Muscular factors in the diagnosis and treatment of malocclusions*

ALLAN G. BRODIE, D.D.S., Ph.D.
Chicago, Illinois

I was taken aback when the program chairman asked me to speak on this subject because, having so recently published an article on the anatomy and physiology of musculature in relation to orthodontia, I thought that it might be difficult to find new things to say. That article, however, was of a very general nature and considered the normal functional role of each of the groups of muscles of the mouth region. I shall not repeat those general considerations because I feel that you are well grounded in them but will rather dwell on certain conditions which we are beginning to suspect may be closely associated with muscular function. Before doing this I should like to convey to you certain concepts that have been forming in my own mind for the past several years; concepts which have helped me in my thinking about orthodontic problems but which I have never before attempted to put into words.

First, I would ask that you visualize a completely edentulous skull with advanced alveolar absorption. The jaws of such a skull represent the skeletal framework of the denture. The mandible is still indispensible after the teeth are lost to afford support for the tongue and pharynx as well as to make possible the maintenance of the posture of the head. The maxilla is equally important after the loss of its teeth to provide for the air passage and its accessory warming mechanism, the sinuses and conchae. Next, visualize the mass of the tongue, lying within and between the two jaws and completely filling all the space between the crests of the mandible and maxilla and even flowing outward over them slightly. Recall that the tongue is maintained in this position by a three point suspension with one point near the lower border of the symphysis and the other two located bilaterally on the base of the skull in the region of the styloid and mastoid processes. The fact that the tongue is a symmetrical muscle mass and that it is suspended in this manner, endows it with singular effectiveness in determining the form and position of the tooth arch around it.

Now picture in your mind's eye a sheet of musculature running completely around the margins of these jaws enclosing the tongue and in contact with it everywhere except in back. As this muscle sheet proceeds posteriorly, it is seen to pass medially to the ramus and medially to the entire pterygoid process except its medial plate. Thus, in the region of the upper jaw, the muscle sheet has narrowed to the width of the nose and in the lower to the width between the lingual surfaces of the alveolar processes of the mandible. This sheet you will have recognized as the buccinator muscle and its posterior limit, set by the pterygo-mandibular raphe' and the medial pterygoid plate, marks the boundary between the mouth and the pharynx.

The pharynx begins where the buccinator ends, that is, it takes its anterior attachment from the same structures

*Presented at the Second Reunion Meeting of the Department of Graduate Orthodontia, University of Illinois, Chicago, Illinois, March 1951.

that afford that muscle its posterior attachments. In man, the pharynx might be said to bend in a right angle to descend to its connection with the esophagus, while in four-footed animals it tends to be a horizontal tube. In either event, it is a muscular tube which must be considered as running forward through cheeks and lips to the midline of the face. Thus, the mouth may be thought of as merely a dilation of the forward extremity of the gut which passes from the lingual to the buccal sides of the maxilla and mandible in order to include the teeth and alveolar process.

Before the eruption of the first dentition and the growth of its alveolar process and again after the loss of these structures, the buccinator runs its course in contact with the tongue and the backward and forward motion of that organ within such a structure makes an admirable pump plunger or sucking device. The eruption of the teeth and the growth of the alveolar process separates the two, but the position and form of the dental arches are determined by the line of equilibrium set up between tongue and buccinator. To put this differently, one might conceive of tooth eruption and alveolar growth as nothing but a piercing of the gut wall from bases that both lie and are controlled, from without. In other words, one can look at the line of attachment of the buccinator muscle as representing quite accurately that controversial zone that separates the skeletal framework of the face from the alveolar process.

Likewise, one can think of the alveolar process and teeth as projecting into a tube but being controlled from outside of the tube. You will remember that the entire ramus of the mandible and the external pterygoid plate, structures that control the movements of the mandible through the muscles which are attached to them, all lie completely outside of the buccal cavity. When the teeth erupt they do so from the sheltered confines of the bodies of the maxilla and mandible into an environment that would appear to be completely controlled by muscular forces. (This was strikingly shown by Woods in his thesis when he traced the path of eruption of four of the teeth, viz, the canines and the molars from the time they were first laid down until they came into occlusion and for some time thereafter.)[1] The crowns of the teeth are apparently positioned at the point of equilibrium established by the tongue within and the buccinator without. Disregarding all other factors, we are faced with the relative size, position and form of the tongue and the effective tonus of the buccinator. As we all know there are other factors which modify this typical or average picture and it is of these that I should like to speak

The attachment of the buccinator, as I have indicated, is at the margin of what one might call the skeletal framework, but we know and are becoming more aware of the fact, that the framework of the maxilla and the mandible do not always bear average or normal relations to each other. They can deviate from their normal relationship both anteroposteriorly and mediolaterally. When they deviate anteroposteriorly, we say we are dealing with a Class II or a Class III condition. Even if musculature is perfectly normal in its growth and its degree of development and perfectly synchronized in time with skeletal growth, it is easily seen that the malrelation of the jaws would set up artificial or unusual muscle tensions.

