

# INTEROCCLUSAL RECORDS IN PROSTHODONTIC REHABILITATIONS - MATERIALS AND TECHNIQUES - A LITERATURE REVIEW

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## Abstract :

To achieve a successful prosthesis it is important to achieve harmony between the maxillomandibular relationship and anatomy of patient. This relationship is not simple opening or closing, but a complex relationship which exists in 3 dimensions. Variations may occur in any direction – vertical, anteroposterior, or mediolateral. Thus, it is essential to record this relationship with the least possible error to obtain a successful prosthesis. However when relating the maxillary and mandibular dental casts, the ultimate accuracy depends on accuracy and dimensional stability of the material and the technique used to record the maxillomandibular relationship.

Keywords : Interocclusal Recording Medium, Interocclusal recording Techniques

## Introduction :

When the maxillary and the mandibular casts are to be held together in a stable and reproducible manner, a tripod of vertical support as well as a satisfactory horizontal stability is necessary. Tripod of Vertical support is essential to prevent the rocking of the casts during mounting. Horizontal stability is essential to prevent the horizontal rotation or translation between the casts and is generally present when good intercuspation exists between the two opposing arches. An interocclusal record is mainly used to achieve the horizontal stability. Hence, when both, tripod of vertical support and good tooth intercuspation is present, the casts can be mounted directly without an interocclusal record. However, most of the patients undergoing prosthodontic rehabilitation present with poor

intercuspation of the remaining dentition. In such cases, the casts cannot be positively articulated in a reproducible position and the use of interocclusal record medium becomes a

must.

## Interocclusal recording medium :

### Ideal requirements of bite registration material

- The materials should offer limited resistance before setting to avoid displacing the teeth or mandible during closure, whereas after setting, it should be rigid or resilient, with minimal dimensional change.
- It should be easy to manipulate with no adverse effects on the tissues involved in the recording procedures.
- It should accurately record the incisal and occlusal surfaces of teeth.
- A very important feature - it should be verifiable.

## Inter occlusal registration material :

### Thermoplastic waxes

Thermoplastic waxes are most frequently used for interocclusal registration either as records or as carriers for registration. Although wax is probably the most maligned, it is yet the most versatile and widely accepted material.<sup>1</sup> This is due to its cost and ease of manipulation.<sup>2</sup> However, studies have demonstrated that wax as interocclusal record material when compared with other materials is

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definitely inferior, inaccurate, unstable, and inconsistent with distortion more frequently in a vertical direction followed by and anteroposterior direction.<sup>2</sup>

#### Impression plaster

Impression plaster is basically plaster of Paris with modifiers. Modifiers accelerate setting time and decrease setting expansion. Records of impression plaster are accurate, rigid after setting, and do not distort with extended storage. Studies show that the plaster records, along with a few others showed the least 3 dimensional changes after 30 min of storage and remained dimensionally stable for more than 24 hours<sup>3</sup>. However, the use of plaster is more complicated than wax or zinc oxide eugenol paste<sup>4</sup>. It is difficult to handle because the material is fluid and unmanageable prior to setting. The final interocclusal record is brittle.

#### Zinc Oxide and Eugenol Paste

Zinc oxide – eugenol paste is an effective and reliable interocclusal registration material. It is simple to use, sufficiently rigid and easy to store<sup>1</sup>. However it dehydrates, is significantly brittle, sticks to the teeth and important portions of the record may be lost due to breakage. Besides, once used it rarely can be used again. It is advisable to use a minimum amount of Zinc Oxide eugenol to avoid excess flash as flash around the teeth can interfere with the accurate seating of the casts<sup>2</sup>. Certain studies do not recommend the use of zinc oxide eugenol paste as it is extremely variable and consistently resulted in an open cast relationship<sup>5</sup>

#### Acrylic resins

The most frequent application of acrylic resins for interocclusal records is in the fabrication of single – stop centric occlusion records. Acrylic resin is both accurate and rigid after setting.

Disadvantages of acrylic resin as an interocclusal registration material includes dimensional instability due to continued polymerization resulting in shrinkage<sup>1</sup>, rigidity of the material can damage plaster cast and dies during mounting on the articulator.

#### Silicone elastomers

Two types of silicone elastomers are available as interocclusal registration materials: condensation silicone and addition silicone. They are highly accurate and were found to be dimensionally stable over a 48 hr time period with negligible weight change.<sup>6</sup> They do not require a carrier. However the disadvantages are their minimum working time and predetermination of the record space is required.<sup>6</sup> One major disadvantage of silicone is resistance to compression of the set material, which contributes to difficulty in the seating of plaster casts.

