

Interocclusal recording materials: A review

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Abstract

To achieve a successful prosthesis, it is important to achieve harmony between the maxillomandibular relationships. This does not pertain only to the opening or closing but is a complex relationship which exists in three dimensions. Hence, it is very important to record this relationship with the least possible error to obtain a successful prosthesis. To record this maxillomandibular relationship, numerous materials are in use and what matters are the precision of the recording materials and their stability. This article seeks to present a review of major bite registration materials and their modification as well as their advantages and disadvantages.

Introduction

Precise articulation of casts is essential for proper diagnosis, treatment planning, and successive prosthetic rehabilitation of the patient. In few cases, the casts can be easily mounted in maximal intercuspation by upholding them with hand articulation, while in others, it is necessary to record maxillomandibular relationship using relevant interocclusal recording medium and meticulously transfer it to the articulator.^[1]

Any imprecision in maxillomandibular records leads to unwanted errors in the final prosthesis.^[1] Numerous materials and methods are being used for interocclusal registration procedures since the first maxillomandibular registration material was introduced by Philip Pfaff, in 1956. Materials that have been intended for intermaxillary recording procedures include plaster, modeling compound, waxes, acrylic resin, zinc oxide-eugenol pastes,^[2] rubber base, and silicone materials.^[3] Newer ones include polyether and polyvinyl siloxane for ideal maxillomandibular registration.

Requirements for ideal interocclusal recording materials

1. Requirements for ideal interocclusal recording materials include: Initial resistance to closure should be finite.
2. Dimensional stability after the final set of the recording material should be proper.

3. Post-polymerization, there must be resistance to compression.
4. Easiness of manipulation.
5. It should be biocompatible with the tissues involved in the recording procedures.
6. The inciso-occlusal surface of the teeth should be recorded precisely.
7. Ease of verification.

There is no material, however, that has all the properties as a “classical” intermaxillary registration medium. The inaccuracies attributed to the maxillomandibular records can be categorized into three as follows:

The biologic characteristics of stomatognathic system, material manipulation, and the properties of the intermaxillary recording media.^[4]

At present, the most commonly used materials for bite registration are polyether and polyvinyl siloxane followed by zinc oxide eugenol.

Other bite registration materials are as follows:

Plaster, modeling compound, waxes, and acrylic resin.

Plaster

Anciently, impression plaster has been used as a maxilla-mandibular recording material. Calcinated calcium sulfate

hemihydrate was one of the main constituents and this reacted to form a rigid mass of calcium sulfate dihydrate on mixing with water (Combe, 1975). Berman (1960) found plaster (1) free flowing, (2) it broke easily as the mix required for the registration was thin, and (3) lack of attachment.

Skurnik (1969) said working with plaster was complicated and not conducive to a neat and clean field of operation. In addition, on removal from the mouth plaster may fracture, if undercuts were present. Craig (1975) noted the launch of the elastic materials, the popularity of dental impression plaster had diminished.^[5]

Dental Waxes

Dental wax may be hard or soft, thick or thin, or heated or chilled throughout its bulk without uniformity. Once the record is made, it is subject to being blunted, distorted, scraped, and compressed. At best, the basic variable nature of wax hinders its usefulness as a recording and transferring material for SO critical a relationship. The material used to achieve this important centric relation record has much to do with its resultant accuracy. The choice of recording medias cut down to plaster, wax, modeling compound, and zinc oxide and eugenol impression paste. Plaster flows readily but breaks easily, lacks adherence, and vital parts of it may be lost since it has to be mixed thin. Modeling compound and wax hold many comparable characteristics. Nonetheless, wax has achieved the extensive recognition for gaining the maxillomandibular record.^[5]

Zinc Oxide Eugenol

Zinc oxide eugenol was discovered by Bonastre, in 1837; Chisholm has used it later on in the field of dentistry in 1876. ZoE paste is an effective intermaxillary recording material. The primary components of many zinc oxide-eugenol pastes were stuck to zinc oxide, eugenol, and rosin. Many additives such as plasticizers, fillers, accelerators, and other substitutes were added to bring in the properties required for different products.^[5]

Advantages

Fluidity before setting – fluidity is a critical quality of a bite recording material because it provides nominal interference with mandibular closure during record making procedures.

- Adherence to its carrier.
- After final set, there is rigidity and inelasticity.
- Accuracy in recording occlusal and incisal surfaces of the teeth.
- High intensity of repeatability.

Disadvantages

- Long setting time.
- Highly brittle.

