

Complete dentures

Importance of a stable maxillomandibular relation

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Would you feel secure if you knew your home was built on a shifting foundation? Would you meticulously fit the gears in a car's transmission if you knew the shafts that supported these gears did not have firm supports in the gear box? We have far too much common sense to do any of these foolish things. We know the end results would be failures.

How can we, as dentists, justify our precision restorative procedures when the dentures are fabricated on an articulator which has been set to mimic a sick or unstable temporomandibular joint (TMJ)? Can we make accurate dentures or restorations of dentitions when the TMJ is unstable? I maintain that such procedures may result in irreversible harm to patients.

Fortunately, most patients have considerable physiologic adaptability, because many dental restorations are made to whatever occlusal relation the patient may have. The dentist may be sufficiently sophisticated to avoid secondary problems, even though he makes only a cursory evaluation of the condition of the TMJ.

(1) He could possibly have sufficient knowledge and experience to judge the stability of the joint, but this could be only an educated guess.

(2) The extent of the restorative procedures may be minimal.

(3) Patient motivation may be so lacking that it is necessary to go ahead and hope for the best or to refuse to treat the patient.

(4) Economic status and available time on the part of the patient may preclude the possibility of rendering the highest quality of dental service.

TERMINOLOGY

For clarification, this article requires some comments on dental terminology. Sophisticated communication among dentists is made more difficult due to variations in the concepts of the meaning of some dental terms.

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The definition of centric relation, as defined by the *Glossary of Prosthodontic Terms*, is not in keeping with current available anatomic and clinical knowledge.¹ *Webster's Third New International Dictionary* states clearly that centric may be used as a noun or an adjective. Many of us feel that, as presently used in the dental literature, the term "centric" is truly a basket case.

"Centric occlusion" is another term that needs an improved definition. There are persons who can fully intercusate their natural teeth only on one side at a time. This is often true in an advanced Eskimo (Moses) wear pattern.

In the dental literature, it is not uncommon to see the word "eccentric" used to describe mandibular movements, either to or from centric occlusion or centric relation. In reading *Webster's Dictionary*, it would seem that considerable poetic license is used to denote such mandibular excursions.

This dissertation on terminology has been included in this article as a protest against any person or group establishing themselves as dental dictators. The exchange of meaningful dental information is hampered when so much confusion and misuse of the English language exist. We must all remember that it is not necessarily so, just because I or some group says it is so. We must have clinical or authentic research material to substantiate the definition of a dental term.

DEFINING "TEMPOROMANDIBULAR JOINT"

What is a stable temporomandibular joint if we omit true organic pathologic involvement, bacterial infection, congenital growth abnormalities, or meniscus irregularities during translatory excursive movements of the mandible? My own definition is that it is a pain-free joint from which accurately taken maxillomandibular records may be duplicated over a period of several years without changes in the border movements of the mandible.

This definition purposely omits the multiplicity of codicils that would modify it—for example, the bending of the mandible.^{2, 3} It also omits the possible changes in the interrelation of the maxillary bones.⁴ Cranial osteopaths are acutely aware of many erroneous concepts the dental profession accepts as axioms. The research, as reported by Moffett and co-authors,⁵ presents scientific proof that the remodeling of the bones of the TMJ may occur. These remodeling changes would, of course, alter the maxillomandibular relations of the mandible to the maxillae. It has been hypothesized that this is a rather slow process occurring over a period of years. It has also been suggested that this could be a part of the aging process. It has also been hypothesized that these reactions are accelerated by continued trauma to the joint as a result of malocclusion, bruxing, and the like.

LOCATING THE TERMINAL HINGE AXIS

Gnathologists normally locate the terminal hinge axis of the mandible as a basic anatomic landmark. A well-informed gnathologist is quite aware of the degree of inaccuracy possible when arbitrary means are used to locate the terminal hinge axis. This includes the caliper type of equipment, as well as measurements taken from portions of the ear.

