Stability is defined as “The quality of a denture to resist displacement by functional stresses.” It is usually the distinguishing factor between success and failure. Patients who possess the so-called “knack” of wearing mandibular dentures will enjoy a certain degree of stability. Those not possessing this “knack” present the dentist with a problem. All of the good that is built into a denture is rather useless to a patient unless he can keep it in position during ordinary oral functions. Building stability into mandibular dentures and teaching patients to take advantage of the quality are often separate problems. Cooperation of the patient will give the best results only when the dentist provides specific supervision.

The stresses causing instability come from many directions and are created during most of the functions of the mouth. The qualities necessary to create and maintain stability are dependent upon the following factors. (1) retention, (2) diagnosis, (3) the functions of the mouth, (4) the denture base outline, (5) the occlusal plane, (6) the arch arrangement, and (7) instruction and education of the patient.

**RETENTION**

Retention is defined as “The resistance of a denture to removal in a direction opposite that of its insertion.” In other words, it is simply the ability of a mandibular denture to resist an upward displacement. Retention in itself depends upon interfacial surface tension and the intermittent use of a partial vacuum. In order to create this partial vacuum, which is evident when one attempts to dislodge a lower denture, the denture border must maintain a seal with certain structures of the mouth.

Since retention is necessary to hold maxillary dentures in place, and since a border seal has to be available for this, it might serve a useful purpose to compare the seal areas of the maxillary and mandibular dentures. Retention of a maxillary denture seldom presents the dentist or the patient with serious problems because the location of the seal area is fairly constant and it does not move during ordinary functions of the mouth.

Retention of mandibular dentures depends upon a seal in the same manner as a maxillary denture, but the seal area is not as readily located, and it has considerable movement during ordinary functions of the mouth.

**DIAGNOSIS**

The examination of edentulous mouths can provide information necessary to make a diagnosis that will relate directly to the retention and stability of mandibular dentures. Many examination charts become too involved in details that have little or no direct significance in either the construction or prognosis of the finished dentures. However, there are some conditions that either affect one’s ability to construct a satisfactory denture or limit the ability of a patient to adjust to a mandibular denture. Successful mandibular denture service depends to a large extent on the patient’s ability to wear dentures. The question is how one can determine by an examination of the edentulous mouth who has and who does not have this so-called “knack” of handling a mandibular denture. Patients who have a normal tongue position are those who have a set of conditions that are conducive to the retention of the mandibular denture. Those who have a retracted tongue position lack the ability to develop or to maintain retention without some degree of training. Clinical experience indicates that the size and condition of the mandibular ridge does not predict the ability of the patient to gain retention. Retention is available to all patients regardless of the condition of the ridge. A poor ridge simply indicates that its use must be limited by its ability to exert an equal and opposite pressure against a functional force tending to dislodge it.

**NORMAL TONGUE POSITION**

When one is examining a patient for tongue position, it is well not to mention the word tongue. Instruct him to open the mouth only wide enough to accept food. Many patients acquire the habit of retracting or withdrawing their tongues when asked by a dentist to open their mouths. This habit, usually developed over a period of years, has to be considered when attempting to examine a patient to determine how he normally carries the tongue in a rest position. If the patient appears to

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with-draw the tongue upon opening, have him swallow and again open. A normal tongue position has the following characteristics (Fig. 1): (1) It completely fills the floor of the mouth. (2) The lateral borders rest over the ridge which would normally represent the occlusal surfaces of the teeth. (3) The tip or apex of the tongue rests on or is just to the lingual side of the lower anterior ridge (Fig. 1). If one has natural teeth, the lateral border of the tongue rests on the occlusal surfaces of the mandibular posterior teeth and on the incisal edges of the anterior teeth or the crest of the ridge just below the lingual surfaces of the anterior teeth (Fig. 1). In other words, with natural teeth in place, one sees only the tongue and the teeth. People who have trained speaking voices or are good singers always have normal tongue positions. Observing these people on television will soon make one conscious of a normal tongue position.

**RETRACTED TONGUE POSITION**

The retracted tongue position is sometimes referred to as an awkward tongue position, and has the following
characteristics (Fig. 2): (1) The tongue is pulled back into the mouth and the floor of the mouth is exposed. (2) The lateral borders are either inside or posterior to the ridge. (3) The tip of the apex of the tongue sometimes lies in the posterior part of the floor of the mouth or may be withdrawn into the body of the tongue.

