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Clinical Evaluation of Interocclusal Recording Materials in Bilateral Free End Cases

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Five combinations of materials commonly used for intermaxillary records in cases of bilateral free end saddle were evaluated: acrylic resin base + wax; acrylic resin base + wax + ZOE paste; acrylic resin base + wax + Duralay resin; condensation silicone; and acrylic resin plate + irreversible hydrocolloid. The materials were evaluated by measuring the vertical distance between pairs of reference points located on the bases of the upper and lower articulated casts. The measurements obtained by manual articulation of the casts were used as the standards to which the measurements obtained with the recording materials were compared. ANOVA revealed significant differences among the materials and the Tukey's test showed that condensation silicone differed significantly ($p<0.05$) from the acrylic resin + wax combination, while no significant differences ($p>0.05$) were observed among the remaining materials. The condensation silicone presented the greatest differences from the measurements obtained by manual articulation of the casts whereas the acrylic resin base + wax combination presented the least differences. Based on the findings of this study, the following scale of fidelity can be settled from best to worst: acrylic resin base + wax; acrylic resin plate + alginate; acrylic resin base + wax + ZOE; acrylic resin base + wax + Duralay; and condensation silicone.

Key Words: interocclusal recording materials, free end cases.

INTRODUCTION

Oral rehabilitation involves a sequence of steps that must be followed in a highly judicious manner. The success of any prosthetic rehabilitating treatment depends on several aspects related to the precise mounting of casts in the articulator.

When maximum intercuspation is considered, in cases in which the number of teeth present is satisfactory and will provide cast stability, the casts can be mounted by manual articulation (1-6). On the other hand, when large edentulous spaces are present, specifically in posterior free end cases, cast mounting is considerably more complex (7). There is a higher risk of distortion due to interference by the soft tissues of the margins, which can be compressed and may give origin to errors on cast mounting, if special attention is not taken during impression.

Furthermore, the lack of teeth that articulate with their antagonists poses an additional difficulty to recording and increases the need for accurate transfer of the interocclusal relationship and vertical dimension (8). These parameters are usually fulfilled by using registration bases fitted into wide edentulous spaces or free ends. The recording base should provide adequate fitting as well as rigidity and stability.

The purpose of this study was to evaluate 5 combinations of materials used in daily clinical practice to obtain intermaxillary records for bilateral free end cases.

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MATERIAL AND METHODS

Five patients with complete upper dentition and bilateral lower edentulousness were enrolled as volunteers for this study. As an inclusion criterion, only individuals who had some teeth remaining in the mandibular arch (up to premolars) were selected, in order to allow manual articulation of the casts by the presence of tripod support and horizontal stability. Stock trays were individualized with utility wax (Wilson; Polidental, São Paulo, SP, Brazil) and impressions of the upper and lower arches were obtained with irreversible hydrocolloid (Jeltrate, Dentsply, Petrópolis, RJ, Brazil). The master casts were prepared with type IV stone plaster (Velmix; Kerr, Orange, CA, USA) poured in the region of the teeth, and type III stone plaster (Herodent; Vigodent, Rio de Janeiro, RJ, Brazil) that formed the base, and the casts were reproduced with reversible hydrocolloid (Vipi, Pirassununga, SP, Brazil). Five cast pairs (upper and lower arches) were obtained for each patient, in such a way that each tested combination of materials would be represented by a pair of casts with their own standard measurements for evaluation. The following combinations of materials were compared for interocclusal records:

1) Acrylic resin base (Clássico; Artigos Odontológicos Clássico Ltda, São Paulo, SP, Brazil) + #7 wax (Wilson; Polidental)
2) Acrylic resin base + #7 wax + ZOE paste (Horus; Herpo, Rio de Janeiro, RJ, Brazil)
3) Acrylic resin base + #7 wax + Duralay acrylic resin (Reliance, Worth, Il, USA)
4) Condensation silicone (3M/ESPE, St. Paul, MN, USA)
5) Acrylic resin plate (Clássico) + Irreversible Hydrocolloid (Jeltrate; Dentsply)

Six pairs of perforations were made with a #4 spherical bur in the lateral (areas of the 1st and 2nd molars) and anterior (between the central and lateral incisors) regions of the base of each cast pair (upper and lower models), and cannulas (25 x 7; model 22 G1; SR Produtos Hospitalares, Manaus, AM, Brazil) were introduced into the orifices and fixed with instant adhesive (Super Bonder, Loctite, Itapevi, SP, Brazil) and transparent self-polymerized acrylic resin (Clássico). The cannulas' entrances allowed adaptation of the tips of a handheld digital caliper (Mitutoyo Digimatic Caliper, model 500-151; Mitutoyo Corp, Tokyo, Japan) used to measure the vertical distance between the predetermined upper and lower perforations (Fig. 1). Thus, 6 pairs of reference points were established to perform the vertical measurements (Fig. 2).

