further excellent paper, suggests the use of orthodontics as a means of correcting certain jaw and dental irregularities in order to improve the embouchure. It would appear that the subjects providing the data were university students and music teachers and were, therefore, at youngest, either older teenagers or much older individuals. The present writer has for long held the view that children playing wind instruments should be under the watchful care of the orthodontist and that the orthodontist carrying out treatment on a child should be made aware of the fact if his patient plays a wind instrument. The possibility of wind instrument playing as a means of correcting facial maldevelopment has also long been recognised, e.g. Strayer (1939). However, in the experience of the writer, as a means of correcting misplaced teeth in an adult mature player orthodontics alone offers limited advantage. It is more likely to be successful when working in co-operation with prophylactic periodontal measures, since retention appliances resisting un desirable forces during playing are likely to give rise to further embouchure complications. The two disciplines while generally inter-related have a specific common ground, so far as the adult wind musician is concerned.

REFERENCES

Bach, V. (1925) The Art of Trumpet Playing. The Vincent Bach Corporation, New York.

—— (1952) *The Instrumentalist* (*U.S.A.*), II, 40.

Bate, P. (1965) The Trumpet and Trombone, chap. 4, p.80. Ernest Benn, London.

Campbell, E. J. M. (1958) The Respiratory Muscles and The Mechanics of Breathing. Lloyd-Luke, London.

Cheyney, E. A. (1949) *Amer. J. Orthodont.*, 35, 440.

—— , and Hughes, B. (1946) *Etude* (*U.S.A.*), July.

Hunt, N. J. (1950) *The School Musician*, Jan. - Mar.

Rohner, T. (1952) *The Instrumentalist* (*U.S.A.*), II, 30.

Strayer, E. R. (1939) *Angle Orthodont.*, 9, 18.

11.—Brass Instruments *(continued)*

IT is clear that many dental and oral conditions may interfere with the playing of wind instruments; what may not be so clear is the fact that certain of these conditions may affect the embouchures of players of the different classes of instruments in different ways and to different degrees. The embouchures of brass players are probably the most easily affected and among these the players of instruments with the smaller mouthpieces are probably disturbed most easily of all and, therefore, most frequently of all.

The Role of the Brass Player's Lips

This is more readily comprehended when it is remembered that the sound generator in the woodwind (e.g. the reed in the oboe) is part of the instrument itself; the sound generator in the brass is part of the player—his lips. Moreover, the sound, once initiated or generated in the woodwind is resonated into precise musical tones by the operation of the keys or holes in the instrument; in the brass, the lips of the player not only initiate the sound by their own vibrations, but they work in close co-operation with the mouthpiece pressure, and the operation of the pistons or slide in order to resonate the exact musical tones. This co-operative relationship between the lips and the instrument might even be referred to as symbiotic, so far as resonance of the musical tones of a brass instrument is concerned.

Dental Factors Disturbing Embouchure

A comprehensive account of the manner in which the playing of wind instruments may be disturbed by dental factors alone would probably be a work of scholasticism, so diverse and detailed are the causes and effects with different instruments and in different players. For the purposes of this article, it would be sufficient to state that the embouchure of the brass player is extremely vulnerable to disturbances through dental and oral conditions, much more so than is the embouchure of the woodwind player.

Some dental and oral conditions may have a sudden onset with an immediate adverse effect on playing, e.g. those due to acute inflammatory processes, whereby playing may be either hindered or prevented. Such conditions usually interfere with the resonating of the musical tones owing to discomfort or pain as a result of pressure of the mouthpiece against the lips; the washer-like function may be disturbed, allowing air to escape; control of size of lip aperture may also be interfered with.

Other adverse conditions, however, may have a much more insidious onset causing playing to deteriorate slowly over a long period of time and eventually to become impossible. In instances of this nature, not only is the resonating of the musical tones affected, but the initiation or generation of the sound becomes increasingly more difficult. In other words, the lips cannot vibrate adequately. A few musical tones may still be emitted from the instrument, but only with difficulty and uncertainty, so that playing, particularly for the professional, has for practical purposes ended unless appropriate treatment is carried out. Attention has already been drawn to the fact that the progressive dental troubles of experienced wind musicians may increasingly interfere with the quality of the tone that they are able to produce during playing (Porter, 1952).