#### Polyether elastomers

Polyether interocclusal registration material consists of the basic impression material augmented by plasticizers and fillers. The advantages of this material as an interocclusal registration material are accuracy, stability after polymerization and during storage, fluidity and minimal resistance to closure, can be used without a carrier. Disadvantages are that resiliency and accuracy may exceed the accuracy of the plaster casts. Both of these factors can interfere with the placement of the plaster cast into the recording medium during mounting procedures. The records are trimmed to remove excess material and preserve only the teeth indentations, avoiding distortions.

#### Techniques :

Recording material is not the only parameter that influences the accuracy of an interocclusal record material. According to many studies, the recording techniques have also been responsible for the error encountered.

â According to a study conducted by Strohaber, the least variable of all methods is the method of Hand articulation of patients casts in maximum intercuspation.<sup>7</sup>

This method is one of the most commonly used methods and commonly employed when patient's centric relation is coincident with the maximum intercuspation, for fabrication of single crown and when the indicated fixed restorations do not interfere with the stable tripodization of maximum intercuspation.

However, according to Muller et al. repositioning of the records acts as a source for incorporating discrepancies for several reasons such as dimensional changes in the material, inaccuracy of the cast or the inability of the material to totally seat on the occlusal surfaces.<sup>7</sup>

Hence a technique that would partly or totally eliminate this inaccuracy would be of great value in clinical practice.

• Aris-petros tripodakis et al in their study have described a technique which, to an extent, helps to overcome these inaccuracies.

They suggested that the record should be incorporated in the impression material itself and then used for the construction of the opposing cast. This would eliminate the need for transferring by repositioning the record on the model. The recommended interocclusal record material is polyether which is one of the most accurate.<sup>7</sup>

Situation when a few teeth are present in the mouth and interarch stabilization is difficult to achieve

• When the distal most molar is prepared as the abutment for three to five unit posterior FPD a clinical situation arises where the interdigitation of the patient's interocclusal relationship is unstable.

In such circumstances, stability is accomplished by supplementing the maximum intercuspation with an interocclusal record or occlusal stop.

In a study on creating an occlusal stop for interocclusal record, the author describes a method of making an accurate interocclusal record when the most distal tooth is an abutment of FPD. The method uses conical stops, prepared in the enamel of the abutment or made of composite or a metal core covered with composite, to maintain the vertical dimension of occlusion and to act as the third point of reference for a stable occlusal relationship when occluding a definitive casts.<sup>8</sup> Materials generally used are polyether, silicone or acrylic resin.

Drawback: The patient should be asked to close very gently only until contact is felt with the stop. Any further closure

will introduce forces that either displace soft tissue or tilt the denture bases.<sup>9</sup>

• Gerald et al has suggested a stabilized baseplate technique for making interocclusal records which provided a means to record centric and eccentric jaw registrations that are stable intraorally and can also be transferred accurately to the working model.<sup>10</sup>

In this technique an impression of the prepared teeth is made and poured in die stone. Relief over the occlusal surfaces of uncut dies is made using silicone putty impression material and the edentulous ridges are covered using tinfoil. A baseplate using selfcure resin is made in the shape of an occlusal rim extending 1-2 mm over the facial surfaces of the prepared teeth. The baseplate is trimmed to achieve a passive fit and relined in the edentulous areas using polyether impression material. Part covering the prepared teeth is relined intraorally with an interocclusal registration paste. The excess is trimmed and the fit is verified on the cast. The baseplate is then returned to the mouth and the occlusal rims are adjusted to achieve a uniform contact with the opposing arch at the desired vertical dimension of occlusion. The maxillary cast is mounted on the articulator. The occlusal surface of the baseplate is covered with wax or registration material and centric relation is recorded. The mandibular cast is now mounted in centric relation. Protrusive and lateral jaw records are made in the similar manner and the articulator is adjusted using these records.

Drawback of using well adapted close fitting baseplate: Application of any undue force during closure can displace the soft tissues. This is not usually detected in complete dentures but inaccuracies and errors are commonly incorporated with partial dentures.

• Stepan Papazian et al described a procedure for making an interocclusal record without the use of record bases for a combined fixed/removable prosthesis.<sup>11</sup>

Try the metal castings for the fixed restorations in the mouth to verify their fit and adjust as necessary. Make an

acrylic resin anterior stop to hold the desired vertical dimension of occlusion. In the dental laboratory, adapt Triad material to the buccal and lingual surfaces of the castings and extend over the edentulous spaces. Make these extensions comparable to the mesiodistal and faciolingual dimensions of an occlusion rim so that they will provide adequate support for the recording medium. For each edentulous space, splint at least two adjacent castings with the Triad material to support the extension over the edentulous ridge. Place the castings with the attached extensions in the mouth and verify occlusal clearance of the extensions. Make an interocclusal record with extra hard baseplate wax and then reline the wax record with zinc-oxide eugenol paste. Mount the master casts with the use of this record.<sup>11</sup>

â Anterior Stop Technique: The anterior stop centric relation record is accomplished with an anterior deprogramming appliance.