The pair of casts of each patient was first articulated manually in maximum intercuspation and fixed with rigid wooden rods and compound. Vertical distances between the pairs of reference points were measured and used as comparative standard for the measurements obtained with interposition of the registrations. Retentive areas of the lower casts were relieved for preparation of five self-polymerized acrylic resin bases. Cylinders of #7 wax were softened with a heated spatula and set in place during the clinical procedures. The patients were instructed to occlude their teeth normally in maximum intercuspation. Excess

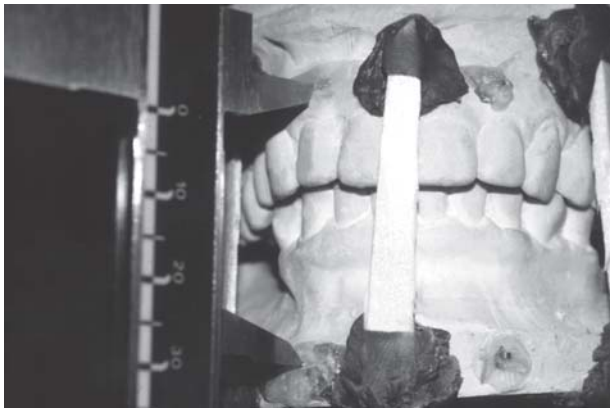

Figure 1. Vertical measurements of the articulated casts with a handheld digital caliper.

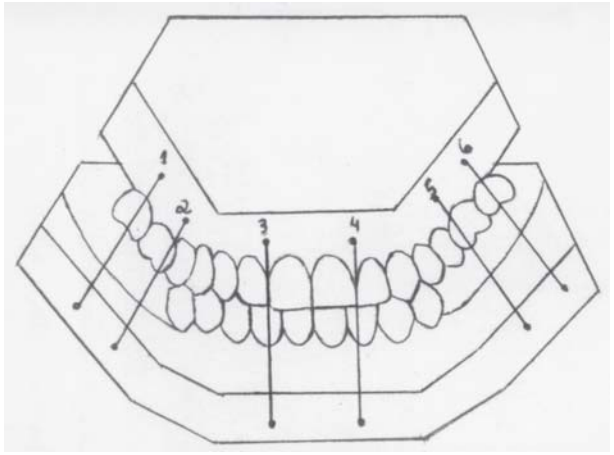

Figure 2. Pairs of reference points for vertical measurements.

wax was removed and the procedure was repeated. After water spray cooling, the records were removed and kept in a humidifier until for reading. In a second stage, the records were interposed between the casts and fixed with wooden rods and compound, so that the measurements could be made.

The records made using acrylic resin + wax + ZOE paste combination and the records made using the acrylic resin + wax + Duralay combination were obtained as described above, except for the fact that a relief was made in the cooled wax cylinders to create space for placement of small quantities of ZOE paste or Duralay on the cusp impressions of the right and left sides.

For the records made with condensation silicone, the material was divided into two equal parts placed in the right and left edentulous regions of the lower arch and the patients were instructed to occlude normally in maximum intercuspation (Fig. 3). After setting of the material, the records were removed and stored in sealed plastic bags with no humidity until reading (9).

Figure 3. Interocclusal record with condensation silicone.

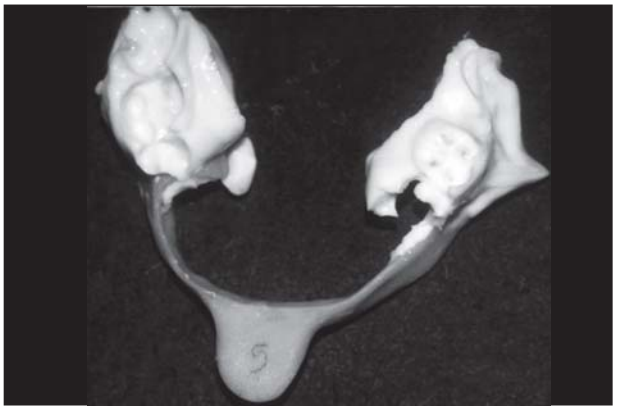

Figure 5. External view of the acrylic resin plate with irreversible hydrocolloid.