Normal tongue positions occur in about three of every four patients examined. Although everyone has a normal tongue position at birth, some lose it, and as a result they acquire a retracted tongue position. When natural teeth are present, a retracted tongue position has little effect on the ordinary functions of the mouth. It is only when a person attempts to achieve perfection in some specific function or becomes edentulous that a retracted tongue position becomes a problem. In order to understand the relationship between a normal and retracted tongue and its significance to denture service, it is necessary to discuss some of the functions of the mouth.

The three structures of the mouth that are of importance to one constructing dentures are the tongue, the teeth, and the medial roll of the buccinator muscle. Each structure is equally as important as the others, and the teeth by themselves represent only one third of the mechanism necessary to chew food. An understanding of how these structures function will enable one to build into dentures the ingredients necessary to gain retention and maintain stability. Since there are three structures, I will consider them first individually and then as they work in unison.

**TONGUE**

The tongue is considered to be the fastest acting and most accurate muscular organ of the body. The tip of the tongue possesses the greatest concentration of nerve innervation found anywhere. It can detect two pins less than one millimeter apart, a property often referred to as the limen of twoness. The tongue is fastened primarily to the hyoid bone and does not necessarily move automatically with the mandible. When one extends the tongue outward, about two thirds of its mass is visible, and the remaining third forms the base. The tongue consists of two sets of muscles: namely, the intrinsic and the extrinsic muscles. The intrinsic muscles are the large muscles forming the mass of the tongue, furnishing its speed and power. The extrinsic muscles are the
smaller peripheral muscles that give the tongue its minute accuracy. Because of its accuracy, the tongue tends to act as a fluid, in that it fills and assumes the shape of the space it occupies.

The tongue functions primarily by the touch and pressure system, in contrast to the skeletal muscles which function by kinesthesis. Kinesthesis is the property a muscle possesses that enables it to function by memory. If one reaches for something repeatedly with his arm, it soon becomes possible to locate the object by muscle memory. This is not true of the tongue because it functions primarily as the result of touch and pressure. This simply means that by touching something, it creates a stimulus that elicits a specific function. For instance, if I were to ask you what position your tongue is in at present, you would be unable to determine this until

Fig. 9. The corner of the mouth is in contact with the buccal surface of the mandibular first bicuspid.

Fig. 10. The uplifted tongue raises the floor of the mouth to the “high level.”

Fig. 11. Dropping the tongue downward relaxes the floor of the mouth.

Fig. 12. The normal position of the floor of the mouth is acquired and maintained when the tongue is in a normal position.

Fig. 13. The styloglossus muscle inserting into the tongue in the region of the taste buds. This muscle forms the posterior wall of the lateral throat form.

Fig. 14. The labial flange area that must be trimmed by eye.

Fig. 15. The denture outline extends from the buccal frenum along the external oblique line to the top of the retromolar pad.
your tongue touches something. Then, of course, your tongue would no longer be in its original position.

The tongue takes part in the functions of sucking, swallowing, receiving food into the mouth, mastication, vocalization, and speech. In speech alone, which encompasses the most accurate and fastest mechanisms of the body, the tongue plays an intricate part in the formation of the sounds of vowels and consonants.

Whenever function occurs within a muscle or group of muscles, such as the tongue, there is an optimum position from which it can most easily start and most effectively perform these functions. In the case of the tongue, it is the “normal tongue position.” This is in contrast to a less desirable position, ordinarily referred to as a “retracted tongue position.”

TEETH

The primary function of the teeth deals with food. Moreover, bringing the teeth together creates desirable leverages for swallowing. The function of incision a carried out by the central and lateral incisors, while tearing food is done by the cuspids. The mandibular first bicuspid neither tears nor chews foods, but performs other functions that, while important, are often overlooked. In normal dentitions, it is the only posterior tooth that is not positioned directly over the center of the alveolar ridge, but usually inclines somewhat toward the cheek.