Accuracy of the registration material may exceed the accuracy of the casts resulting in proper fit.^[6]

Zinc oxide and eugenol type of bite registration paste is one material of choice for the maxillomandibular record. This material can be mixed to a proper fluid consistency, offering no resistance to closure, and adheres to its carrier. It sets to a hard, non-compressible consistency and is sharp and easily read. Articulation of the casts may be accomplished accurately without fear of distortion or compressing the record unevenly in the vertical dimension.^[7]

Gurav *et al.* in a study stated that the comparison of dimensional stability showed that zinc oxide eugenol and polyether were more dimensionally stable followed by silicone.^[4]

Polyether

Polyether impression material is an elastic type material, as is the polysulfide and silicone materials. These materials have demonstrated good accuracy in clinical evaluations and are thixotropic, which provide good surface detail. The polyethers have low-to-moderate tear strength and much shorter working time and setting times, which can limit the usefulness of the material.

The flow characteristics and flexibility of the polyether materials are the lowest of any of the elastic materials. These characteristics can limit the use of polyethers in removable partial denture impression procedures. The stiffness of the material can result in cast breakage when removal of cast from custom tray is attempted. These materials have a higher permanent deformation than addition reaction silicones. Some have an unpleasant taste, and the material will absorb moisture, it cannot be immersed in disinfecting solutions or stored in high humidity for any extended period of time.^[8]

There were many studies conducted on evaluating the precision of polyether occlusal bite registration material compared to other commercially available bite registration materials.

In a study conducted by Joshi *et al.* concluded that Ramitec polyether bite registration material is the most handy material when compared with commonly used modeling wax during the tooth preparation.^[9]

Owen and Goolam recommend that polyethers should not be immersed for duration surpass 5 h because they may expand.^[10]

Silicones

Silicones are synthetic compounds. The chain is composed of silicon and oxygen linked to form a 16 siloxane chain. The molecular weight was determined by the length of the siloxane chain, and thus, silicone character was affected. Viscosity of the material increased with increase in the length of siloxane chains. Furthermore, polymer properties were affected by cross-linking, as observed in silicone resins and rubbers. When the material was stressed, sliding of polymer chains over one another was prevented by a small degree of cross-linking. Thus, there was an increase in the elasticity of the material.

Extreme cross-linking affected hardness and chemical reactivity and during setting, dimensional changes occurred. Polymerization affected shrinkage, also the loss of alcohol as the setting reaction proceeded (Philips, 1973).^[5]

Merchant *et al.*^[11] found that polysulfide and vinyl polysiloxane did not show any dimensional change after immersion for half an hour in different disinfectant solutions. Measurements were carried out with a Boley gauge and a micrometer and the results were duplicated in a following study using a digital electronic caliper.^[12]

Vinyl polysiloxane impression material was tested by Toh *et al.* after immersing in 16 disinfectant solutions for 30 min and found that there were changes in dimension post-immersion in the iodophors and the glutaraldehyde except one.^[13]

Soganci *et al.* in a study stated that dimensional accuracy and stability of two elastomeric impression materials, polyether and vinyl polysiloxane, are alike when immersed in two different disinfecting medias. Dimensional changes in impression materials may not occur with small time period (maximum 24 h). It can be concluded that both elastomers are superior and alike. Further clinical studies need to be carried out to stimulate oral environment.^[14]

According to a study conducted by Godbole, the effect of ultraviolet (UV) radiation on dimensional stability of vinyl polysiloxane materials was not significant. Before and after disinfection with UV light, there was no difference in dimensional stability of impression.^[15]

Anup *et al.* in a study stated that, among all materials tested, polyvinyl siloxane showed more accuracy, at different time intervals followed by zinc oxide eugenol and Aluwax, respectively.^[16]

Conclusion

During restorative phase of any dental treatment, the proper articulation of patient's diagnostic or working casts is essential for fabrication of clinically acceptable prosthesis. Apart from the operator's clinical capability and the procedure followed, the material chosen can affect the accuracy of the bite registration and thereby ultimate outcome of the restoration.

Bite registration materials such as wax and zinc oxide eugenol are used for registering intermaxillary relationship. The introduction of polyether and polyvinyl siloxane bite registration materials has made clinicians unclear of which material to be used. These elastomeric materials are chemically identical to the impression materials that have been used for many years. To increase the chance of success of the recording properties, alterations have been made by adding plasticizers and catalyst to bring in different handling characteristics; however, it remains anonymous whether these modifications in the parent impression materials have modified their properties such as accuracy and dimensional stability.

Polyether bite registration paste is gaining acceptance due to its ease of manipulation and accuracy. Polyether exhibited

outstanding flow characteristics than addition silicone and waxes.

Numerous techniques and bite registration materials for recording the maxilla-mandibular relations are described in the dental literature, but there is little agreement between the materials and their correlation with dimensional stability and accuracy post-impression techniques.

To summarize, in the past 2–3 decades, many new materials have been introduced along with new techniques. Many of these materials have shown promising results, but clearly, there is a need for long-term studies to identify the best material for obtaining the better or best maxilla-mandibular relations or the interocclusal records.

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