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Jaw relation records for fixed prosthodontics

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Jaw relation records are a fundamental and crucial component of providing accurate, high-quality fixed restorations. A disciplined and efficient practitioner understands that the use of accurate records minimizes the need for intraoral adjustments before prosthesis delivery and can therefore reduce overall treatment time and cost. Because all dental materials have their inherent limitations and because there exists variability in intraoral conditions, learning to minimize discrepancies in making jaw relation records is critical.

This article reviews the concepts of jaw relation records (or interocclusal records) and discusses the selection of interocclusal records for a variety of clinical situations. In addition, articulator choice, the purpose of a facebow, and materials for jaw relation records are discussed. Some ''pearls'' are offered to help avoid common problem areas, including making impressions, pouring impressions, mounting casts, and making interocclusal records.

General principles

If the goal of restorative treatment is to maintain a patient's pretreatment intercuspation and vertical dimension of occlusion (VDO), casts should be mounted in a manner that maintains the same tooth-to-tooth relationship that existed before treatment. This maximum intercuspal position (MIP) facilitates treatment and works with the patient's existing occlusion. The vast majority of cases treated fall within this MIP category. The situation becomes more difficult if a patient requires extensive treatment or if the VDO needs to be altered. In these circumstances, a reproducible maxillomandibular position from which treatment is performed is essential and

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requires a centric relation record made at the terminal hinge axis. This article deals with situations where the patient's MIP and VDO do not change as a result of treatment.

Function of the jaw relation record

Jaw relation records, or interocclusal records, have the following functions: (1) They provide the stability or support that the casts of the remaining dentition lack, (2) they reduce chair time for the delivery of the restoration, (3) they reduce the likelihood of making restorations in hyperocclusion or without occlusal contacts, and (4) they reduce the chance of perforation of restorations being inserted with excessive adjustment or having to adjust the opposing dentition inappropriately.

For opposing casts to relate well, there must be a tripod of vertical support and horizontal stability between the two casts. A minimum of three widely spaced tooth-to-tooth contacts should be present during mounting to ensure adequate stability. Casts that rock or wobble due to an insufficient tripod require an interocclusal record to stabilize them before mounting. Full-arch working and opposing casts frequently have sufficient occluding natural teeth to accurately position the casts in a stable MIP occlusion, and horizontal stability is generally present when there is good intercuspation between teeth. However, in a patient with worn occlusal surfaces, although a solid vertical tripod may be obtained, the horizontal stability may be inadequate to accurately mount the casts. The goal of the interocclusal record is to provide the support or stability that the casts of the remaining dentition lack.

Interocclusal records used to mount casts in MIP can be separated into two categories: (1) records made when a tripod of vertical support is available from the remaining tooth-to-tooth contacts (an "existing tripod" interocclusal record) and (2) records made when a tripod of vertical support is not available from the remaining tooth-to-tooth contacts (a "created tripod" interocclusal record) [1].

The existing tripod interocclusal record

When there is a tripod of widely spaced contacts and good intercuspation of the teeth, an interocclusal record is not needed. In this situation, hand articulation is the most accurate means of mounting a mandibular cast to a maxillary cast. Practitioners frequently waste time and materials making an interocclusal record when one is not needed. In addition, the use of an interocclusal record when hand articulation is sufficient creates a potential for error because the record can often prevent the casts from fully intercuspating (Figs. 1 and 2). Therefore, full-arch impressions made for a minimum number of teeth being restored usually need no interocclusal record due to the number of intact occlusal contacts.