The buccal surface of the bicuspid forms a point of fixation for the medial roll of the buccinator and other muscles at the corner of the mouth that are commonly known as the purse-string muscles. This activity helps to keep the saliva and food inside the mouth during chewing and swallowing. It provides the buccinator with sufficient leverage so that, with the aid of the tongue, it appears to create a peristaltic movement necessary to the function of chewing. Also, the fixation of the medial roll of the buccinator helps to prevent chewed food from passing forward into the anterior part of the mouth.

The second bicuspid assists in the mastication of food, while the first molar initiates all of the chewing.
The second molar may assist in chewing, but it obviously must have functions other than that of chewing.

**MEDIAL ROLL OF BUCCINATOR**

The medial roll of the buccinator is a band of muscle fibers within the larger buccinator muscle. Originating in the pterygomandibular raphe, the fibers extend forward to the corner of the mouth. The roll appears to be approximately one-half inch wide inferiosuperiorly and one-quarter inch in width. At rest, the center of the medial roll is slightly above the occlusal surfaces of the mandibular posterior teeth. Its main function is to form the buccal wall of the food trough and to retrieve food that is forced into the buccal pouch. There is an inclination to minimize its significance in the over-all function of mastication, but it is as important to chewing as either the teeth or the tongue. To substantiate this statement, one has only to observe that if the motor supply to this muscle has been destroyed, a patient can never again use this side of his mouth for chewing.

**FUNCTIONS OF THE MOUTH**

An understanding of the combined functions of the tongue, teeth, and buccinator will inevitably lead to better denture construction. Since we build dentures, it is only reasonable that we should know how they function in the mouth and what soft structures of the mouth work so intimately with the teeth in the performance of these functions.

**HOW FOOD IS RECEIVED INTO THE MOUTH**

As food is directed toward the mouth, it is necessary for the tongue to be in a normal position for the recep-
tion of food. If it is in a retracted position, it must assume a normal position. As the food enters the mouth, it is touched by the tongue (Fig. 3). This serves a twofold purpose in that the tongue controls the extent that food penetrates past the incisors and, touching the food, keeps the tongue in a normal position. The food is then incised by bringing the teeth together. If one has the patient open the mouth immediately following incision, it will be seen that the food is always on the top of the tongue (Fig. 4). This serves the purpose of preventing the food from falling into the floor of the mouth (Fig. 5) and of having it in position so that it can be placed ready for chewing.

THE FUNCTION OF CHEWING FOOD

Following incision, the food is placed by the tip of the tongue onto the occlusal surface of either the right or left mandibular first molar (Fig. 6). Patients usually continue to place food on one side and, therefore, most people are either right- or left-side chewsers. There are those who shift the food back and forth during continued chewing, but return it to the starting side before swallowing. Since the tip of the tongue is a necessary adjunct to chewing food, it is impractical, if not impossible, to chew effectively on both sides of the mouth at the same time. Chewing only on one side seems quite logical, in that it permits the other side of the mouth to create a more orderly bolus of food for swallowing. Also the swallowing groove (the groove seen on the posterior part of the tongue when a patient says “ah”) is always on the side opposite the chewing side.

FOOD TROUGH

After the food has been placed on the occlusal surface of the first molar, the medial roll of the buccinator moves inward toward the teeth to form the buccal wall of the food trough, while the tip of the tongue moves to form its lingual wall. With the formation of the food trough, the food is ready to be chewed (Figs. 7 and 8).

FUNCTION OF CHEWING

With the formation of the food trough, chewing starts and the chewing pattern that is followed will usually depend upon the food being chewed. Food that stays fairly intact while being chewed presents fewer problems than food which disintegrates. However, for purposes of illustration, we will discuss the chewing of food that breaks up easily, with some of it falling into the buccal space and some onto the floor of the mouth. That which falls into the buccal vestibule is retrieved by the medial roll of the buccinator, while that which falls onto the floor of the mouth is picked up by the tongue and replaced on the first molar. On occasion, the tongue has to help the buccinator retrieve food from the buccal vestibule. Once the food is back on the molar, the food trough is again formed and chewing starts. At this point, the opening and closing movements of the jaw seem to be controlled by the tongue. It is only on rare occasions that the signals get crossed and one bites the tongue.