Using the kinematically located terminal hinge axis as a starting point, the bruxing relations of the mandible to the maxillae are recorded by numerous pro-

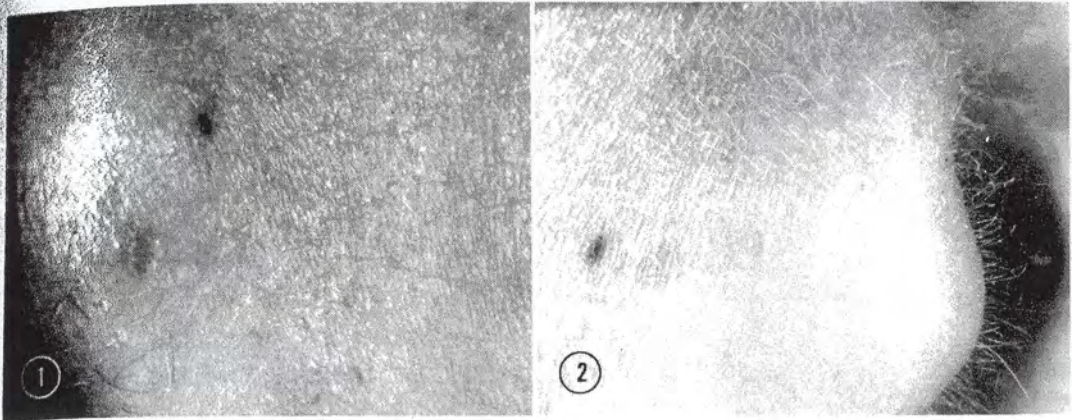


Fig. 1. Tattoos on the right side. The original terminal hinge axis location prior to TMJ stabilization was below and behind the tattoo of the terminal hinge location following TMJ stabilization.

Fig. 2. The original tattoo on the left side is faintly visible and nearest to the ear. The terminal hinge location following TMJ stabilization was almost directly mesial to the original tattoo marking.

cedures. Some dentists use cartesian coordinates. The writing in three planes of the Denar and Stuart articulators and several others is an example of this geometric law. The recording equipment of the analogue instrumentation of Lee⁶ traces a true pantograph of the movement of the terminal hinge axis. In my estimation, this is the most accurate method of recording maxillomandibular movements available at this time. Some dentists may rely on positional recordings, such as wax interocclusal records. In this article, no attempt is made to list all of the various methods of recording maxillomandibular relations. Regardless of the procedure used, the methods are equally nebulous if made while the TMJ is unstable.

A method of determining the stability of the TMJ through the use of a maxillary orthopedic appliance will be presented. Should the appliance disclose an instability of the TMJ, this same appliance may be used in an attempt to achieve stability: An outline of its use is contained herein.

There is always the possibility that the degenerative changes that have already taken place are irreversible. It may be impossible to achieve an acceptable degree of stability. Carlsson and associates⁷ have shown irreversible changes in the meniscus of patients in the 21 to 25 year age range. Their histologic studies have disclosed gross degenerative changes of the meniscus, even at that early age.

Maxillomandibular relations are normally recorded to enable the dentist to transfer these records to some mechanical device. This device is usually a dental articulator. An articulator is, "A mechanical device that represents the temporomandibular joints and jaw members to which maxillary and mandibular casts may be attached."⁸

Whether the recording procedure is simple or highly sophisticated, the duplication of maxillomandibular relations of an unstable or sick TMJ should not be used as a foundation for occlusal therapy or denture construction. These recordings are of value only if they are used for research purposes or as a base on which to construct

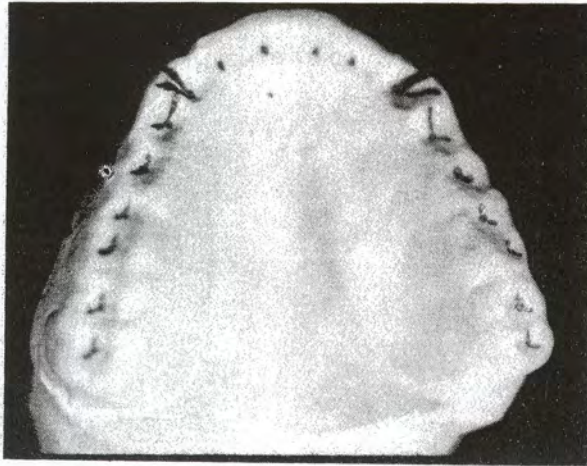


Fig. 3. A diagrammatic illustration of border movements as marked by the lower cuspid excursion on a maxillary orthopedic appliance. The path became more acute due to the decrease in lateral shift of the mandible (Bennett movement) as the TMJ became more stable.

some form of treatment appliance. Initiating other than minimal therapeutic tooth reshaping to eliminate gross occlusal interference is certainly contraindicated. To proceed with other than initial dentures from such records may be a disservice to the patient.