An Illustrative Case

In the following case, not only had this occurred but the generation of sound, the resonating of the musical tones and confidence in ability to play, had all deteriorated in a profound manner. The major cause was acid erosion of the teeth; unusual in a wind instrument player. The patient had been a professional trumpet player but about eight years ago, previous to his seeking dental treatment, his playing had steadily deteriorated until he found the strain of producing and maintaining musical tones too difficult. He had lost his sense of smell and according to medical advice his loss of smell and his inability to play were probably due to a chronic sinusitis. He had been in the habit of gargling with one or two teaspoonfuls of proprietary lemon juice daily. Since losing his ability to play he had changed his occupation to that of 'maintenance electrician of domestic appliances.'

When he presented for dental examination, he had what appeared to be an open bite in the anterior region; his maxillary and mandibular anterior teeth showed extreme erosion, which affected the premolar region rather less. The eroded anterior teeth left a wide gap between the uppers and

FIG. 54.—Erosion of teeth in a trumpet player, probably due to proprietary lemon juice. *Note:* (1) Most of crowns and nearly all buccal surfaces of anterior teeth missing. (2) Bite apparently open anteriorly and gap widest to left of centre.

lowers and the separation was widest between $|\underline{12}$ and $|\underline{\bar{1}\bar{2}}$ (fig. 54). It was observed that the patient applied the mouthpiece to his lips so that it was definitely to the left of centre, as expected in view of the wider space between $|\underline{12}$ and $|\underline{\bar{2}\bar{1}}$ (fig. 55). When viewed in profile, embouchure support by the

FIG. 55.—Same patient as figure 54 (during playing, front view). *Note:* Mouthpiece applied to left of centre.

anterior teeth was not enough to prevent the small mouthpiece being pushed too far back into the mouth (fig. 56).

The palatal vault showed a papillation of the mucosa at the right of the central area of the torus palatinus and had a 'bubbled' appearance (fig. 57). Incidentally a similar appearance had been noticed in at least one other patient, not a wind instrument player, who had been in the habit of gargling with lemon juice.

Attempts at playing produced many uncontrolled bleated sounds in the higher and middle registers. It was apparent that far too large an air column was forcing its way past the patient's lips in an uncontrollable manner and that the lips were unable to maintain the rhythmic series of regular vibrations

FIG. 56.—Same patient as figure 54 (during playing, lateral view). *Note:* Mouthpiece pushing lips into mouth due to insufficient dental support.

which are always required to produce musical tones, particularly in the higher register. To produce a high tone, the aperture between the lips should be comparatively small, the lips should be more tense, and to help this labial tension, the mouthpiece pressure against the lips would need resistance by the anterior teeth. Since most of the structure of the crowns of the anterior teeth was lost owing to their erosion and as the bite anteriorly was excessively open, production of high tones was impossible by this patient.

FIG. 57.—Same patient as figure 54 (palatal view). 'Bubbled' appearance of mucosa on torus palatinus. (Confluent papillomatous effect.)

Clinical Experimental Measures

Experimenting with gutta-percha in a way which simulated the restoration of the open bite to a normal relationship in the anterior region, i.e. by applying the material to the upper and lower anterior teeth, the patient was enabled to produce musical tones again almost immediately. From this initial experiment it was obvious that crowning of the affected teeth would restore the ability to play to a substantial degree. At the same visit, temporary crown forms were fitted to $\underline{21|123}$ (fig. 58). The immediate effect was extremely encouraging. Most tones

FIG. 58.—Same patient as figure 54 (front view) showing temporary crown forms fitted to 21|123 to test effect on blowing.

were produced with increasing ease; some in the higher register were somewhat uncertain, but it was clear that these would be regained with some practice. This was quite understandable in view of the fact that the patient, not being able to practise for a long time, had lost the spontaneous response from an erstwhile efficient embouchure. The elated patient felt that he would soon regain all his long lost confidence in playing. No doubt the provision of permanent metal-bonded porcelain jacket crowns would enable him to regain even his professional ability.