During the continuous chewing of food, some of it passes to the second bicuspid which also assists in the chewing. This movement of food is easily understood when one considers the scissorlike action of the jaws. As a result of this action, some food continues past the second bicuspid to the first bicuspid. At this point, an entirely separate function seems to take place which not only prevents food from passing further anteriorly, but appears to place it back on the surface of the first molar. As previously stated, the most important function of the first bicuspid is to afford a point of fixation for the medial roll of the buccinator (Fig. 9), so that, in conjunction with the tongue, it provides what appears to be a form of peristaltic movement to force the food back onto the surface of the first molar so that chewing can be resumed. The amount of chewing that occurs depends upon the type of food and the chewing habits of the patient. There appear to be many slight variations in both the mechanics of chewing and in patient’s chewing habits. However, the object of this discussion has been served when attention is focused on the harmonious relationship that must exist between the tongue, the teeth,
and the medial roll of the buccinator in order to carry out the function of receiving food into the mouth and the subsequent chewing of this food.

THE BORDER SEAL OF THE MANDIBULAR DENTURE

The lingual border seal area of the mandibular denture is the floor of the mouth and the lateral throat form. These structures are extremely active, and it is difficult to know exactly where these structures should be when the impression is made.

THE FLOOR OF THE MOUTH

The floor of the mouth functions at both a high level and a low level and at many intermediate levels. Somewhere between the high and low levels is a level referred to as the “normal” level. The floor of the mouth is at the high level when the tongue reaches into either cheek or up to the roof of the mouth (Fig. 10), while it is at the low level when the tongue drops below the level of the occlusal surfaces of the mandibular teeth (Fig. 11). An example of the low level would be when the tip of the tongue reaches down to retrieve food that has fallen off the teeth during the function of chewing.

The normal position which is somewhere between the high and low level, can be determined accurately only by having the patient place the tongue in a normal position (Fig. 12). There is no other way to accurately determine this normal level of the floor of the mouth.

LATERAL THROAT FORM

The lateral throat form is that part of the mouth in contact with the disto-lingual extension of the denture. This area serves as the limiting factor in the downward and backward extension of the lingual flange. It is formed by the styloglossus and palatoglossus muscles as they pass from the lateral walls of the throat into the sides of the tongue in the region of the taste buds (Fig. 13). The lateral throat form, like the floor of the mouth, moves with the tongue, and therefore, the tongue controls all of the positions that the lateral throat form assumes.

The only accurate method to maintain the floor of the mouth and the lateral throat form in their normal positions is to have the tongue in a normal position. Any position of the tongue other than normal fails to establish a usable lingual seal area for the mandibular denture.

DENTURE BASE OUTLINE

A properly formed denture base outline develops a seal that can be maintained during most of the normal oral functions. The technique used for forming the impression is not as important as the denture base outline.

The labial flange from one buccal frenum to the other buccal frenum (Fig. 14) is most accurately trimmed by eye. The muscles of the lower lip are not conducive to the so-called “muscle-trimming” (border molding) method, because of the fact that the muscle fibers are parallel to the oral orifice. An example of the inability of this muscle to trim accurately is demonstrated when food drops into the labial fold. To remove this food by muscular action is extremely difficult, and the normal procedure for the patient is to reach into the fold with the tongue and sweep the food to the corner of the mouth where there are muscles at right angles to the opening. Here the food is easily retrieved and placed on either the teeth or the tongue.

The buccal flange from the buccal frenum to the retromolar pad is extended to cover the external oblique line. The landmark is well defined, and trimming with a knife is probably the most practical method. Overextension in this region invariably results in soreness. The posterior border is extended for complete coverage of the retromolar pad (Fig. 15).

The only part of the border outline that is entirely arbitrary is the distolinguinal extension of the lingual flange which is limited by the lateral throat form. This is the beginning of the seal area of the lower denture. This border should extend downward and backward from the retromolar pad at an angle of approximately 45 degrees (Fig. 16). It is practically impossible to check the exact position of the lateral throat form and determine by eye the distolinguinal extension. However, studies show that when the tongue is in a normal position, thus creating a normal position for the lateral throat form, an extension of the distolinguinal flange as described will approximate the desired length for most patients. Furthermore, slight overextensions in this region are easily adjusted within the first few days of wearing the dentures.