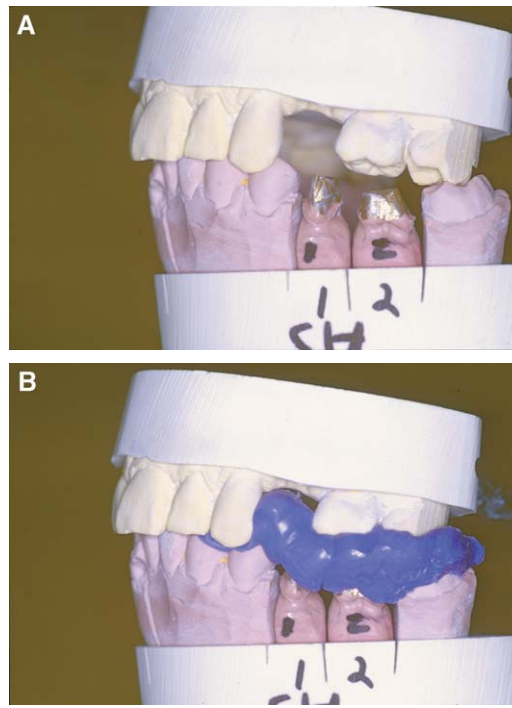

Fig. 1. (*A*) An existing tripod of widely spaced contacts with good intercuspation of the teeth does not require an interocclusal record. (*B*) An interocclusal record was unnecessarily made and will most likely prevent the two casts from articulating well.

In patients where vertical support is adequate but horizontal stability is lacking, an interocclusal record is needed to mount casts. Elastomeric materials such as polyvinylsiloxane are ideal for making interocclusal records where only horizontal stability is needed [2,3]. However, their accuracy can be compromised if they are not properly trimmed. These records should be carefully trimmed to remove all areas of the record that contact soft tissues and the axial surfaces of the teeth (Fig. 3). This is done to minimize the areas where the casts and the record touch, allowing the practitioner to visualize how the casts seat into the record and ensuring that the record provides only the horizontal support, with the contacting teeth providing the vertical support.

Rigid materials, such as resins or waxes, can also be used to make existing tripod records where horizontal stability is compromised. However, unlike the elastomeric materials, the rigid materials should be used only for segmental records and not for full-arch interocclusal records because they could cause an inadvertent increase in the VDO if used incorrectly. These rigid materials require adequate interocclusal space, such as between a prepared tooth and its opposing teeth.

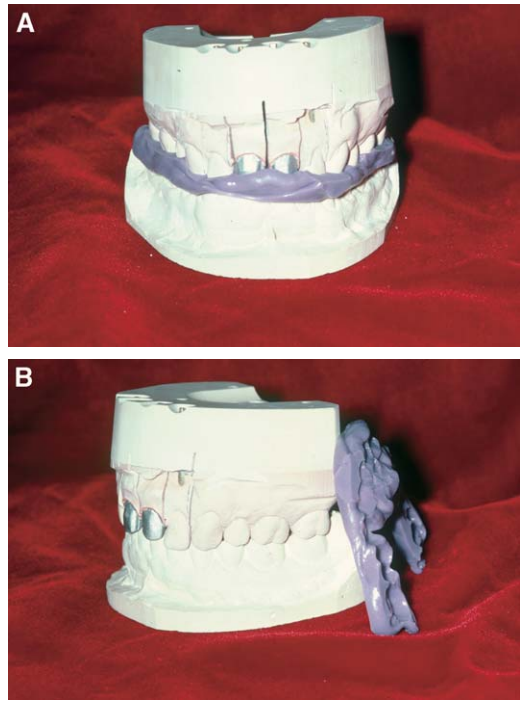

Fig. 2. (*A*) An interocclusal record was made unnecessarily. (*B*) Removal of the interocclusal record shows that it was not needed due to a good tripod of vertical support and horizontal stability.

The created tripod interocclusal record

A tripod of opposing teeth is present but without occlusal contacts

A practitioner has to "create" a tripod of vertical support where one does not exist to mount opposing casts. A classic example of a created tripod interocclusal record is a fully dentate patient who has teeth #18 through #20 prepared for a fixed partial denture. Although the teeth are well positioned around the dental arch, the tooth preparations prevent the existence of the third leg of the tripod. In this situation, the tripod has to be created so that the working and opposing casts can be mounted accurately. The materials best suited for this purpose are those that are soft at placement and then become rigid before their removal from the mouth, such as waxes, resins, zinc oxide and eugenol pastes, and impression plasters. The materials of choice for the general practitioner are resins (DuraLay [Reliance Dental, Worth, Illinois] or GC Pattern Resin [GC America, Alsip, Illinois]) or waxes. Resin placed conservatively between the tooth preparations and the opposing teeth creates the needed leg of the tripod for mounting (Fig. 4). The practitioner should avoid the elastomeric materials for this situation because these materials exhibit compressibility and rebound, often resulting