It uses an anterior jig that is fabricated before the interocclusal record, or leaf gauge composed of several 0.1 mm thick plastic strips. This deprograms the influence of the posterior dentition by creating a platform that the incisal edge of the mandibular central incisor contacts. This provides posterior space for the interocclusal material and the carrier.

â Martin F. Land described an anterior deprogramming device fabrication using a thermoplastic material.

He states that use of an anterior programming device allows separation of the posterior teeth immediately prior to centric relation record fabrication. This results in the patient "forgetting" established protective reflexes that are reinforced each time the teeth come together, making mandibular hinge movements easier to reproduce. The resulting anterior stop acts as a fulcrum, allowing the directional force provided by the elevator muscles to seat the condyles in a superior position within the fossae. The technique can be coupled with the bilateral mandibular manipulation technique and has been shown to result in greater mandibular displacement from the intercusp

position than with a centric relation record alone.<sup>12</sup>

â To record the maxillomandibular relationship in centric relation, the most common technique is a thermoplastic bite wafer made from base plate wax or a similar material.

Centric relation record is obtained using a warm wax wafer. After verification of the record, the mild indentations in the wax are "washed" with a more accurate material (usually ZOE paste) and the recording is repeated. The interocclusal record obtained represents a stable laminate consisting of the thermoplastic wafer and a wash of ZOE paste or an elastomer.

Eccentric interocclusal registrations :

The purpose of eccentric interocclusal registrations or "check-bites" is to assist the clinician in setting the articulator fossa elements on a semi adjustable articulator.

There are two types of eccentric registration.

- Lateral-excursive records
- Protrusive records

Lateral interocclusal records

Lateral positional records are useful to correct the errors incorporated due the slight shifting of the teeth in the wax as well as during processing. They can also be used to obtain bilateral balanced occlusion in new denture wearers or to correct the occlusal interferences in existing dentures.<sup>13</sup>

â Arthur Michael La Vere has suggested a method to use Lateral Positional records with Hanau Model H articulator.

In this method, the maxillary and mandibular remounting casts are poured in the completed dentures and the maxillary denture is mounted on the articulator using the facebow. The mandibular denture is mounted using an interocclusal centric relation record and the occlusion is corrected such that the centric relation coincides with the centric occlusion. The patient is then made to practice the various lateral movements and the occlusal contacts in

working and balancing positions are noted. The maxillary denture is placed in the mouth. The mandibular denture with ZOE paste distributed over its posterior teeth is placed in the mouth and the patient is asked to close in the rehearsed left lateral position until the paste sets. The completed record should have an even layer of paste with none of the opposing teeth penetrating the record medium. The Maxillary denture is sealed to the cast while the mandibular denture and cast are mounted using the Lateral interocclusal positional record. The Hanau articulator is now used as a Hinge instrument and the tips of the cusps are selectively ground until a balanced occlusion is achieved on the working and the balancing side. Balanced occlusion for right lateral as well as for protrusive position is obtained in the same manner.

Drawback: The lateral shift of the mandible is recorded in only one position.<sup>13</sup>

Protrusive Interocclusal records:

The purpose of recording protrusive jaw relation is to adjust the condylar elements of the articulator such that they have inclinations as near as possible to those in the temporomandibular articulation.<sup>14</sup>

• Earl pound has described a method of recording accurate protrusive registrations for patients edentulous in one or both jaws.

The maxillary and mandibular anterior teeth are arranged and vertical dimension at occlusion is recorded using a facebow. The maxillary posterior teeth are tentatively arranged opposite hard wax occlusal surface on mandibular trial denture base and the articulator is adjusted such that the incisal edges of upper and lower anteriors are in direct contact. It is then closed onto soft wax adapted over the mandibular anteriors and premolars until the incisal edges of upper and lower anteriors contact in the predetermined position. Trim the excess wax. This wax record is attached in its correct position to the denture base using sticky wax. If either upper/lower anterior natural teeth are present, the wax record is prepared in a way that it can be taken off and on the cast and fit well

around the natural teeth. Soften two sections of Aluwax which will overfill the space existing between the posterior teeth and attach them on the occlusal surface of lower trial denture base. The articulator is closed into the warm wax to register the occlusal surfaces of all the upper posterior teeth at this protruded setting. Trim and chill the wax. The patient is made to rehearse this forward position. The upper and lower denture are placed in the patient's mouth with the softened Aluwax and the patient's mandible is guided such that the teeth fit into the anterior control wax and close until the anterior teeth make contact. The record so obtained is then transferred to the articulator.<sup>15</sup>

Graphic methods:

Maxillomandibular relations have also been recorded using graphic methods like intra oral or extra oral Gothic arch tracing, pantographic tracing.