The only remaining problem is to determine the length of the lingual flange. Its length must be such that it maintains contact with the floor of the mouth when the floor is at its normal level. Here again is a situation where it is just about impossible to check, visually, the position of the floor of the mouth and arbitrarily determine by eye the extent downward of the lingual flange. Studies indicate that the level of the floor of the mouth in its normal position (determined by having the tongue in a normal position) is about the level of the internal oblique ridge. Therefore, to secure a seal, an extension downward of two millimeters onto the floor of the mouth is necessary (Fig. 17). Most of the movements of the tongue necessary to carry out its normal functions occur above the mandibular teeth, but it appears that the two millimeters of extension below the internal oblique ridge provides the necessary seal for these movements without the problem of overextension.
A diagnostic impression that covers the areas described will enable one to secure a study cast from which it is possible to develop an accurate tray. The only flange length necessary to check in the mouth is that of the labial flange, and even that should not be checked until the wax occlusion rim is formed on the tray.

**OCCLUSAL PLANE**

Any attempt to establish an occlusal plane must be an approximation. However, enough facts have been learned from the observation of hundreds of mouths with natural teeth so that we are able to locate occlusal planes for edentulous mouths quite accurately. The requirements for establishing the occlusal plane are: (1) The occlusal surfaces in the region of the mandibular first molars are approximately two millimeters below the top of the retromolar pads (Fig. 18). (2) The remaining plane anteriorly is parallel to the crest of the residual ridge. This is not always easy to determine and depends somewhat upon judgment. However, as an added reference check, the top of the wax rim in the region of the mandibular first bicuspid should never be above the corner of the mouth. The corner of the mouth follows the mandibular first bicuspid during the function of chewing, and placing this tooth too high creates problems for the musculature at the corner of the mouth.

The study of functions of the mouth during chewing shows an intimate relationship between the tongue, the mandibular posterior teeth, and the buccinator muscle. If the occlusal plane is incorrectly located, it results in malfunctions of the soft structures. An occlusal plane that is too high forces the tongue into a new position that is higher than its normal position. This causes the tongue to lose much of its accuracy. Furthermore, the higher position of the tongue causes the floor of the mouth to raise and create undue pressure on the border of the lingual flange. All of this can lead to disruption of the normal position of the floor of the mouth and result in a partial loss of the border seal. An occlusal plane that is too high creates unnecessary troubles, while an occlusal plane that is slightly low causes no problems for denture patients.

**ARCH ARRANGEMENT**

The term “arch arrangement” is used to indicate the buccolingual relationship of the teeth, to either the crest of the ridge or the stress-bearing area, and is used only in reference to the positions of the mandibular teeth. The functions of the mouth clearly indicate the importance of the buccolingual relationship of these teeth to the tongue and the medial roll of the buccinator muscle. The natural tendency is to set the mandibular posterior teeth in too far so that the dental arch is too narrow. This has an unfavorable effect on the normal tongue position and diminishes the effective functioning of the medial roll of the buccinator.

The general rule for establishing a satisfactory arch arrangement is to set the anterior teeth on the anterior part of the crest of the ridge with an incisal tilt of about twenty degrees, and to set the posterior teeth over the center of the stress-bearing part of the basal seat. In other words, when one looks down on the occlusal surfaces of the posterior teeth, an equal amount of the denture base will be seen on both the buccal and lingual sides of the teeth (Fig. 19).

**EDUCATION OF THE PATIENT**

Every patient should be informed regarding the care and proper use of his dentures. There are many patients who will disregard reasonable limitations in the use of their dentures, and this often results in considerable inconvenience and the need for adjustments. Failure to heed the dentist’s advice will eventually lead to damage to the supporting tissues.

Patients who have a retracted tongue position present the dentist with the added responsibility of guiding the patient through a retraining period. This can be accomplished by showing the patient the normal tongue position and demonstrating its significance. Those failing to respond to this simple treatment can be given a series of tongue exercises.

These exercises were developed by speech pathologists and tend to strengthen the larger muscles responsible for keeping the tongue in its normal position (Figs. 20 to 23). The dentures should be removed and the exercises practiced twice daily for periods of five to ten minutes. Young patients usually respond within two or three weeks while older patients may require more time. Unfortunately, a few patients will never enjoy a satisfactory result. These patients will never get the “knack” of wearing mandibular dentures. However, it is usually obvious to them that their failure to master their denture problem is not the fault of the dentist, but rather the fault of their own inability to master the normal tongue position.