TMJ DYSFUNCTION SYNDROME

Recognizing the syndrome. TMJ dysfunction syndrome may force its recognition if the patient presents with any of the following conditions: (1) an acute TMJ pain syndrome, (2) a true fibrosis of the muscles that activate the mandible, (3) inability to open the mouth, due to muscle spasm or the like, (4) overdeveloped coronoid processes,⁹ or (5) TMJ ankylosis.

It is unfortunate that some dentists seldom evaluate the stability of the TMJ prior to starting dental restorative procedures. From my own observation, it appears that dental schools are equally guilty of this same failure. Many undergraduates receive inadequate training to assist them to recognize the importance of this evaluation. Some schools, however, are making an effort to incorporate further instruction of the TMJ and its relation to dental occlusion.

Observations. I have treated many patients who have manifestations of some form of the TMJ pain syndrome. During treatment, I observed definite changes in the maxillomandibular relations. The members of the various study clubs with whom I have been associated have observed the same changes in treating patients in their practices. These changes also have been observed in patients treated within the operations of the postgraduate study club.

This article is not intended to be an in-depth evaluation of diagnosis and treatment of the TMJ pain syndrome, and patients with irreversible damage to the components of the TMJ are not included.

Changes noted. Following the placement of a maxillary orthopedic appliance, there should be a series of appointments that involve reshaping the resin of the

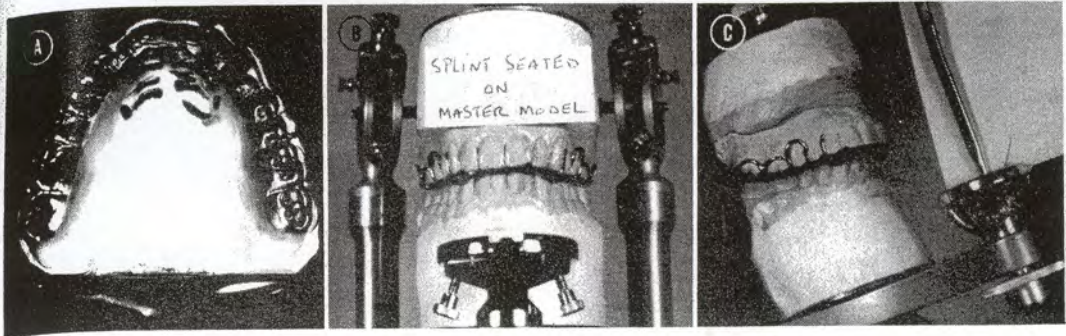


Fig. 4. Cusp-fossa wax-up made to the terminal hinge relation (A) on the articulator (B). (C) The lower buccal cusps of bicuspid and molars and the lower anterior teeth are in contact with the wax. The incisal guide pin is in contact with the incisal guide table (arrow).

appliance to keep up with the changes in the TMJ. If this is not done, the appliance may become a source of malocclusion instead of a mask for malocclusion.

Major changes we have observed. (1) A person's terminal hinge axis moves in its skull relations as the TMJ becomes more stable. Experiments now underway will give us scientific facts about definite predictability of the direction of this movement. Clinically, the terminal hinge axis appears to move mesially as stabilization occurs (Fig. 1). Movement of approximately 4 mm. upward and forward has been observed over a period of 18 months with an appliance (Fig. 2). A movement of approximately 2 mm. was almost straight mesially. These changes were on the right and left sides of the same patient.

(2) The protrusive path seems always to flatten. Stated in another way, the condylar guidance in protrusive movements becomes less steep in relation to the axis-orbital plane of the head. This clinical phenomenon is most dramatic. Anterior protrusive interference continues to recur in spite of the fact that the appliance used does not allow elongation of the lower anterior teeth or intrusion of the upper anterior teeth.

(3) The lateral (Bennett) shift tends to continue to decrease in magnitude. This is seen in the path that the lower cuspid traces on the upper appliance. The guided border movement in the lateral excursion becomes more acute as the TMJ becomes more stable (Fig. 3). The change to a nearly straight path of border movement in the cuspid area is indicative of considerable lateral mandibular shift. As the joint becomes more stable, the lateral shift is less as measured by the border path of the lower cuspid on the appliance.