In the past, according to one authority at least (Black, 1959), it was considered an advantage when wearing artificial dentures to have an open bite in the anterior region so far as the playing of the larger brass instruments was concerned. With these instruments, the column of air entering the mouthpiece is of a greater diameter than that necessary for the smaller instruments such as the trumpet, cornet or even the horn. The author is of the opinion that had this patient played one of the larger instruments with a larger mouthpiece, e.g. the trombone or the tuba, he probably would have suffered much less incapacity.

This case would appear to confirm:

(1) That the embouchure is dependent upon the dentition.

(2) That the neglect of regular dental attention could be a calamity for the professional wind musician.

(3) That prompt intelligent restorative treatment is essential for the professional wind musician if he is to maintain his livelihood.

Psychological Considerations

In addition to the above considerations, the author is of the opinion that psychological disturbances in some professional players might give rise to psychosomatic effects. With the patient under examination this did not occur, since he was of a disposition which enabled him to apply himself to a different occupation, but some professional players, having devoted their lives and interest to little other than this form of music-making, are incapable of learning or are unwilling to learn an alternative means of employment. They tend to panic when an embouchure mishap occurs and this gives rise to a state bordering on utter despair.

The routine dental treatment of the brass instrument player necessitates at least the frequency of care given to children, pregnant women and nursing mothers. They should be examined clinically and radiographically (unless contra-indicated) at least three times annually. Instruction in oral hygiene should be carefully given and it is essential that its value and practice should be clearly understood by the patient.

Suggestions for Clinical Treatment

Needless to say, restorations, where possible, should be the best appropriate to the case; for example, gold inlays, metal bonded porcelain jacket crowns and bridge work in preference to dentures. The vitality of the pulp should be retained where this is possible: the approach should always be conservative rather than radical. Depending on the instrument played, hasty removal of teeth could well court other unexpected embouchure complications.

In this last respect, players of the larger brass instruments respond better to removal of teeth and their replacement by dentures than do players of the smaller instruments with smaller mouthpieces (fig. 59 A, B, C and D).

Fillings in anterior teeth, particularly those impinging upon the part of the lips which bear the pressure of the mouthpiece rim, should conform

A

B

C

D

FIG. 59.—Full upper denture in tenor horn player. Larger mouthpiece of this instrument is tolerated more easily during playing than smaller mouthpiece of cornet or trumpet. A, Full upper denture in centric occlusion. *Note:* Space between $\overline{1}|\overline{1}$ to left of centre. B, Mouth open. *Note:* Upper and lower incisal edges approximately equidistant on either side. C, During playing (front view). *Note:* Mouthpiece slightly to left of centre and more on lower lip than usual to gain expiratory comfort of exit aperture between $\overline{1}|\overline{1}$. D, During playing (lateral view). *Note:* (1) Mouthpiece less than two-thirds on upper lip (two-thirds is usually the case with larger mouthpieces). (2) Direction of mouthpice against upper lip helps to retain denture in position.

strictly with the anatomical form of the tooth and should be very smooth and highly polished.

Where the upper lip is rendered uncomfortable by a slightly projecting corner or incisal edge of a tooth, a very limited amount of grinding and polishing may be sufficiently effective. If necessary a suitable obtundant may be applied where the stoned area is sensitive. It is usually the projection in a horizontal direction that offends in these players; vertical prolongation does not usually give any trouble, unless the tooth is loose.

Local Correction for Embouchure Comfort

Should the lip be very uncomfortable owing to the projecting corners of two teeth adjacent to a palatally inclined tooth between them, a porcelain jacket crown on the instanding tooth with its buccal surface built up to bring it in line with its neighbours may be indicated. It would be wise, however, to experiment first with gutta-percha on the instanding tooth, simulating a jacket crown built up in the same way. The tooth should first be dried, the site protected with a cotton-wool roll, wiped with a little oil of cajuput and dried again before the warm gutta-percha is applied. The patient should then test the effect by playing his instrument. If satisfactory, a temporary crown form should be tried over a period of a week or two before any preparation for a permanent crown is carried out. Endodontic treatment requires a period of a few weeks rest from playing and is best undertaken, if possible, during a holiday period. It might also include a form of temporary removable periodontal splinting to ensure minimal exposure to undesirable forces exerted during playing, especially where apicectomy has been carried out.