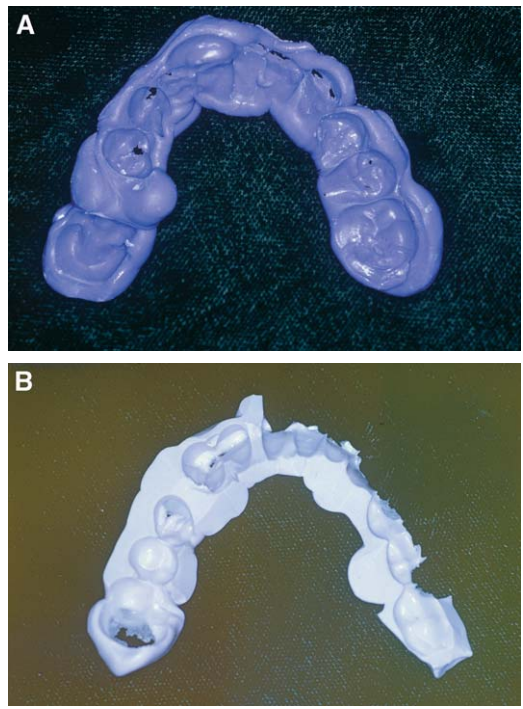

Fig. 3. (*A*) An interocclusal record that has not been trimmed. (*B*) An interocclusal record that has been trimmed properly on one side to remove all areas of the record that contact soft tissues and the axial surfaces of the teeth. The other side has not been fully trimmed to demonstrate the difference in the amount of material needed.

in an inaccurate mounting that may lead to the need for excessive adjustments upon delivery of the restoration or the possibility of no occlusion between the restoration and the opposing teeth.

Opposing teeth are absent at one or more desired tripod stops

When teeth are absent at one or more potential tripod stops, a record base-occlusion rim is indicated to obtain support from the edentulous ridge. The practitioner may use a record base-occlusion rim made on a cast or can make an intraoral segmental interocclusal record composed of rigid setting materials that do not displace the soft tissues of the edentulous ridge at the time of placement. If the choice is a record base-occlusion rim, the record base must be made on the cast(s) that is to be mounted and not on earlier made diagnostic casts [4]. A record base made on one cast does not predictably transfer to another cast due to differences between the casts. These discrepancies are the result of minor differences in soft tissue displacement and tooth position and differences from the dimensional accuracy of impression materials and dental stones.

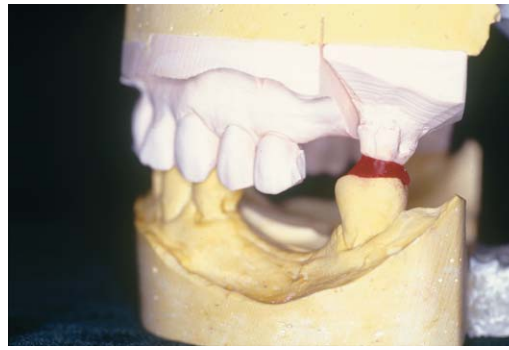

Fig. 4. Interocclusal record made with a rigid autopolymerizing resin. In a distal extension situation, resin placed conservatively between the tooth preparation and the opposing tooth creates the needed leg of the tripod for mounting the casts.

The record base is adapted to the edentulous portion of the cast and often to the lingual surfaces of the remaining teeth to enhance stability and retention (Fig. 5). Record bases usually are made from light-activated resin or autopolymerizing resin. The occlusion rim is able to function only as a substitute for a leg of a tripod when the record base is stable in the mouth and on the cast. The occlusion rim can easily and cheaply be made from baseplate wax to imprint the cusp tips of the opposing teeth, or other materials may be used, including metal-impregnated wax or the more rigid of the elastomeric interocclusal recording materials (eg, Blu-Mousse; Parkell, Farmingdale, New York).