Shryock¹⁰ has measured a decrease in the lateral shift of approximately 50 per cent. He re-recorded a patient's mandibular movements one year following the original recording. At that time, he had proceeded with full mouth reconstruction. Due to the good visibility through the clear plastic recording blocks of the Analogue recording apparatus,⁶ this decrease in lateral movement is apparent to the eye. It is also measurable for depth of cut. Any dentist familiar with the escapeways for the lingual cusps of the upper teeth through the grooves carved into the lower teeth will fully appreciate the clinical significance of this change in the lateral border excursions.

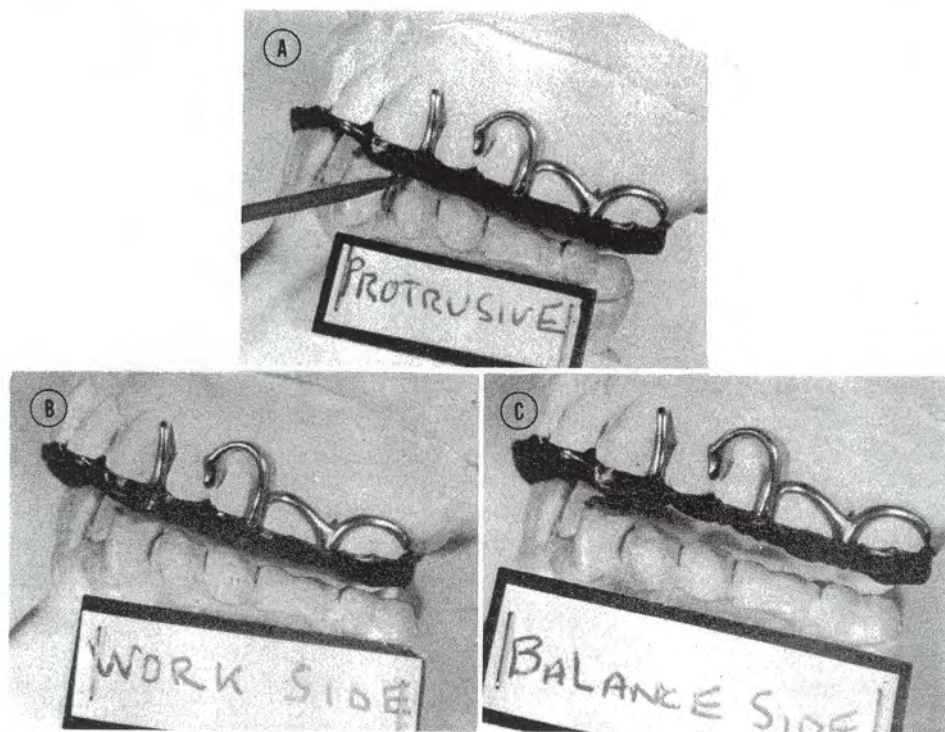


Fig. 5. The wax-up incorporates cuspid guidance in (A) protrusive and (B) lateral excursions into working and (C) balancing occlusions. The cuspid guidance is waxed to an abrupt rise in the protrusive and lateral excursions.

DETERMINING TMJ STABILITY BY A MAXILLARY ORTHOPEDIC APPLIANCE

(1) We will presume that the patient is able to open the mouth so accurate upper and lower impressions of the dental arches can be made. Stone casts, suitable for articulator mountings, are poured in these impressions.

(2) The posterior terminal hinge axis is located using graph paper-covered flags over the hinge axis region. A lower universal clutch is attached to the lower teeth with fast-setting plaster.

The terminal hinge axis normally is not located as meticulously as it would be if the patient had stabilized, nonsymptomatic temporomandibular joints. In other words, the terminal hinge axis is located to the degree of accuracy possible, as limited by the tenderness of the joint or joints. This will make the cast mountings more accurate but will not further traumatize already sick joints. The terminal hinge axis is marked, but not tattooed, as we anticipate change in its location as we proceed with the treatments with the maxillary orthopedic appliance. It would only be marked if we intend to measure the magnitude of change when stability is achieved. The head is always out of the headrest when this terminal hinge location is transferred to the skin.

(3) A kinematic face-bow is used to transfer the axis-orbital plane to an articulator for the mounting of the upper cast. For the construction of this type of appliance, transfer to a simple articulator (such as a Dentatus) is all that is indicated. The articulator must accept the hinge axis as transferred by the face-bow.