With brass players the advantages of the lip shield are far more limited than with the reed instrument players. The lips of the brass player are much more sensitive to alteration in anatomical form and bulk of the anterior teeth, doubtless due to their function of sound generator and to their contribution to the resonating of the musical tones. Where there is an appreciable loss of tooth structure, such as in the case of erosion, earlier referred to, a lip shield accurately replacing the lost dental tissues could conceivably be effective.

Lip Comfort during Periodontal Treatment

Periodontal treatment, which includes gingivectomy packs, sutures and so forth, requires some special attention to allow the lips to vibrate, if the patient is permitted to continue with his playing between visits. In this event, it might be considered advisable for the patient to try the effects of the mouthpiece against the lips, as in playing, while he is still in the surgery and before the pack has set.

Although this may not be easy, since the area of operation may be anæsthetised, it is worthy of trial in order to shape the gingival pack to allow comfortable application of the mouthpiece to the lips. Alternatively, the position occupied by the mouthpiece rim on the lips may be noted prior to anæsthetising and carrying out the gingivectomy.

REFERENCES

Black, T. F. (1959) *The Musician*, pp.10, 30, 46, 59 and 94. (reprinted from earlier editions).
Porter, M. M. (1952) *Brit. dent. J.*, 93, 66.

WHEREVER possible, a bridge is preferable to a partial denture for players of brass instruments, but certain precautions in its construction should be observed.

Since the forces exerted by the mouthpiece during playing are almost invariably in an antero-posterior direction, full crowns are preferable to threequarter crowns and pin-lays to keyed inlays on abutment teeth, and such teeth should have reasonably firm attachment to the jaw. Where the rigidity of abutment teeth is in doubt, some additional reinforcement may be advisable to resist labial pressure. The sensitivity of the lips during the generation and the resonating of the musical sounds should not be burdened by any protruding irregularity of pontics in the construction of the bridge.

Any models or photographs taken before extraction of the teeth may be used to advantage; enlargement to life size of the oral area of the photographs would help. The degree of overbite, the amount of free-way space and the form of the teeth should all be noted and copied later where necessary; the relationship between length of teeth and length of lips is also important.

Cantilever bridges are usually not recommended for players of brass instruments because whether the palatal arm is long or short it allows some mobility of the pontic which may lead to deformation of the arm.

Bearing in mind the forces exerted by the mouthpiece, much the same conditions which apply to an upper bridge apply also to a lower bridge.

Partial Dentures

Provided there is sufficient retention, the construction of satisfactory partial dentures for players of brass instruments is not unduly difficult. Anterior teeth should be evenly alined and not too long, so that the lips may vibrate freely and there is no discomfort when they are pressed against the teeth by the mouthpiece rim. The open palate of a skeleton denture, will allow more freedom for the tongue to articulate staccato passages in the music. Clasps should not irritate the lips, which may be pressed against them by the mouthpiece.

The artificial teeth on a partial denture should match the remaining natural teeth in form where possible, and buccal artificial gum should not be too thick, so as to allow the buccinator and modiolus to contract at will; in fact, it is an advantage to shape it to accommodate those muscles. Whether these requirements have been met may be tested during the various stages of construction with the mouthpiece in position as in playing, i.e. when registering the bite and when trying the denture in the mouth at the waxed-up stage. Mobility and flexibility of lips and tongue should be prime considerations in order that the patient's particular embouchure demands are met.

Full Dentures (The Single Full Denture)

Needless to say, one should be quite sure that the remaining teeth are really beyond restoration before any extractions are undertaken, in order to preserve an existing comfortable embouchure for as long as possible. The author has retained many seemingly hopeless teeth for many years by means of crowning, inlay splinting, removable splinting, gingivectomy and so forth, which enabled professional musicians to continue playing comfortably and regularly. Partial dentures are always likely to be more rigidly retained in the mouth during playing than are full dentures. One very able professional orchestral player, with four remaining upper anterior teeth and two lower canine teeth, is now 73 years of age and hopes to retain their present state for many years to come! The author has been attending him regularly for the past 17 years, at the beginning of which the same teeth were not much better than they are now.

Where the removal of remaining teeth has been inevitable in a professional player, the author for several years past has rarely extracted more than one or two teeth at a time; whenever possible artificial ones have in each case been added immediately to the existing dentures so that the patient could continue to play.

