The interocclusal registration

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Ensuring the correspondence of dental casts through the interocclusal registration is the most critical step in instrumental functional diagnosis and in oral reconstruction. This paper reports on the effect of materials themselves on the reproducibility and practical usefulness of such registrations as examined experimentally.

Introduction

Initial studies were made with centric interocclusal registrations of patients having no temporomandibular joint problems. Each investigator used his personally preferred technique for centric mounting, and then the techniques of each of the other investigators. All registrations were surveyed in the Condymeter III (SAM-Präzisionstechnik GmbH) so that comparative evaluations could be studied.

The results produced a distribution of values such that no reproducible mounting of the opposing jaw could be achieved. It was apparent from the measurements, however, that a specific type of registration, independent of patient and treating dentist, led to a much narrower range of distribution. This finding was confirmed through studies made on a second patient series. These results led to the postulation that registration errors are affected chiefly by the technique and the materials used for the purpose.

Materials and methods

Polyurethane models, known to be especially abrasion resistant and dimensionally stable, were mounted in the SAM II reference articulator. Each investigator prepared 10 registrations per registration type in the reference articulator.

All registrations were measured to the nearest 0.01 mm three-dimensionally for deviations from X, Y, and Z coordinates in both right and left condyle regions with the SAM Condymeter III (Figs 1a and 1b).

Fig 1a The interocclusal registration establishes the position of the models with respect to each other. The SAM Condymeter III shows condylar displacements in three dimensions on the right and left sides.

Fig 1b The precision of the Condymeter III is of the order 0.01 mm. Markings indicate sagittal (X), transversal (Y), and vertical (Z) excursions. R and L indicate right and left sides, respectively.
Various waxes, "tempered" lead foil of various thicknesses and profile, and laboratory-fabricated, cold-curing acrylic trays were used as carrier plates for the bite registrations. The registrations were lined and built up with waxes, zinc oxide-eugenol, and a number of cements. The cements were developed especially from specifications arising through experience with the test groups. Each of the 30 registrations per type was removed from the Condymeter, remounted, and resurveyed five times during the test series. When changes in value appeared during the measurements, additional measurements were made at 10-minute intervals. All materials were used in accordance with directions supplied by the manufacturers.

Prefabricated cold-curing acrylic trays require relatively large amounts of laboratory effort and should be stored for a period before their use (P. Engelhardt and A. Gutowski, personal communications).

Conclusions

Optimizing the carrier plate

Alloy, thickness of the registration layer, and profile thickness were variables. A tempered alloy carrier plate having a thickness of 0.3 mm, with a palatal vault and ribbing extending to the outer margin, was found to be the most practical solution. A universal-sized carrier plate, having the advantage of not greatly limiting the tongue, was defined.

Liner materials

Zinc oxide pastes were used initially to improve the surface profile of the carrier plate. Bite registration paste (Opotow) was found to be too soft for repeated placement. Temp-Bond (Kerr Mfg Co) was better but not very stable at the margins. It was further characterized by undesirable strong bonding to teeth and models, leading to the danger of fracture of the material. Samples manufactured in the United States had better characteristics than those made elsewhere. Dycal (L.D. Caulk Co) produced the best results; the good values measured initially improved after the registration was stored for 2 hours (Fig 4). However, sharp impression margins tended to fracture with this material as well. For that reason, and because of its high price, the material cannot be considered for this use.

All zinc oxide pastes require time-consuming placement of a costly adhesive to ensure sufficient adhesion to the carrier plates. These considerations led to the need for a material that:

1. Is suitable for application of thin layers
2. Is adherent without additional adhesive
3. Has a short setting time
4. Has high edge-tear resistance
5. Is pleasant in taste and odor
6. Is inexpensive
Fig 2  Variations in range of measurements in deep (TI) and flat (FI) impressions.

Registration impressions flat – deep

Fig 3 Means of ranges in wax registrations after ice water cooling and storage at room temperature.

Wax at room temperature – ice water

Fig 4 Comparison of Dycal measurements made immediately after registration and after 2 hours.

Liner – Dycal 2 hr – Dycal
Fig 5a. The fracture-resistant edge and flat impression on a profile-enhanced carrier plate made of tempered metal foil is coated with a thin layer of Steffens cement No. 11.