The more accurately the terminal hinge axis can be located (even though it is

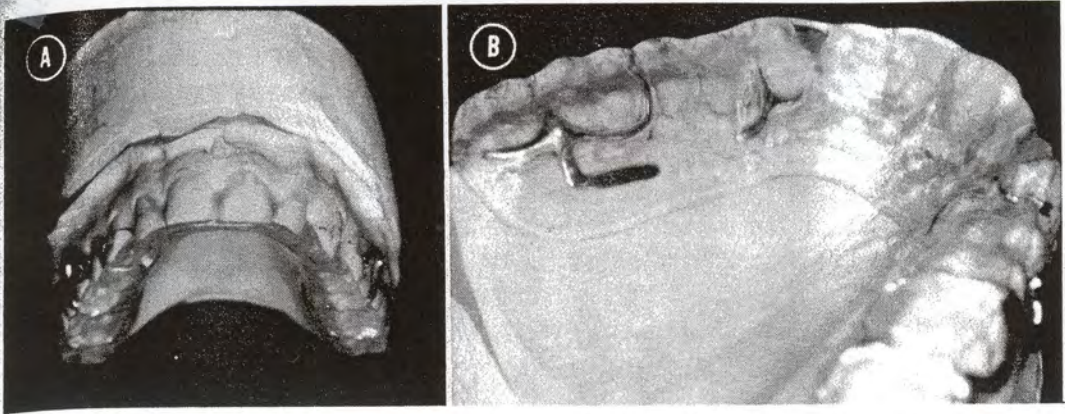


Fig. 6. The appliance is processed and polished and returned to the original cast. The transparent, heat-cured, acrylic resin appliance (*A* and *B*) will be adjusted to correct contacts in the terminal hinge position and in the protrusive and lateral excursions in the mouth.

unstable at this point), the less adjustment necessary when the prosthesis is first fitted to the patient.

(4) The lower cast is mounted by means of a terminal hinge record. Common sense and experience will help in making as accurate a terminal hinge axis record as the condition of the patient's TMJ will allow. In making such a record, attempt to incorporate only the tips of the cusps in the recording medium; records that involve the occlusal fissures seldom accurately fit the stone casts.

(5) Duplicate casts are made from the original casts and mounted on another articulator.

(6) A refractory duplicate of the upper cast is made for the construction of cast gold clasps. The cast is surveyed, and the clasps are designed with all the accuracy that goes into well-designed partial denture clasps. Each retentive clasp has a lingual stabilizing arm and does not depend upon the resin part of the prosthesis to compensate for the spring of the retentive arm of the clasp.

(7) The cast clasps are finished and polished before they are placed on the duplicate mounted cast for the wax-up of the prosthesis. Beading is placed in the original cast to provide a better seal against palatal tissues. A horseshoe-shaped major connector normally is used. The palate should not be encroached upon more than is necessary for strength. An exception to this would be when there are no posterior supporting teeth. A full-coverage palate is often necessary to carry the occlusal load in this situation.

(8) The final wax-up (Figs. 4 to 6) incorporates a cusp-fossa relation in the occlusion. All lower teeth are kept in contact with the upper wax-up with the mandible in the terminal hinge relation.

(9) The anterior guidance¹¹ is used to achieve vertical forces when the teeth contact in terminal hinge relation (Figs. 7 to 9) and demonstrate the cuspid area contacts that encourage a near vertical force as the teeth reach terminal hinge relation.

(10) The denture is processed in heat-curing acrylic resin. After processing, the prosthesis is seated on the original stone cast. Occlusal adjustments are made in the laboratory on the articulator until there is approximately 2 mm. of acrylic resin

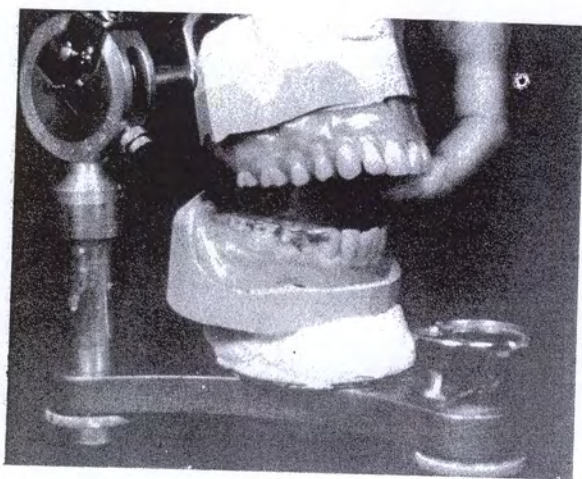


Fig. 7. A terminal hinge record made with warmed Aluwax is luted to a lower denture (Lauritzen technique).