Figure 1 represents the classical picture of Class II, Div. I and it indicates the sort of situation that I am describ-

---

[1] "Changes in width dimensions between certain teeth and facial points during human growth." Am. J. Orth., 36: 676-700, 1950.

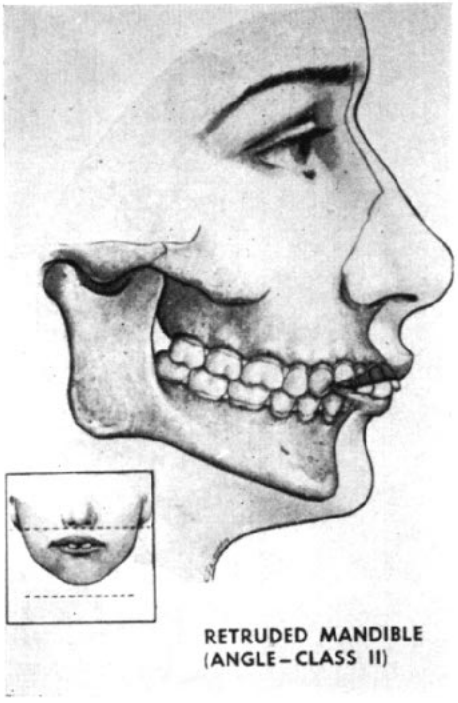

Figure 1

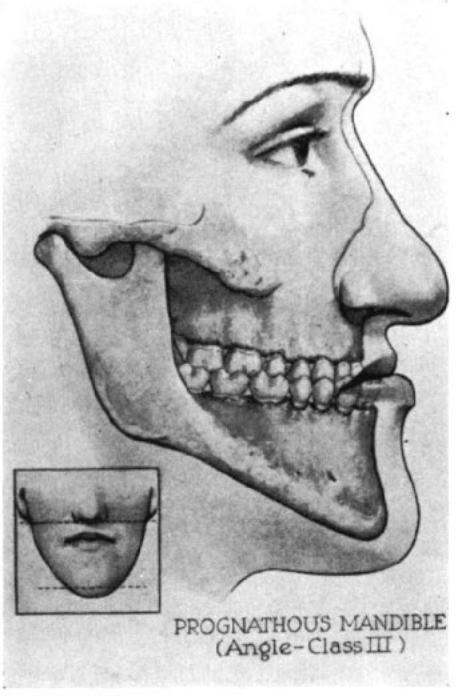

Figure 2

ing. I do not have to explain to anyone in this room the alterations that take place in the labial musculature in this type of case. The mandible, being retruded in relation to the maxilla, breaks the union of the lips, the upper of which curls up over the roots of the maxillary teeth. Increased strain from the external oblique line through the triangularis muscle to the upper lip crushes the canines lingually, and the muscle balance is completely altered, although the muscles themselves may be perfectly normal. We also know that in many of these cases the treatment of the case, i.e., its reduction to Class I, brings about a spontaneous correction of the muscle balance.

In the Class II, Div. II condition, the level of the lip line, coupled with the fact that the lips do not part, results in increased pressure on the upper incisal region with the result that it buckles in a lingual direction. This is, again, merely the result of a malrelation of the skeletal parts which give origin to the muscles of the lips.

In the Class III case (Fig. 2) the picture is completely reversed. Here we are dealing with a maxillary skeletal structure that is relatively smaller and more posterior than the mandibular and we can understand why the dental arches present their characteristic appearance. In those cases the maxillary teeth have a strong tendency to flare outward and the mandibular teeth a strong tendency to lean inward but both quite accurately reflect the course of the buccinator muscle from its superior to its inferior attachment.

In a similar way, the medio-lateral or width differences between maxilla and mandible can bring about marked deviations of the occlusion between the right and left side, or on both sides if the skeletal differences are bilateral. We are quite used to seeing asymmetries of

greater or less degree in our frontal headplates. When these are excessive, as for instance, when the middle third of the face shows inadequate development from midline to its lateral points, the origin or the superior attachment of the buccinator must travel in an outward direction to reach its mandibular attachment and this is reflected in the inclination of the teeth. Somewhere between the extremes represented by the intermaxillary differences an equilibrium will be set up between the force within and the force without.