Study models are always advisable prior to the removal of any remaining teeth and the impressions should be taken with any existing dentures in position in the mouth. Some means of recording facial contour and relationship of the lips to the vertical dimension of the teeth and jaws would be of much advantage. The author finds photographs (full

face and profile, without the instrument and with the instrument as in playing) and certain measurements a great help. The measurements required are: the distance from mean incisal edge of the upper centrals to the junction of philtrum of upper lip with septal cartilage of nose; the distance from mean incisal edge of lower centrals to the inferior border of the mental protruberance of mandible; and the overall measurement from the septal cartilage to the inferior border. Callipers or a Willis bite gauge may be used for the purpose. Any other characteristics, such as free-way space, overbite and so forth, may be reproduced from photographs and models.

Where a full single denture is already worn, impressions should be taken with it in position in the mouth. Additional impressions of the edentulous jaw should be taken with a special tray that is suitably muscle trimmed. A bite block should be already mounted on the tray. After a preliminary registration of centric occlusion, the wax block is trimmed to conform as near as possible to the vertical dimension already recorded and with the facial contour as shown in profile on the photograph. The incisal region should be narrow and the molar region a little wider. A slow-setting impression paste will permit manœuvrability of the lips and adaptation to them of the mouthpiece as in playing, before it sets. The centric occlusion and the original vertical dimensions should be rechecked. The periphery of the impression should be extended as far as possible and labial and buccal 'fossæ' should be reproduced on the wax. The technician should copy the minutest details for the try-in stage.

At the try-in stage, the patient may, with care, endeavour to play a few notes on his instrument. The teeth should be suitably waxed to a baseplate which may be retained in position during playing by a fixative if necessary. It is helpful to remember that the expired air vibrating the lips passes through the 'flattened tube' between them as it does between the two blades of a double reed, e.g. as in the oboe or bassoon, and that the column usually passes the teeth at the widest separation between the upper and lower incisors.

Observation of the full-face photograph during playing could indicate the exit aperture between the lips and should the patient find it difficult to produce a musical tone at the try-in stage, the anterior teeth may be repositioned, or the edges may be stoned to allow for a similar exit aperture for the column of expired air. In this last respect the mouthpiece rim or a rim replica could help to arrange a suitable exit aperture.

Full Denture Prosthesis

The Full Upper and Lower Denture

In order to avoid repetition, the reader is referred to part 5 of this series where a technique for the construction of full dentures for the single-reed instrumentalist is described. While much of the method suggested applies also to the brass instrumentalist, certain other requirements should be borne in mind in view of the fact that in his case an extra-oral embouchure is involved, in contrast to intra-oral embouchure used by the single-reed instrumentalist.

The dislodging forces exerted by the mouthpiece in the brass are in an antero-posterior direction and all stages in the construction of the denture should be directed to finding adequate means of resisting these forces. For example, having taken suitable initial impressions, well fitting, muscle-trimmed special trays are made with bite blocks mounted on them. The bite blocks should be narrow in the incisor regions and a little wider in posterior regions. The buccal surfaces of both dentures when in occlusion may be made somewhat concave to accommodate the contracting buccinators and modioli, so that the dentures may be held in position by the buccal muscular pads which are accentuated during blowing.

Narrow posterior teeth help to create such concave buccal surfaces or 'fossæ'. The lingual surface of the lower denture should slope downwards and backwards in the anterior region and downwards and medially in the posterior region, so that the tongue cannot easily lift it off the alveolar ridge during its 'tonguing' function for the purpose of producing staccato sounds. To help the dentures allow a suitable column of air to pass and vibrate the edges of the lips, the upper anterior teeth may be set as though the incisal edges were conforming to a flattened tube, e.g. a bassoon reed. This will necessitate the laterals being as low incisally or even lower than the central incisors; this arrangement should be subtle and not overdone in players of brass instruments with small mouthpieces. The use of the replica mouthpiece rim might help in this respect.

Aids in Full Denture Prosthesis

It should be emphasised that over many years the author has encountered few players of brass instruments who either required full upper and lower dentures or who played with full upper and lower dentures. There may be many reasons for this. Some of these musicians might have given up playing altogether, usually with much regret; others might have taken up musical instruments other than brass, or they might have followed other musical pursuits. Still others may have been determined to retain their remaining teeth, or were persuaded to retain them, for a very long time, by such means as careful oral hygiene or by regularly visiting their dentists, so that they were able to continue playing without needing full dentures. The author includes

among his patients many of the latter group and has directed his efforts towards the prevention of an edentulous state.