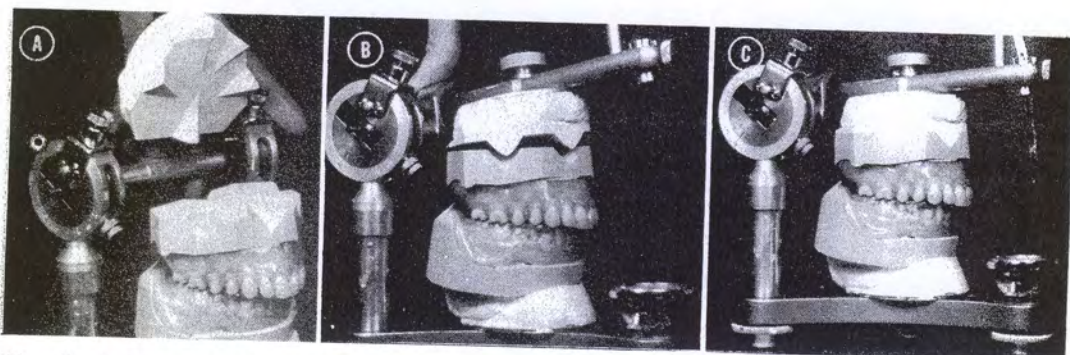


Fig. 8. A demonstration of detail of the split cast construction and its use for checking the accuracy of repeated terminal hinge relation records: *A*, the shape of the modified base of the cast and the mounting stone poured against it; *B*, if an error is revealed, the parts do not fit together; *C*, the parts fit perfectly when an accurate record is checked.

over the initial interceptive occlusal contact in the posterior terminal hinge position.

No attempt is made to shape the cuspid guidance to any degree of accuracy (Figs. 10 and 11). The resin in these regions is left thick enough so there is plenty of material in the right places to make these adjustments in the mouth.

(11) The final adjustments are made in the mouth as enumerated in a previous article.¹ It is important, at this time, not to overdo the adjustments made in the patient's mouth. When dealing with a sick TMJ, you may severely increase the patient's pain problem.

(12) The patient is instructed to wear the prosthesis at all times, even while eating. It is only removed for necessary oral hygiene.

(13) The prosthesis is adjusted again in seven to ten days to accommodate for changes that have occurred in the patient's maxillomandibular border movements.

(14) It is important that the cuspid guidance not be so steep that it interferes with the patient's normal jaw closing cycle. Neither should the cuspid guidance be so

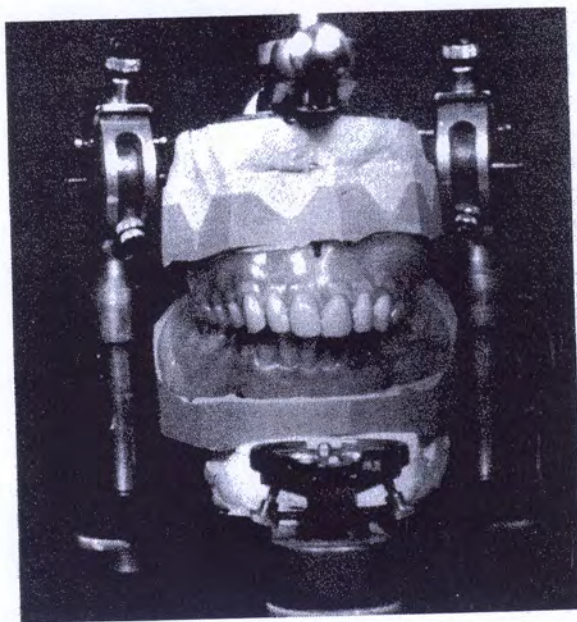


Fig. 9. Following TMJ stabilization, the split-cast technique is used again to verify the reproducibility of all maxillomandibular records to be used in developing denture occlusion.

abrupt as to produce any distal thrust to the mandible or a tightly locked terminal hinge relation.

(15) It is extremely important that the patient be examined for deviate swallowing habits.¹² If a deviating swallow is not corrected, the appliance often is of little benefit in producing stability of the TMJ.