In many of these cases we know that we cannot change conditions a great deal and the axial inclination of the teeth in these cases is one of the best signs as to whether we are dealing with a condition which will respond to treatment or one for which there is little hope. In those cross bites, for example, where there is a medial or palatal inclination of the maxillary teeth we do not hesitate to predict successful treatment. On the other hand, if there is a marked buccal inclination of the upper buccal teeth and if the mandible is normal and well developed laterally, there is little hope of expanding the maxillary arch sufficiently to bring it over into its correct relationships with the mandible. The fault here lies with those areas of bone that control the origin and insertion and hence the course of the buccinator muscle.

Another condition which we have all met but of which we talk very little due to our ignorance, is what I shall call for want of a better term, constitutional tension. This is the high strung youngster, thin, angular in type, with high and thin alveolar process, and prominent roots. He finds it impossible to sit still in the chair; he chews his finger nails, and twiches his face. The most discouraging aspect of such a case, however, is the thin and stiff nature of the cheeks and the lips. Linear development may be adequate but there is a constant tension in the facial musculature that will not permit of the proper arrangement of the teeth. These are cases that will continue to give us a great deal of trouble until means are found to induce relaxation. Many of them are traceable to psychological maladjustment.

And then, of course, there is the matter of habits. Habits, for the most part, operate on localized areas. There are habits of the tongue which may give us malrelation of teeth for two different reasons. There is one that is not a habit at all but rather a lack of timing between the growth processes of the muscle system on the one hand and that of the bony skeleton of the face on the other. The tongue at birth is probably closer to its adult size than any other part of the head with the exception of the brain. As you have all seen in the infant headplates, it occupies the entire buccal cavity and sometimes the buccal cavity cannot even contain it.

I presently have two cases illustrating this disparity of muscular and osseous growth, one of which I have watched for eleven years. When I first saw the child he was three years of age. His tongue protruded from his mouth, his incisors were completely procumbent, both upper and lower, and there was an open bite in front of about 7/8ths of an inch. You can imagine his appearance. There was nothing to be done for the case at that age except a tongue resection, which I scarcely wanted to recommend. But I had a great deal of difficulty in convincing the parents that nothing should be done. He was observed periodically and over a period of three and a half or four years, he shed his deciduous incisors and erupted his permanent incisors. These erupted in the same procumbent position. And now it did require powerful persuasion to avoid treatment. But a year or so later conditions began to change rapidly. The jaws caught up with the tongue

and the teeth completely inclosed it, the axes straightened, and today the patient has an overbite of almost half the height of his lower incisors. He still has some spacing of his teeth but it is not severe and he has a completely normal dentition without any treatment.

Another case of a similar nature, but a girl this time, presented three years ago. I shall have to treat this case because it is a Class II malocclusion but her anterior open bite has closed spontaneously from 7/8ths of an inch to about 1/8th in a period of about a year and a half.

Speaking strictly of habits of the tongue, we have the well known thrusting habit and the various biting habits. These need not necessarily be restricted to the incisal region. I recently treated a child who formed the habit while he had his deciduous dentition, of chewing on his tongue in the molar region. There was an open bite, in the region where the habit was indulged, that was very difficult to control. We finally resorted to a "fence" to keep the tongue within bounds and the correction was spontaneous.

The abnormal resting habit of the tongue is characterized by a perfectly straight line along the incisal edges of the mandibular teeth. The position assumed by the maxillary teeth in these cases varies depending upon the lip positioning habits of the patient. They may show no deviation in the upper, there may be an open bite, or it may be difficult to detect anything wrong until we see the teeth in occlusion. The tongue biting or thrusting habit in the front of the mouth is quite different from that of mere resting in that there is apt to be a protrusion, a procumbency of the teeth.

Turning to the lip, we have the usual licking and biting habits, yes, and there are even sneering habits. I have in mind one individual who, at a very young age, acquired the habit of sneering, that is, of curling up one side of the lip. It was one of those peculiar little individual facial tricks but it had gotten to be what might be called an "ingrown" sneer. The dental arch in that area had bowed out and, of course, it will stay bowed out until that musculature is brought into balance by control of the habit.

The lip-wetting habit is unusually bad here in Chicago where lips get dry and chapped, particularly in winter. This habit may be either symmetrical or unilateral, but in either case it is discouraging if it persists after treatment. In spite of an excellent buccal occlusion it will carry those incisors upon which it works, into an overjet of greater or lesser degree and spoil the whole result.