If the working cast with crown preparations contains the edentulous areas where tripod stops are desired, the record base cannot be made until the final impression is made, poured, and separated and the cast is trimmed. This usually requires that the patient make a separate brief appointment for a jaw relationship record before fabrication of the restorations. However, if the edentulous areas are located in the opposing arch, the practitioner who has planned ahead may have the record base-occlusion rim made on the opposing cast before the final impression visit, allowing the interocclusal record to be made at the final impression appointment.

Because of the popularity of the elastomeric materials for interocclusal records, they are often abused. One situation where this is the case is when there is an absence of a tripod of support and there is a need to create the tripod. Polyvinylsiloxane and polyether are ineffective materials when creating a tripod of support due to their inherent compressibility. Although the materials are easy to use for interocclusal records, their use during the mounting of the casts can be technique sensitive. It is difficult to objectively determine the amount of force that should be exerted on the casts when mounting them with the interocclusal record. Too much force can cause compression of the elastic record, resulting in some part of the casts placed

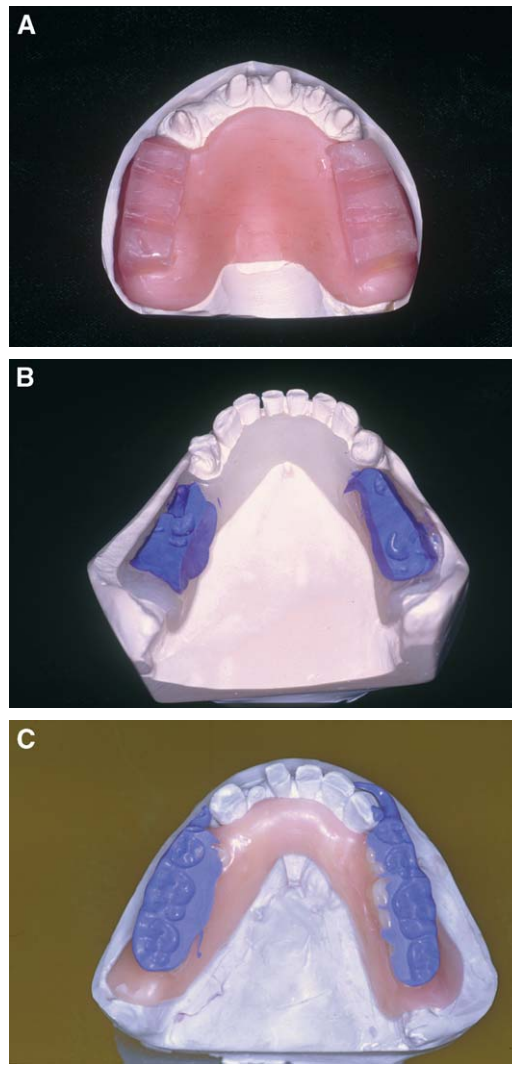

Fig. 5. (*A*) A light-activated resin record base with wax occlusion rim for making an interocclusal record. (*B* and *C*) Light-activated resin record bases with respective interocclusal records made in an elastomeric recording material. Note how the record bases are supported by the lingual surfaces on the remaining teeth and that a minimum of recording material is used to record only the cusp tips of the opposing teeth.

too closely together, and too little force can allow for inadequate seating of the cast into the record, resulting in casts that are too far apart. Therefore, despite the relative accuracy and dimensional stability of elastomeric materials and their ease of use and convenience, their use in these circumstances is likely to result in an inaccurate mounting and subsequent

difficulty in delivering the final restoration(s) because of no occlusion or a resulting heavy occlusion.