(16) As articulation adjustments on the appliance continue, articulating tape should not be relied upon for these adjustments. Rely upon the patient's proprioceptive feedback to inform you where they first touch in terminal hinge relation. The proprioception is far more accurate than the thinnest articulating material available. Adjust for even contact at the first bicuspid and proceed posteriorly. The lower anterior teeth only contact in terminal hinge position to the extent necessary to prevent elongation of the teeth. The deflexive and interceptive occlusal contacts are only meaningful if the patient touches his teeth together in the terminal hinge relation.

We may assume we have achieved stability when there are no more changes in the occlusal contacts between appointments, even when these appointments are spaced at three- or four-week intervals.

(17) The patient should use the appliance for several months before making maxillomandibular records to transfer to an articulator. At this point, any restorative therapy that may be indicated is justified. The terminal hinge should now be very accurately located and tattooed. We may, with confidence, obtain any maxillomandibular records that may be indicated for mounting casts on an articulator.

TREATMENT WITH COMPLETE DENTURES

It is far more difficult to determine the stability of the TMJ for completely edentulous patients and to obtain TMJ stability for them.

Many complete denture patients have sloppy TMJ's. Their temporomandibular joints usually have been subjected to long-standing malocclusion. In many patients, this contributes to loss of the natural teeth. Many patients wear the same dentures over extended periods of time. The excessive residual ridge shrinkage during this time forces the patient to close his jaws with the mandible in a protruded position. This may result in excessive trauma on the TMJ.

(1) The existing dentures are used in the treatment procedure if possible. If the individual bases are stable, it is not necessary to make new dentures at this time.

(2) Block out all undercuts in the dentures, and make stone remounting casts. Make a split cast for the upper denture by the Lauritzen technique.¹³

(3) Locate the terminal hinge using a mandibular clutch on the lower denture. Use flags and axis locators as previously discussed. Mark, but do not tattoo, this axis.

(4) Mount the upper denture using the remounting cast which has been made into a split cast. The face-bow procedure is the same as that used for making the maxillary orthopedic appliance.

(5) Mount the lower remounting mast and denture according to the patient's existing terminal hinge. This is done by luting Aluwax* onto the lower teeth from the cuspid to the second molar on each side. The dentist must make this terminal hinge interocclusal record without allowing the patient to bite.

This wax record is chilled in ice water and reinserted in the mouth to check for even pressure on both right and left sides. The proprioceptive nerve response of the patient is extremely accurate (Fig. 12).

(6) Mount the lower denture using quick-setting plaster.

(7) Loosen all locks, including incisal pin, and check the accuracy of the mounting by means of the wax record. The split cast will disclose any discrepancy that may have been incorporated in the record.

(8) Make two more interocclusal records of the patient's existing terminal hinge relation. After chilling them in ice water, check to see if all three records check to a split-cast accuracy. If they do not, remount the lower denture until they do (Figs. 13 through 15).

(9) When the denture mountings check to split-cast accuracy, remove the luted Aluwax from the lower denture. Then record the protrusive and lateral relationships.

(10) Determine if new anatomic posterior teeth must be used or if those already on the dentures are suitable to achieve the desired intercuspation in the terminal hinge position. It is usually necessary to use new posterior teeth and to reshape them to achieve ideal intercuspation in the terminal hinge relation. This is adjusted by reshaping the teeth using 0.001 cellophane feelers to check the contacts. Develop lateral and protrusive occlusions as desired.

(11) When the dentures are placed in the mouth, check again for a deviate swallowing pattern.

(12) Remount the dentures at regular intervals to split-cast accuracy in the terminal hinge relationship. Repeating this process may eventually require the use of a new set of posterior teeth because of the changes in the maxillomandibular relationship as the TMJ becomes more stable.

*Aluwax Dental Products Company, Grand Rapids, Mich.

(13) When the TMJ is judged to be stable, new dentures may be made as the maxillomandibular relations may continue to be stable for a reasonable period of time (Fig. 16).

SUMMARY AND CONCLUSIONS

A method of determining the stability of the TMJ has been outlined. If the TMJ is unstable, one method of achieving stability (if still possible) has been suggested. The fallacy of using records made of an unstable TMJ, regardless of the technique used, has been shown to be potentially dangerous to the best interest of the patient.

The stability or instability of the TMJ has been observed by a significant number of members of our articulation and occlusion study clubs to warrant this report to the dental profession.

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