Fig 5b. The underside of the carrier foil shows an anterior stop, and a sequentially applied Alu-Wax layer made fracture resistant at the margins and precise by a coating of Steffens cement No. 11.

The Steffens Cement No. 11 (Steffens Chemie), specially developed for these studies, fulfilled these requirements completely. With it, the most exact positioning of the models on the carrier plate was achieved (Fig 6, row 1).

The vertical stop

Use of the carrier plate does not prevent deflecting contacts of occlusion. A vertical space maintainer must be provided to prevent the effect of any inclined plane. The vertical stop placed well to the anterior is also required for the stimulation of the neuromuscular system. This stop, fabricated in compound, is placed in the incisal region. It must not fulfill a guiding but only a supporting function, i.e., it must not lead to formation of an inclined plane. Different heights of the stops did not lead to significantly changed measured values in the articulator registration (Fig 7). Accordingly, for well-known reasons, all stops should be held as small as possible in the patient’s mouth.

The posterior support zone

Sequential placement of a posterior occlusal support serves not only to stabilize the carrier plate, but to stimulate the proprioceptive reflexes as well. If compound is used, good values can be obtained. The uncontrollable momentary hardness of the material when placed into the patient’s mouth, however, leads to the danger of distortion in the joint. Similar negative experiences occurred with Beauty Pink Wax (Moyco). The risk of compression exists because of the initially pasty consistency of the material when light-cured composite resins are used posteriorly. Best results in practice were obtained through sequential, drop-by-drop application of Casting Wax (Kerr Mfg Co). Alu Wax Denture (Aluwax) even better fulfilled the need for even support of the mandible without danger of distortion or compression. These materials can be manipulated without time constraints, and the depth of impression is easily corrected. Because some sinking of the models occurs with all waxes, additional requirements arise.

Stabilization and fine profile formation of waxes

To ensure clear, form-stable impressions, the wax surface must be covered. As it was for the maxilla, Steffens cement No. 11 was most suitable for this purpose.
Fig 6 Comparison of values of all registration types. Each column represents the mean value of 10 measurements. Row 1: Optimal registrations made by the authors; Row 2: Dycal after 20 min storage; Row 3: Opotow bite registration paste; Row 4: Temp Bond; Row 5: Composition compound; Row 6: Waxes at room temperature.

Fig 7 Comparison of the distribution of the measured values with varying thickness of registration.

Procedure

A profile-stabilized metal foil is adapted by having the patient close on it. The exact profile for mounting the maxillary model is completed by applying a Steffens No. 11 cement lining. To avoid adhesion of the cement to the teeth, particularly on restorations, a separating medium must be used on the occlusal surfaces. A vertical stop made of compound is placed in the incisal region as a neutral supporting element, without an inclined plane and without an impression. Alu-Wax is applied step by step against the teeth of the mandibular arch from the anterior to the posterior to support the carrier tray. Finally, a Steffens cement coating is applied to establish the detailed profile and stabilize the wax (Figs 5a and 5b).

Only flat depressions of the cusp tips should be reflected in the impression. We were able to obtain registrations having reproducible values in this laboratory experiment only through application of this systematic procedure.
Discussion

Every tooth contact can elicit tooth movement, mandibular deformation, and condylar displacement. All usable impressions act without pressure, thus providing a static depiction of these changes. However, the occlusal impression and bite registration must be dimensionally equal for positive mounting of models. This can be achieved only by similarly pressure-free interocclusal registration procedures. For that reason, all waxes are as inappropriate as elastomeric materials. Carrier plates (trays) of cold-curing resins provide good values, but can be made only indirectly via mounted models in the dental laboratory. For absolute stability of form, they must not be used until the following day. Tempered metal carrier trays are in danger of deformation and must be stabilized through appropriate build ups. For use in the maxilla, they must be lined. Their use requires placement of an anterior stop and liner-coated wax impression in the mandible.

The entire registration, ie, the carrier plate, the vertical stop, the cover coating, and the adhesion of all components, must remain unchanged through several repetitions of removal from and replacement on the model.

On the basis of our present findings, all previous commentaries about the reproducibility of centric registrations must be reconsidered because of errors inherent in the systems used.

The registration form described here appears to have solved the problems, at least in laboratory experiments. The second part of this study will determine whether reproducible registrations can be achieved under the conditions described, and the extent to which such registrations are independent of the person providing treatment.

References


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