Five self-polymerized acrylic resin plates were prepared to obtain interocclusal records with irreversible hydrocolloid. Rolls of #7 wax (of uniform thickness) were placed on the alveolar margin crest to create space for the alginate under the plate. Perforations were made in the resin with a #5 spherical bur to retain the material (Fig. 4). Small portions of alginate were placed above and below the resin plate. After the material jelled, the records were removed (Fig. 5) and kept in a humidifier until reading.

Special care was taken not to change the vertical dimension of occlusion at the moment of interoccusal recording. Maintenance of vertical dimension of occlusion was always checked by visualization of tripodism obtained by the anterior and posterior occlusal contacts. Data were analyzed statistically by analysis of variance and Tukey's test for individual comparisons. Significance level was set at 5%. Square root transformation was done to allow the use of parametric statistical tests.

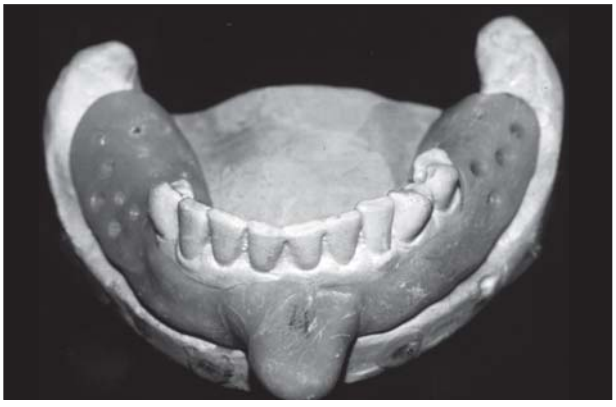

Figure 4. Perforated acrylic resin plate.

RESULTS

Analysis of variance showed significant differences in vertical distance among the combinations of materials under study.

Tukey's test showed that the condensation silicone differed significantly at 5% level from the acrylic resin + wax combination. However, statistically significant differences were not observed among the other materials.

Figure 6 illustrates the differences between the measurements obtained with the interocclusal records and the standard measurements.

DISCUSSION

In all cases of prosthetic rehabilitation, accurate diagnosis, proper planning and correct execution of clinical and laboratory procedures are mandatory for high-quality results. Moreover, successful treatment is highly dependent on precise mounting of the casts in the articulator. Thus, intermaxillary recording plays an extremely important role in final results.

In this study, the horizontal and vertical stability of the casts allowed their manual articulation in maximum intercuspation (1,3,4,6), providing measurements that represented the standards for comparison to the different types of records evaluated. Therefore, the method permits the transposition of the results obtained to edentulous cases that require intermaxillary records for mounting in maximum intercuspation when the stability factors are not present, or in centric relation.

Condensation silicone is extensively used for interocclusal records (10). In this study, however, silicone presented the highest mean value of vertical separation between casts, although it did not differ significantly from the combinations of materials under study (except for acrylic resin base plus wax). Figure 6 shows that condensation silicone presented the greatest differences compared to the standards. These results are consistent with those reported by other authors, who stated that elastomers may suffer distortion at the time of cast joining, due to the compressive force generally exercised to maintain the casts in position (5,11,12).

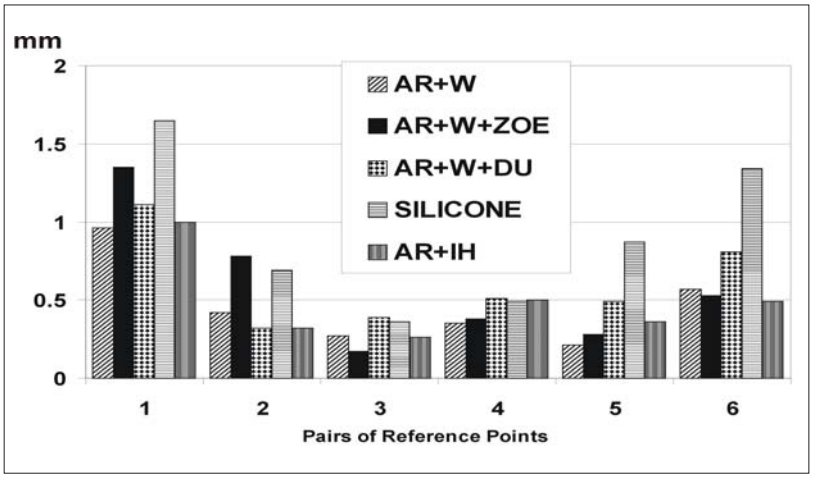

Figure 6. Differences between the measurements obtained with the interocclusal records and the standard measurements at the 6 pairs of reference points.