The use of prosthesis frameworks

For a variety of clinical conditions, a fixed metal framework or a metal framework for a removable partial denture can be used to support an interocclusal record. The benefit of using a metal framework to support an interocclusal record is that the metal framework usually has more stability and retention than a record base-occlusion rim. For instance, when one is remounting casts after the metal try-in of fixed restorations, the recording material may be added directly to the metal framework [5]. The framework may carry an elastic material to make a segmental existing tripod record or a rigid material to contact the opposing teeth and make a created tripod record. When a practitioner requests a metal framework to be returned for try-in before porcelain application, not only should the metal be examined for fit, but also the opportunity should be taken to verify the accuracy of the articulation of the working casts. The added time in verifying the articulation could save considerable time at the insertion appointment.

When fabricating fixed restorations in combination with a removable partial denture (RPD), jaw relation records are often difficult due to the difficulty in achieving good stability of a record base and occlusion rim. The fitted framework of the RPD can be used as a record base, and the occlusion rim can be formed directly into the meshwork areas [4,5] (Fig. 6). The framework adds retention and stability for an interocclusal record, thereby increasing its accuracy.

Articulator choice

When fabricating fixed and removable prostheses, the use of an adjustable articulator usually reduces the amount of intraoral adjustment

Fig. 6. A fitted RPD framework used as a record base and the occlusion rim formed directly into the meshwork areas. The framework adds retention and stability for the interocclusal records, thereby increasing its accuracy.

needed. A more anatomically sized articulator, such as a programmed adjustable or a semiadjustable articulator, better reproduces the mandibular border movements compared with a simple hinge articulator. An articulator that is more true to human size allows the restoration to be adjusted by the technician to a greater degree and to a closer approximation of the patient's intraoral situation. A full-size adjustable or semi-adjustable articulator is an excellent investment for the dentist who does a substantial amount of crown and bridge.

Purpose of a facebow

The purpose of a facebow transfer is to orient the maxillary cast to the transverse axis of the articulator. Its use is limited to adjustable and semi-adjustable articulators. Facebows are not necessary if there will be no change in the VDO. However, if any alteration of the VDO is planned, as in a full-mouth rehabilitation, a facebow (and a full-sized articulator) should be used. Another positive aspect of using a facebow is that it makes it easier to mount a maxillary cast to a full-sized articulator.

Avoiding errors and inaccuracies

Inaccuracies in jaw relations can be caused by a number of factors besides a poor interocclusal record. Errors can be introduced anywhere from impressions to cast accuracy to problems with the articulation of the casts. These areas are often overlooked and are as important for overall accuracy as the interocclusal record.

All impression materials, all dental stones or plasters, and all interocclusal materials have inherent inaccuracies: they shrink or expand. Learning how to minimize these inaccuracies improves the end product and results in a more successful outcome to the practitioner and to the patient.

Accuracy of dental casts and their subsequent successful articulation are essential when trying to maximize quality while minimizing treatment time with a patient. The following ''pearls'' elucidate common problem areas and discuss how to handle them.

Movement during setting of material

Movement of the impression tray during the setting time of the impression material leads to inaccuracy. Minor movement while making an impression for study casts may not be too harmful in the overall scheme of treatment; however, the same movement for a final impression is detrimental to the fabrication of a fixed restoration. Once the tray with impression material is seated in the mouth, it is essential that any movement

by the operator or the patient be prevented. An impression tray should never be left in a patient's mouth without being stabilized by the practitioner or dental assistant. Additionally, a patient should not be allowed to close into a full-arch impression tray at any time; the practitioner's or dental assistant's fingers should prevent this from occurring.

Impression material dislodged from the impression tray

Dislodged impression material occurs most frequently with alginate impression material. If a plastic stock tray is used and if the impression tray is not adequately painted with adhesive, the alginate has to rely solely on the perforations in the tray and may separate from the tray as the impression is removed from the mouth. This may happen with a metal stock tray as well because adhesive is generally not used in these trays for added security. Once distorted, the alginate cannot be pushed back into place; a new impression has to be made. This separation of alginate from the impression tray may be overlooked as a non-essential factor or may go unnoticed. Separation of the impression material from the tray is a common cause of inaccurate casts.

