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Occlusal Changes in Complete Dentures Processed by Pack-and-Press and Injection-Pressing Techniques

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Abstract - *Ten pairs of stone casts were mounted in an articulator using a standardized maxillomandibular relation, on which trial dentures were constructed. Two groups were established: GI- pack-and-press technique; GII- injection-pressing technique. Intermaxillar contacts were marked and counted, and the contact between incisal pin and incisal table was measured, before and after the processing. The average contact loss after the processing was 37.85% (GI) and 20.8% (GII). The average incisal pin opening after the processing was 1.3mm (GI) and 0 (GII). Data differed statistically (Mann-Whitney's test,* $p<0.05$*). The injection-pressing system was superior according to contact loss and incisal pin opening.*

KEY WORDS: Acrylic resin, Polymerization, Occlusion

INTRODUCTION

During the rehabilitation of edentulous patients, many factors should be observed in order to improve the success of treatment with complete dentures. Among the most important factors, the occlusal stability has an important role and can be obtained with the highest number of intermaxillary contacts during the artificial teeth positioning in wax, by the use of a semi-adjustable articulator. However, this stability in wax is rarely observed when the dentures are ready for patient use. This problem probably occurs during the polymerization of the acrylic resins, and results from dimensional changes in this material[1–8]. Since the dentures have different thickness areas, the dimensional alteration may cause complex alterations in the final product[3,6,8]. It can also be aggravated by the presence of artificial teeth, palatal form[2,7], and other variables introduced during the different steps for the making of a denture, such as investing media; monomer/polymer ratio; polymerization cycles; packing techniques and wax instability[3,9–13].

In order to minimize the dimensional changes in dentures, an injection polymerization system was introduced in 1942[14]. This system compensates the shrinking of the acrylic resin by the continuous injection of resin under pressure during the polymerization process. Research conducted by others compared this process with the pack-and-press technique, examining the dimensional alterations produced by both methods, and found the injection moulding system superior[1,2,5,6,12,15–17,19–22]. The dimensional changes can also affect the previously established occlusion vertical dimension (OVD), which can be measured by the distance between the incisal pin and the incisal plate[4,5,11,12,17,18,20].

The literature lacks information on occlusal changes[10–12,18] (distribution of contacts and loss of contacts before and after processing) and methods for evaluating these changes. This study introduces a technique to standardize the procedures of denture setting in the articulator evaluating the changes before and after denture processing and, moreover, analyzing the loss of occlusal contacts, a fact observed in clinical practice.

The purpose of this study was to compare two different processing techniques, pack-and-press and injection moulding, regarding the loss of occlusal contacts and incisal pin opening, verifying if they have the same performance.

MATERIAL AND METHODS

For the analysis, a method was developed in order that the casts could be removed and repositioned in the articulator, even after the dentures were processed. With the repositioning of the casts, it was possible to count the number of occlusal contacts before and after the polymerization, establishing a new method to evaluate the changes that occurred during the processing of acrylic resins. For the incisal pin opening, other authors made this kind of analysis[4,5,11,12,17,18,20,22].

Sample preparation

Metallic casts with an standardized specific maxillomandibular relation (30° of occlusal plan inclination) were specially made for this study. The semi-adjustable articulator (Bio-Art) had magnetic plates and on these, the metallic casts were positioned by using metallic discs bonded to their bases.

Both the metallic casts and the metallic disc were reproduced with laboratory silicone (Zetalabor), confined in a metallic flask to prevent distortion during the stone pouring (Durone). It is important to emphasize that the negative print of the metallic discs on the silicone was filled with new metallic discs before the pouring of the stone. This procedure was repeated ten times for each cast (maxillary and mandibular) and resulted in ten copies of the metallic casts with the standard maxillomandibular relation.

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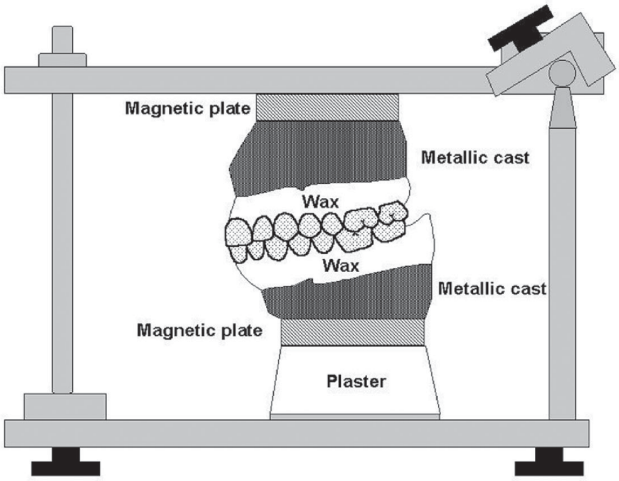

Figure 1. *Set up of casts in articulator and artificial teeth positioning system used in all samples.*

On each cast, 1 mm thick plastic vacuum trial bases (Bio-Art) were made using a plastic vacuum Plastivac P6 (Bio-Art). On these the wax and artificial teeth (Ivostar/Gnathostar) were positioned, as shown in *Figure 1*. With a silicone pattern made on the initial artificial teeth positioning, all specimens had their artificial teeth and wax contours similar to the first one. All specimens were reproduced and stored in the same temperature conditions (21°C). This procedure was made in order that the results could be comparable among specimens, since the tooth movement in the wax, would be similar in all specimens.