**TONGUE EXERCISES**

*Exercise No. 1.*—Thrusting the tongue out and in, in rapid succession. This causes an alternating action of the posterior and anterior fibers of the genioglossus muscles (Fig. 20).

*Exercise No. 2.*—Swinging the tongue sideways with great rapidity. The tongue should be out beyond the lower lip about one-half inch (Fig. 21). This causes an alternating activation of the styloglossus muscles while the tongue is held in its narrowed high position by the transversus muscles.

*Exercise No. 3.*—Thrusting the tongue out to its most extended position and pulling it back quickly (Fig. 22).
On extension, this action is produced by the posterior fibers of the genioglossus muscles, and, on retraction, it is the action of the anterior fibers of the genioglossus with assistance from the styloglossus and hyoglossus muscles.

**Exercise No. 4.**—Raising the tongue to its highest position well forward in the mouth through the articulation of “ceyu” (Fig. 23). To get the full benefit of this exercise the “ce” should be spoken on as high a pitch as possible before saying the “yuh.” This produces an action of the styloglossus, stylohyoid, stylopharyngeus, the levators and palatopharyngi, the tensors and the palatoglossi, the posterior fibers of the genioglossus as well as the intrinsic muscles of the tongue shaping the “ce” vowel.

**CONCLUSIONS**

1. Retention is a prerequisite to stability. Some degree of retention must be present for mandibular dentures to have the quality of stability.
2. In order to provide the property of retention, a border seal area must be available.
3. The seal areas for mandibular dentures are the floor of the mouth and the lateral throat forms.
4. The floor of the mouth and lateral throat forms make extensive movements to carry out the complex functions of the oral cavity.
5. The floor of the mouth has three levels.
6. The high level of the floor of the mouth accommodates for those functions of the tongue which require it to be more than moderately extended.
7. The low level of the floor of the mouth accommodates for the movements of the tip of the tongue as it moves to the floor of the mouth, such as when it retrieves food.
8. The normal level of the floor of the mouth, along with the corresponding position of the lateral throat form, serves to satisfy the tongue for practically all of its functions.
9. The normal tongue position places the floor of the mouth and the lateral throat forms in their normal positions.
10. The floor of the mouth at its normal level appears to be approximately even with the internal oblique lines on the body of the mandible.
11. The lateral throat form appears to make an angle of approximately 45 degrees downward and backward from the posterior border of the retromolar pad.
12. The lingual flanges of average mandibular dentures should be extended downward one to two millimeters below the internal oblique line to make the border seal.
13. The distolingual extension into the lateral throat form should extend from the retromolar pad backward and downward making an angle of approximately 45 degrees with the floor of the mouth and be continuous with the border of the lingual flange.
14. A wax occlusion rim must be in place before the mandibular tray is placed in the mouth. This occlusion rim should simulate the correct occlusal plane and the proper arch arrangement.
15. Since the tongue functions primarily by touch and pressure, a wax occlusion rim simulating the occlusal plane and arch arrangement will facilitate the maintaining of a normal tongue position.
16. To test a tray, it is necessary to have the tongue in a normal position in order to secure the seal. This would then serve as the starting point for testing the tongue movements.
17. All procedures leading to completing a lower impression should be done with the tongue in its normal position.
18. When testing the finished impression, one should keep in mind that extensive movements of the tongue can cause dislodgment.

**SUMMARY**

The border seal area for the mandibular denture extends downward to the floor of the mouth and posteriorly into the lateral throat form. These areas undergo extensive movement during many of the functions of the oral cavity. It is important for the dentist to know what tongue positions are necessary to maintain a seal during the major functions of the mouth. It is also essential to know the relationship between normal tongue position and the floor of the mouth and lateral throat forms.

It, therefore, becomes possible for the dentist to instruct the patient so that these positions will remain constant during the making of a mandibular impression and when retention is tested.

Retracted tongue positions are not compatible with stability. Therefore, recognition of normal and retracted tongue positions and means of improving retracted positions are important adjuncts to successful denture service.

**REFERENCES**