Although less likely than with alginate, the same separation of impression material from an impression tray may occur with elastomeric final impression materials. After removing any impression from a patient's mouth, the overall adherence of the impression material to the tray should be examined. This step reduces cast inaccuracies and the resultant errors in the fabrication of a restoration.

Laying alginate on tabletop with long extensions

Alginate impression material that is unsupported by an impression tray is under stress. Using an impression tray that does not adequately match a patient's arch size runs the risk that a large portion of the alginate will be unsupported and therefore may become distorted. In addition, after an alginate impression is made, the practitioner usually places it on a countertop with the overextended alginate in direct contact with the flat surface. Any direct pressure on the unsupported alginate distorts the impression. Ideally, an impression as discussed would be made and then disinfected and poured in dental stone while being held in a holding "tree" so the impression tray hangs from its handle rather than rests on the countertop (Fig. 7).

Pouring casts on time

Certain impression materials, such as reversible and irreversible hydrocolloids (alginate), must be poured promptly after making an impression, or rapid distortion occurs. After disinfection of either impression material, a cast should be poured immediately. Failure to do so causes loss of water

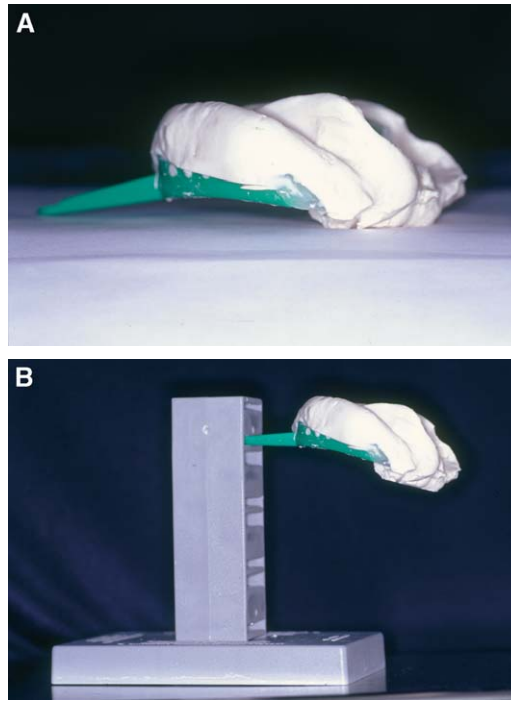

Fig. 7. (*A*) An overextended alginate should never be placed directly into contact with a flat surface. This causes distortion of the unsupported alginate material and results in an inaccurate cast. (*B*) Ideally, an alginate impression with distal extensions should be placed in a holding "tree" where the impression hangs from its handle rather than rests on a countertop during disinfection and pouring in dental stone.

from the impression material. This loss of water distorts an impression and produces inaccuracies in the cast that affect the working dies for a fixed restoration or the articulation of the casts. It is important when using any impression material to read the manufacturer's recommendations for the maximum time allowable before pouring the impression to reduce inaccuracies.

Casts have major blebs on occlusal surfaces affecting articulation

The majority of dental casts have "blebs" on the occlusal surfaces of the teeth. If they are large enough and go unnoticed, the articulation of casts can be significantly altered, leading to a false mounting of the casts. The occlusal surfaces of the teeth on the casts should be free of these blebs, which interfere with the proper relationship of the casts. After impressions are poured and before mounting the casts, the occlusal surfaces should be examined and freed of any major blebs that would interfere with an accurate intercuspation of the teeth.

Hand articulate whenever possible

In a fully dentate patient with good maximum intercuspation and a widely spaced tripod, the most accurate method of relating casts is by hand articulation. The use of an interocclusal record in such a situation can result in (1) the inability to accurately mount the casts due to the thickness of the recording materials (see Figs. 1 and 2), (2) wasted time, and (3) wasted material and, therefore, money.

Heels of the casts touch

Casts that are improperly trimmed may have interferences that make mounting difficult. One common site for this is the heel of the casts. Casts that extend too far posteriorly behind the retromolar pad and the maxillary tuberosity often interfere when the casts are mounted. Sometimes this goes unnoticed, especially when these extensions are preceded by edentulous areas. Touching heels prevents interocclusal records from fitting accurately to the casts and results in inaccurate mountings.