Register of the number of occlusal contacts and incisal pin checking

Before counting the number of occlusal contacts, the relation of the incisal pin with the incisal plate was checked with the interposition of a polyester film (Herpo) and the articulator was locked. The occlusal contacts were marked with articulating film (AccuFilm II)[17]. A calibrated investigator counted the maxillary and mandibular marked contacts, and divided by two, in order to obtain the arch average number of contacts. These values were recorded in tables for the analysis of contact loss.

Test groups

The samples were split into two groups containing five samples each:

- Group I (control): Processed in a conventional brass flask by the pack-and-press technique in water bath (73°C for 9 h) with a pressure of 1.25 ton (psi). The resin used was a pink SR Triplex Hot (Ivoclar) and the topping was made with laboratory polyvinylsiloxane.
- Group II: Processed in an injection moulding system (SR-Ivocap, Ivoclar) following the manufacturer's instructions (100°C during 35 minutes under continuous injection pressure of 6 bar). The acrylic resin used was the pink SR-Ivocap (Ivoclar).

Data analysis

After deflasking, the stone casts were repositioned in the articulator by the magnetic plates and metallic discs. Three different investigators verified the repositioning, in order to assure that a full contact between the magnetic plates and the casts were kept. The repositioning was made without finishing and polishing, and also without separation of the dentures from the casts.

A new contact counting was made by the same method described previously. The relation between the initial number of contacts and the final number of contacts was converted into percentage numbers and submitted for the Mann-Whitney's U test ($p<0.05$).

The relation of the incisal pin and the incisal guide plate was checked again with the interposition of a polyester film, and in the presence of opening, this was measured with a digital calliper (500-193U, Mitutoyo UK). These data were also analysed by the Mann-Whitney's U test ($p<0.05$). It is important to emphasize that during all procedures, the same articulator was used.

RESULTS

The average percentage of contact loss was 37.85% for Group I and 20.8% for Group II. The data were compared using the Mann-Whitney's U test ($p<0.05$), which showed statistical differences between the groups. Regarding the incisal pin opening, the results were 1.3mm (s=0.295) for Group I and no opening for Group II (s=0), being the data also analysed by the Mann-Whitney's U test ($p<0.05$). Differences were also observed in this case.

DISCUSSION

Despite the importance of analyzing occlusal changes during complete denture processing, this information was lacking in the literature[10–12], particularly regarding the loss of occlusal contacts. However, this fact is often observed in clinical practice and needs to be evaluated, as it is known that the higher the number of occlusal contacts between maxillary and mandibular dentures, the better the stability gained in the prosthetic treatment[15]. Considering the lack of information on occlusal contact loss, a unique method for this kind of evaluation was specifically developed in this work, distinct from the other methods employed in the literature review.

In the present study, the testing of the incisal pin showed better results for the injection moulding system than the pack-and-press method, since the first did not present any change, while for the second procedure an average opening of 1.3 mm was identified. The data is in agreement with most authors[5,17,19,20,22]. However, it disagrees with the study of Garfunkel[4], which, although confirming the superiority of the injection moulding system regarding horizontal changes, concluded that the pack-and-press method is better when analyzing the vertical changes. Certainly, vertical pin opening can be a function of horizontal cusp movement that could create interference or, as observed in the present study, eliminate occlusal contacts verified before the polymerization of the resin. This can explain why, despite the absence of incisal pin opening, the injection moulding system had loss of about 20% of the contacts. However, this loss was significantly lower than the loss of contacts found in the pack-and-press method.

Data from the vertical changes and occlusal changes assert the superiority of the injection pressing system a fact already described by other authors[1,2,5,6,12,15–17,19,22]. All available data, from the present study and from others, suggest that the use of the injection system under manufacturer's instructions results in better dentures, decreasing the time spent in the occlusal adjustment[17,19,20].

Obviously there are limitations with this method, since the making of a denture is a complex process, which requires standardization of artificial teeth positioning and the comprehension of wax instability. Other authors have noted these limitations[2–4,11,13,18]. To decrease the influence of these limitations, all specimens were stored at the same temperature conditions, in order that the results would be consistent. The making of complex specimens with areas of different thickness and presence of artificial teeth makes the standardization difficult but produces a situation similar to that found in clinical practice[2].

From this, it can be suggested that further studies evaluating the movement of artificial teeth, both in horizontal and vertical plains, and also the influence of the materials and techniques used are required. Moreover, the laboratory results presented here should be analyzed with patients, in order to define whether the percentage of contact loss identified has a clinical significance.