Experience, however, has suggested several possibilities of dealing with those few players who are likely to request the provision of full dentures in the near future, and with the larger number who are likely to require them later when they realise that the dental surgeon is in a position to help them. Among these possibilities is the 'embouchure denture' referred to in part 6 whereby a system of inclined planes may be incorporated in the denture in a way which is intended to resist dislodgment by the pressure of the mouthpiece against the lips. Also included is the possibility of the provision of spiral springs in the denture during playing; these would be retained within sheltered arches or recesses incorporated in the buccal aspects of the region of the posterior teeth. If springs are used they must be carefully positioned or they will not seat the dentures correctly and they may cause irritation of the buccal mucosa (Simms, 1928), or alveolar resorption (Mack, 1964). Nevertheless the player, especially the professional one, has such a desire and compulsion to continue playing that he would willingly try any means that might enable him to do so.

No doubt in the future numerous other aids will be suggested for the retention of full dentures in the mouth during the playing of brass instruments.

Further Observations on Wind Instrument Playing

The playing of wind instruments evidently occupies much time in the lives of many people who may play in groups or alone, either for their own amusement or for the entertainment of others. The number must be very large and a good proportion spend their whole working lives playing in a professional capacity.

Since, with each of them, the embouchure depends on the dentition and since the dentition may be influenced to advantage or disadvantage by the embouchure adopted for the instrument chosen, it behoves dental surgeons and those teaching dentistry, whether they be interested in music or not, to have at least a basic understanding of the unusual functional demands on the mouth and its associated parts during playing.

Armed with such knowledge, the dental surgeon is obviously in a better position to protect his patient and to ensure more success for any treatment he may provide. It is doubtful whether any branch or specialty in dentistry would be entirely excluded from some of the problems involved. These problems, particularly when associated with a professional player, may demand a standard of attention to a type of detail which is not normally envisaged in patients who do not play wind instruments. Equally, when the problems are associated with young players, orthodontists may find their work impeded unless they recognise the functional demands of the individual embouchure, even though they may be told that the child plays a wind instrument. Indeed, with the knowledge of such functional demands, the orthodontist may in some cases advise the use of certain wind instruments to augment a form of successful treatment which may at the same time be of some educational benefit or even pleasure to his young patient.

The author has for long held the view that expert supervision by the orthodontist would be advisable in the very young player. The following case is an example in point, which was referred by an enlightened teacher of the clarinet at one of the foremost colleges of music.

The patient, aged 22 years, a very talented student of the instrument, had an almost perfect dentition, but one which suggested the probable conformation of the incisor region of both jaws to a wedge-shaped

FIG. 60.—Dentition of clarinet player. Models in centric occlusion. Apparent overcrowding in pre-maxilla $\overline{1}|\overline{1}$ lingually inclined.

FIG. 61.—Same player as figure 60 viewed more palatally to show extent of free-way space between $\underline{1}|\underline{1}$ and $\overline{1}|\overline{1}$.

intra-oral instrument which had been played regularly during the early years of bone growth (figs. 60, 61 and 62). Oral hygiene had, no doubt, been exceedingly well observed. The recorder had been played from 6 years of age and, from 9 years on-

FIG. 62.—Same player as figure 60. *Note:* (1) Short upper lip. (2) Lower jaw and lower lip in relation to upper jaw and upper lip. These conditions would indicate a single lip embouchure.

wards, the patient had proceeded to the study of the clarinet. 'Point-pressure' had lately been experienced due to the prominent corners of $\overline{2}\overline{1}|\overline{1}2$ impinging on the lower lip which necessarily had to be curled over them (fig. 63). A single lip embouchure being used, the upper incisors rest on the sloping upper surface of the hard mouthpiece (figs. 64 and 65). A shield made by the player in gutta-percha was used to protect the lower lip temporarily for embouchure comfort (fig. 66). A permanent one was made, covering more teeth.

FIG. 63.—Same player as figure 60. Mouth open. *Note:* Prominent incisal corners of $\overline{2}\overline{1}|\overline{1}2$ over which lower lip is stretched during playing.