"Mush bites"

When a patient is asked to bite into a large amount of material, it is often impossible to determine whether their teeth are coming into contact with one another because the amount of material obscures the practitioner from visualizing good tooth contact (Figs. 8 and 9). In addition, when applying the material for this type of record, if part of it sets while the rest of it is dead soft, the accuracy is compromised. In general, interocclusal records should be made with a minimum of material between the teeth or applied to a record base.

Mouth open during triple tray impression

When a patient bites into a large amount of impression material, the teeth frequently do not make contact. Triple tray impressions are notorious for this because it is often difficult to visualize tooth contact with the impression material in a patient's mouth (Fig. 10). It may not be noticed until the dental laboratory pours the impression and mounts the casts that the patient had not closed completely. When using triple trays, it is essential that the practitioner runs the patient through the motion and discusses with them what it should feel like when they close down through the material. One should not assume that the patient would close all the way through the material without proper instruction. In addition, the teeth on the opposite side of the arch to be impressed should be examined, and contacts should be visualized between the teeth before making the impression. When the impression is seated in the mouth and the patient closes, the practitioner should re-examine these same tooth contacts to ensure that they are the

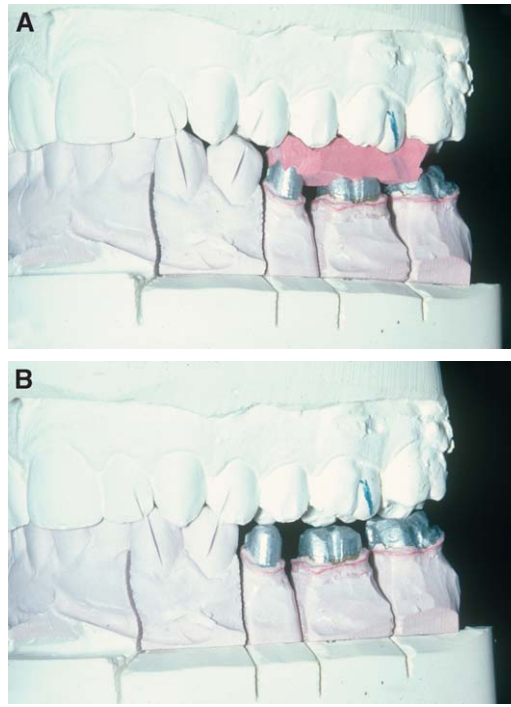

Fig. 8. (*A*) This patient was asked to "bite" into a large amount of putty material as an interocclusal record. (*B*) In the laboratory, it was clear from the marks on the adjacent teeth that the "mush bite" prevented the patient from fully closing. In addition, there was insufficient occlusal reduction of the tooth preparations. In this situation where the restorations serve as the third leg of the tripod, a more rigid interocclusal material, such as resin, would be preferred over an elastomeric impression material due to increased accuracy.

same. If not, there is likelihood that the patient did not close correctly or fully through the impression material.

Casts moved during articulation

When mounting dental casts onto an articulator, it is essential that the maxillary and mandibular casts be joined in such a way as to avoid any potential movement. Even in patients with good intercuspation, if the casts are not held immobile during mounting, any slight movement translates into some amount of discrepancy. There are multiple methods of mounting casts. The best method is the use of a combination of rigid sticks and compound or sticky wax (Fig. 11). The casts must be dry when using these materials to avoid any movement. Sticky wax placed directly onto the opposing teeth can also be used; however, when the sticky wax is removed, the teeth often break off the cast or are severely broken.

Fig. 9. A similar patient situation to Fig. 8 illustrating the same principles.