Donald A. Curtis had conducted a study wherein he had compared the protrusive interocclusal records to pantographic tracings using wax and polyvinyl siloxane addition silicone as interocclusal recording medium. He concluded that pantographic recordings of protrusive movement were slightly higher when compared to silicone recording material but significantly higher when compared to wax laminate records.<sup>16</sup>

Interocclusal registration for fixed implant-supported prosthesis

• Omid Savabi described a method for interocclusal registration with the impression copings for a fixed implant-supported prosthesis.<sup>17</sup>

Make an impression with a custom tray and elastomeric impression material. Insert the provisional restoration. Place the impression coping. Remove any part of impression copings that interferes with complete closure in the maximum intercuspation position with a sharp scalpel. Make the interocclusal record with a putty-type vinyl polysiloxane impression material. Place the impression copings and interocclusal record over the shoulder of implant analogue on the definitive cast. Mount the mandibular cast in an articulator with the aid of the

interocclusal record. Evaluate the fit and occlusion of definitive restoration, and lute the definitive restoration.<sup>17</sup>

• Haralampos P. Petridis described a method to record stable interocclusal records for implant patients with posterior endentulism.<sup>18</sup>

Make the definitive impression of the implants. Connect castable plastic burnout abutments to the implants. The abutments should permit rotation to connect multiple implants. Alternatively, use titanium abutments. Adjust the height of the abutments to the available interocclusal distance. Connect the abutments together intraorally with a low-shrinkage autopolymerizing acrylic resin and create a platform to act as a carrier for the interocclusal registration material. Make index grooves on the top of the platform to orient the interocclusal registration material. Proceed with the interocclusal registration with a suitable material such as vinyl polysiloxane. Transfer the information to the dental laboratory for fabrication of the prostheses. The castable plastic burnout abutments can be used for the definitive restoration.<sup>18</sup>

#### Discussion :

Construction of a prosthetic restoration involves many steps and it is important to understand that incorporation of error can occur at any step. However a major source of error is while taking the registration records and transferring them to the articulator. These errors can be minimized by proper selection of the materials and technique used, by knowledgeable application of the properties and the various shortcomings of the interocclusal recording mediums and the technique used to record the relationship.

Despite the opinion of several investigators that wax is an unfavourable material for interocclusal registration, it is the most utilized material in the dental practice because of its ease of handling, clinical versatility, ease of corrections and low cost. Combinations of wax with rigid materials like Zinc oxide eugenol paste and acrylic resin have also been used as they incorporate less error. However, these have their own drawbacks. The major problem with Zinc oxide

eugenol paste is that it is a brittle material that tends to adhere to the teeth and when used in excess, it may distort. Acrylic resin provides more security to the operator at the time of seating the casts on the registrations. Elastomeric impression materials are amongst the preferred materials as per the various investigations conducted over their accuracy and dimensional stability. However, their major setback is the affordability.

Based on the existing clinical condition, the clinician needs to decide the most suitable material-technique combination. In a clinical condition wherein there is good intercuspation between the existing teeth, no record may be needed whereas if there is poor intercuspation, a full arch or segmental record may be made using elastomeric materials or a segmental record may be made only over the prepared tooth/teeth using rigid materials like wax, plaster, resin or paste.<sup>19</sup>

Although the errors can be minimized by careful technique and control of materials, it is a known fact that they cannot be completely eliminated because of the inherent properties of the various materials that may be used in the procedure. Investigations have shown that most of the materials continue to undergo dimensional changes even after the setting time indicated by the respective manufacturers. Besides, the possibility of human error always exists. Registration taking is an exacting task. Hence it should not be done in a hurry by the clinician. The patient, on the other hand, must also be co-operative. Once the record is obtained, it must be carefully handled by the laboratory personnel while using it to mount the models on the articulator.

#### Conclusion :

To properly evaluate a patient's occlusion and to build up an artificial dynamic occlusal scheme, it is mandatory that the diagnostic casts and the final casts are placed in an articulator in approximately the same relationship to the temporomandibular joint as it exists in the patient. The ideal material-technique combination for making interocclusal records would allow the placement of indirectly fabricated prostheses in the patient's mouth with

no occlusal adjustment and hence play a major role in the success of the rehabilitative procedures in terms of function and esthetics.

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