Nevertheless, while playing now proceeds with more comfort, an irregularity persists which might have been avoided.

The writer has in the past always advised that wind instruments should not be taken up at too early an age, owing to the possibility of moulding the

FIG. 64.—Same player as in figure 60. *Note:* (1) $\underline{1}|\underline{1}$ rest on upper surface of mouthpiece. (2) Effect of lower (reed) surface of mouthpiece on lower lip and $\overline{1}|\overline{1}$.

FIG. 65.—Same player as in figure 60. Mouthpiece approximately centrally placed.

FIG. 66.—Same player as in figure 60. Temporary gutta-percha lip shield made by patient to prevent point-pressure on lower lip.

jaws and moving the teeth in undesirable ways, unless under the watchful eye of the orthodontist or unless such playing is beneficial to the patient from an orthodontic point of view. It may be better for

the patient, from a dental point of view, either to play an instrument such as the piano—provided he expresses a desire to do so—or to sing in choral groups with other children, so that he is usefully occupied in the musical field. He may then proceed to the most suitable wind instrument at or near the time of termination of bone growth, i.e. at adolescence, so that any undesirable effects on the development of the jaws and teeth may be avoided.

Unfortunately, the functions of the mouth and its associated parts in the playing of wind instruments, both by amateurs of all ages and by professionals, would appear to have been somewhat overlooked in the curricula of dental undergraduate and postgraduate study. Just as the more usual functions and development of the mouth and its related parts should be understood in order to carry out prophylactic and therapeutic dentistry, so, it would seem, should the lesser usual functions and their effects on development be understood, especially when they concern so many patients who actually play, those involved in their musical education, and the vast number who may derive so much pleasure from their playing. In this last respect, it is suggested that the dentist may be regarded as a vital link between certain sections of the two cultures, the arts and the sciences.

Conclusion

Today there is a very large number of wind instrument players, both adults and children. It may be presumed that all of them require dental treatment sooner or later. The presence of dental defects can affect playing, as also can the treatment for them. Furthermore, the playing of wind instruments can affect the dentist's treatment both to adults and to children. This subject has been very largely overlooked in the past and in view of the importance of his teeth to the musician—whether a professional or an amateur—the subject is one that calls for intensive study and much more consideration both in undergraduate and postgraduate education.

Moreover, it would be appropriate to add here that the relationship between dentistry and the playing of wind instruments has aroused some interest among those dealing with forensic stomatology. It has been shown, for instance, that certain markings on the lips may suggest the playing of a wind instrument; those markings on the cutaneous portions could indicate the playing of a brass instrument; those on the mucous aspect could indicate the playing of a reed instrument. It has also been shown that accidents or treatment could affect playing to an extent in which courts of law may be concerned.

It is for all these reasons that the author was prompted to write this series, for the benefit of dentists and those of their patients who play wind instruments. Much of any successful treatment described has been the result of lessons learnt by trial and error in many earlier cases, since references regarding functional demands and rational treatment were somewhat scanty.

ACKNOWLEDGMENTS

It is with pleasure and gratitude that I acknowledge the help given me by the senior staff of the *B.D.J.* and the Librarian of the B.D.A. I am grateful for the kind co-operation of Professor H. M. Pickard and Mr. Ivan Curson, Head of the Division of Conservative Dentistry, both of the Royal Dental Hospital of London, for arranging the completion of the treatment for two of the musicians and for furnishing slides for two of the illustrations (figs. 54 and 57). My thanks are due to the artists, Mr. Patrick Kemmish, Miss Sylvia Treadgold and Mr. Richard Harrison, and to the photographer, Mr. Jack Cook of the Photographic Unit of the Royal Society of Medicine, for their excellent work. I wish to thank also the publishers, Messrs. Boosey & Hawkes, London, for allowing me to reproduce figure 3 from my book 'The Embouchure' and for furnishing other illustrations. Finally, I am grateful for the ready co-operation of the musicians photographed.

REFERENCES

Mack, A. (1964) *Brit. dent. J.*, **117**, 128.

Simms, W. (1928) Manual of Dental Prosthetics, XIX, 312-13. Sherratt & Hughes, Manchester.