Using a second pour of your final impression

Most practitioners send their final fixed impressions to a dental laboratory to be poured. The laboratory does the cast and die work and returns the restoration to the dentist. An important and often overlooked service that the laboratory can provide is to pour a second unsectioned cast of the final impression. This second pour may be more accurate than the cast with sawed dies for adjusting the occlusion and the contacts. The dies of a working cast have some amount of mobility due to the pindexing system, a fact that makes getting perfect contacts difficult. In addition, the adjacent and opposing teeth on a stone cast invariably are abraded during restoration fabrication. Using a solid, unsectioned second pour allows the dental technician to examine the proximal and occlusal contacts achieved on the working casts and to improve these contacts when deficient before returning

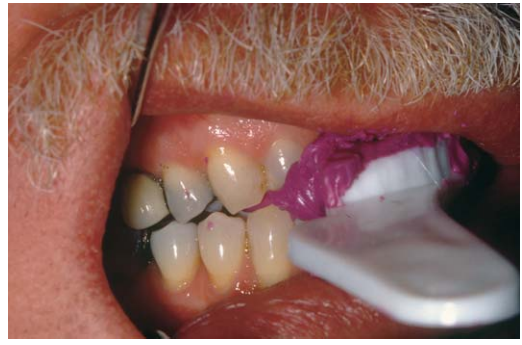

Fig. 10. A triple tray impression can be problematic because it is often difficult to visualize tooth contacts with a large amount of impression material in a patient's mouth. In this case, it is clear that the teeth on the opposite side of the arch are not contacting. If the tooth contacts are not the same as without the impression in the mouth, there is likelihood that the patient did not close correctly or fully through the impression material, and the impression should be remade.

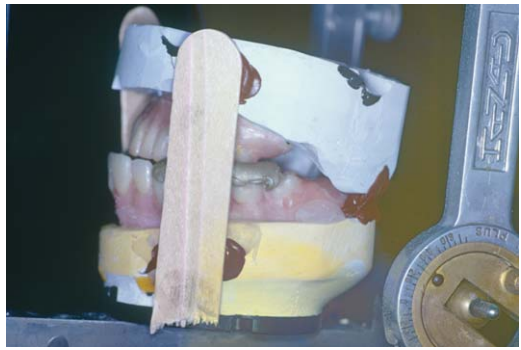

Fig. 11. The best method of mounting maxillary and mandibular casts on an articulator to avoid any potential movement is to join the dry casts with a combination of rigid sticks and compound. Before joining the two casts, the heels of the casts were checked for any interference. Note that the maxillary cast has already been mounted using a facebow, and the articulator has been inverted to mount the mandibular cast after the two have been joined rigidly.

the restoration to the dentist for delivery. This step can reduce the number of returns of the restorations to the laboratory for the addition of proximal and occlusal contacts and can make delivery of final restorations easier and more pleasurable.

Materials for interocclusal records

The most commonly used materials for interocclusal records are the fast-setting elastomeric interocclusal registration materials or wax. Elastomeric materials such as polyvinylsiloxane are well suited for making interocclusal records where only horizontal stability is needed. However, their accuracy can be compromised if they are not properly trimmed. These records should be carefully trimmed to remove all areas of the record that contact soft tissues and the axial surfaces of the teeth. This is done to minimize the areas where the casts and the record touch, allowing the practitioner to visualize how the casts seat into the record and ensuring that the record provides only the horizontal support with the contacting teeth providing the vertical support. To assure accuracy, only cusp tips of opposing teeth should be registered in the material used. Excess material that flows on the axial surfaces of natural teeth invites error when repositioning the working casts in the registration. The following adage says it well: ''In most instances, a minimal amount of registration material will give a maximum amount of accuracy.''

Summary

This article discusses and reviews general principles of jaw relation records, including the purpose of a jaw relation record and the concept of

a tripod of vertical support with adequate horizontal stability to allow opposing dental casts to be mounted accurately on an articulator. The use of the MIP position for the vast majority of patients is favored when the goal of restorative treatment is to maintain a patient's pretreatment intercuspation and vertical VDO. In addition, articulator choice, purpose of a facebow, and materials for jaw relation records are discussed. Common errors in making impressions, pouring impressions, mounting casts, and making interocclusal records are elucidated, providing the practitioner important information with which to avoid inaccuracies that may lead to additional time spent making intraoral occlusal adjustments at the insertion of fixed restorations.

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