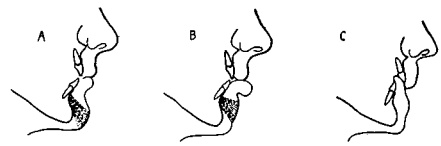

Fig. 3. Mentalis muscle.

One of the most troublesome habits is that of a hyperactive mentalis muscle and particularly if it is coupled with sucking of the lower lip. In Fig. 3, *A* represents the course and attachment of the mentalis muscle, which you will note is not properly a muscle of the lips, but rather a muscle controlling the lips. Running from the incisal fossa of the mandible downward and forward to the integument of the chin it is a real mischief maker. It can pull the lip up and pucker it as seen in Fig. 3 *B*, but the type of damage it does depends almost entirely on the level of the lip line. If the lip line is low, this bunching up of tissue opposite the gingival level of the lower teeth will cause a persistent gingival inflammation and frequently the recession of both soft tissue and alveolar bone.

Fig. 4. Left, prior to treatment. Right, after use of shield, but failure to break habit.

In those cases in which the jaws are in a Class II relation and, in addition, the patient develops a fondness for the taste of his own lip, we are faced with a difficult problem. As the lip is sucked up betwen the upper and lower incisors, (Fig. 3 *C*) the upper arch may not be disturbed in the least because it is supported both from from inside and outside. The lower incisors, however, are tipped back into the mouth. We had such a case when Dr. McGonagle was here and he treated it. It was the most severe one I have ever seen. It was treated by placing a shield in front of the lower incisors teeth and keeping the lip away from them. Before the shield was used, the projecting arch, which we thought would break the habit, almost went through the lip; but when the shield was placed it took the pressure off the teeth. However, this case did not respond spontaneously and we had to tip the incisors labially with the appliance. But the case has held, indicating that the patient broke the habit.

And then one of those things happened that a person dreams about; a pair of identical twins presented for examination and one of them had this same habit and one of them did not. It was a perfect opportunity to check the correctness of our reasoning. We placed an arch with a shield on the lower teeth of the "experimental" twin and did nothing else. Figure 4 is the case as it presented with the lower incisors pushed back. The shield was made in such a way that its labial surface was just forward of where the corresponding surfaces of the lower incisors would be if they were in their normal positions. In the space of seven months the incisors were touching the shield, having assumed their normal axial inclinations in relation to the rest of the denture. At this time the arch was removed and the case was retained. The lower canine teeth had erupted in perfect alignment and these teeth were banded and a lingual wire was formed and soldered to connect them on the lingual side.

But we were over confident. In a matter of only months the lower arch had broken distally to the canines and the entire anterior segment had moved back blocking out the first bicuspids. The habit had not been broken.

Finally I would like to talk to you for just a minute about the matter of muscular adaptability. We know very little about this property of muscle but I think that on the basis of logic alone

we must assume that if there is growth of all other parts of the body there must be growth of muscle tissue also. We also know enough about variation today to realize that parts do not always grow synchronously and that we do not always have simultaneous timing between different groups of factors. Consider then the possibility of a muscle pattern ahead of a skeletal pattern in which case one might expect an over flaccidity of the muscle system. At the other extreme, imagine a muscle developing a little behind the skeletal system and leading to just the opposite type of conditions, or tenseness. It we complicate the picture further by considering that there may be lack of synchrony between those two very dissimilar processes of tooth eruption on the one hand and jaw growth on the other, and then still further complicate it by endowing the musculature with the ability to accommodate, we can see that a situation could develop where merely a lack of correct harmony in the timing of the various growth processes could lead to very serious malocclusions, conditions which, if they could be controlled or eliminated for a longer or shorter period of time would eventually permit a case to resolve itself spontaneously without any treatment.

It is this sort of evidence, I believe, that headcap treatment is beginning to yield. I am talking about such cases in which there is precocious eruption of the teeth. There may be a retrusion of upper incisors and a secondary crumpling of the lower arch. We despaired of treating such cases a few years ago but we are now beginning to discover that they can often be handled by merely extending the upper arch backward through headcap treatment and by liberating the forces on the lower incisors. There are many cases, I am sure, that go into an "ugly duckling" stage and are held in that stage by muscular adaptation. If we could learn to control the musculature through that critical period we might be able to expect that, in at least a proportion of them, there would be a spontaneous unfolding of development that previously we thought must be managed with orthodontic force.

I am going to stop now because I think we are all looking forward eagerly to this next hour with our most recent alumnus, who came as a guest but who became an intimate member of the family.

808 South Wood Street