Duralay acrylic resin is a material with great dimensional stability, rigidity, precision in the reproduction of details, ease of handling and favorable degree of hardness during the setting process, which does not offer resistance to mandibular closure (13,14). In spite of these advantages, the combination of acrylic resin + wax + Duralay presented the second highest mean value of vertical separation between casts, even though it did not differ statistically from the other material combinations. Figure 6 shows that the differences obtained with this combination of materials were more marked at the reference points 3, 4, 5 and 6.

Although the association of acrylic resin base + wax + ZOE paste is widely used in daily clinical practice because the zinc-eugenol paste provides a rigid stop point, prevents mandibular deflection and promotes refined records (15,16), in this study this combination presented the third highest mean values of vertical separation between casts, although nonsignificant differences were found from the other material combinations. Despite its favorable properties, ZOE is a brittle material that strongly adheres to the dental surface due to contractions and, in the presence of excesses, it may suffer rupture and distortion and cause vertical displacement (9,17,18). In cases of edentulous areas, the ZOE paste in combination with the register base tends to dislocate the underlying mucosa, resulting in articulator mounting with a slight vertical opening (19).

The combination of acrylic resin plate + irreversible hydrocolloid presented the fourth lowest mean value of vertical separation between the casts, although, again, the difference was nonsignificant compared to the other combinations of materials. Figure 6 shows that this association of materials had a similar behavior to that of the acrylic resin base + wax combination at the reference points 1, 3 and 6.

The use of wax as a interocclusal recording material has been debated because it reportedly causes mandibular deflection, resistance to closure and distortions with changes in temperature (3,9,14,20). Notwithstanding the criticisms, this is still the most often

used material in daily clinical practice because of its ease of handling, clinical versatility and low cost (3,18). In this study, the combination of acrylic resin and wax presented the lowest mean value of vertical separation between casts.

In conclusion, the combination of acrylic resin base and wax for interocclusal record yielded the least differences in comparison to the measurements obtained by manual articulation of the casts, i.e., it was the combination of materials that best reproduced the position occurring in the oral cavity. Intermaxillary record with condensation silicone (putty) produced the greatest differences compared to manual articulation of the casts. From the combination of materials investigated in this study, the following scale of fidelity can be settled from best to worst result: acrylic resin base + wax; acrylic resin plate + alginate; acrylic resin base + wax + zinc oxide-eugenol paste; acrylic resin base + wax + Duralay; and condensation silicone.

RESUMO

Cinco combinações de materiais comumente utilizados para registros intermaxilares em casos de extremidades livres bilaterais foram avaliados: base de resina acrílica + cera; base de resina acrílica + pasta zincoenólica; base de resina acrílica + cera + resina Duralay; silicona de condensação; e placa de resina acrílica + hidrocolóide irreversível. Foi realizada a medida da distância vertical entre pontos referenciais em 6 regiões nas bases dos modelos articulados. As medidas obtidas com a articulação manual dos modelos foram tomadas como padrão de comparação para as medidas obtidas com os materiais testados. Os resultados foram submetidos à análise estatística por meio de análise de variância e teste de Tukey. Houve diferença estatisticamente significante ($p<0.05$) entre a silicona de condensação e a combinação da base de resina acrílica + cera, porém entre os demais materiais não houve diferença estatisticamente significante. A silicona de condensação apresentou as maiores diferenças em relação às medidas obtidas pela articulação manual dos modelos e a combinação da base de resina acrílica + cera apresentou as menores diferenças. Com base nos achados deste estudo, a seguinte escala de reprodutibilidade pode ser estabelecida, do melhor para o pior: base de resina acrílica + cera; placa de resina acrílica + hidrocolóide irreversível; base de resina acrílica + cera + pasta zincoenólica; base de resina acrílica + cera + resina Duralay; e silicona de condensação.

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