CONCLUSION

Under the experimental conditions of this study, it was concluded that the injection moulding system showed better results according to the loss of occlusal contacts, when compared to the pack-and-press technique, and also presented better results according to the incisal pin opening.

MANUFACTURERS' DETAILS

- Semi-adjustable articulator, Bio-Art, São Carlos, São Paulo, Brazil
- Laboratory polyvinylsiloxana, Zetalabor, Zhermack, Badia Polesine, Rovigo, Italy
- Stone, Durone, Dentsply, Petrópolis, Rio de Janeiro, Brazil
- Plastic vacuum trial bases, Bio-Art, São Carlos, São Paulo, Brazil
- Thermo heated vacuum device, Plastivac P6, Bio-Art, São Carlos, São Paulo, Brazil
- Artificial teeth, Ivostar/Gnathostar, Ivoclar, Liechtenstein, Germany
- Polyester film, Herpo, Rio de Janeiro, Rio de Janeiro, Brazil
- Articulating film, AccuFilm II, Parkell, Farmingdale, New York, USA
- SR Triplex Hot acrylic resin, Ivoclar, Liechtenstein, Germany
- Injection moulding system, SR-Ivocap, Ivoclar, Liechtenstein, Germany
- SR-Ivocap acrylic resin, Ivoclar, Liechtenstein, Germany
- Digital calliper, 500-193U, Mitutoyo UK, Telford, UK

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REFERENCES

1. Anderson, G.C., Schulte, J.K. and Arnold, T.G. Dimensional stability of injection and conventional processing of denture base acrylic resin. *J. Prosthet. Dent.,* 1988; **60**:394–398.
2. Salim, S., Sadamori, S. and Hamada, T. The dimensional accuracy of rectangular acrylic resin specimens cured by three denture base processing methods. *J. Prosthet. Dent*., 1992; **67**: 879–881.
3. Wolfaardt, J., Cleaton-Jones, P. and Fatti, P. The influence of processing variables on dimensional changes of heat-cured poly (methyl methacrylate). *J. Prosthet. Dent*., 1986; **55**:518–525.
4. Garfunkel, E. Evaluation of dimensional changes in complete dentures processed by injection-pressing and the pack-and-press technique. *J. Prosthet. Dent*., 1983; **50**:757–761.
5. Sykora, O. and Sutow, E.J. Comparison of the dimensional stability of two waxes and two acrylic resin processing techniques in the production of complete dentures. *J. Oral Rehabil.,* 1990; **17**:219–227.
6. Latta, G.H., Bowles, W.F. and Conkin, J.E. Three-dimensional stability of new denture base resin systems. *J. Prosthet. Dent*., 1990; **63**:654–661.
7. Abuzar, M.A.M., Jamani, K. and Abuzar, M. Tooth movement during processing of complete dentures and its relation to palatal form. *J. Prosthet. Dent.,* 1995; **73**:445–449.
8. Jamani, K.D. and Abuzar, M.A.M. Effect of denture thickness on tooth movement during processing of complete dentures. *J. Oral Rehabil.,* 1998; **25**:725–729.
9. Anusavice, K.J. *Philip's Science of Dental Materials.* 11th edn. London; Sanders, 2003, Chapter 22.
10. Grant, A.A. Effect of the investment procedure on tooth movement. *J. Prosthet. Dent.,* 1962; **12**:1053–1058.
11. Zakhari, K.N. Relationship of investing medium to occlusal changes and vertical opening during denture construction. *J. Prosthet. Dent.,* 1976; **36**:501–509.
12. Mainieri, E.T., Boone, M.E. and Potter, R.H. Tooth movement and dimensional change of denture base materials using two investment methods. *J. Prosthet. Dent*., 1980; **44**:368–373.
13. Shetty, N.S. and Udani, T.M. Movement of artificial teeth in waxed trial dentures. *J. Prosthet. Dent.,* 1986; **56**:644–648.
14. Pryor, W.J. Injection molding of plastics for dentures. *J. Am. Dent. Assoc.,* 1942; **29**:1400–1408.
15. Ghazali, S.E., Glantz, P. and Randow, K. On the clinical deformation of maxillary complete dentures. *Acta Odontol. Scand*., 1988; **46**:287–295.
16. Huggett, R., Zissis, A., Harrison, A. and Dennis, A. Dimensional accuracy and stability of acrylic resin denture bases. *J. Prosthet. Dent.,* 1992; **68**:634–640.
17. Nogueira, S.S., Ogle, R.E. and Davis, E.L. Comparison of accuracy between compression-molded complete dentures. *J. Prosthet. Dent.,* 1999; **82**:291–300.
18. Wesley, R.C., Henderson, D., Frazier, Q.Z., *et al.* Processing changes in complete dentures: Posterior tooth contacts and pin opening. *J. Prosthet. Dent.,* 1973; **29**:46–53.
19. Trage, R. Experience gained with the SR-Ivocap system. *Quintessence Int.*, 1980; **11**:23–28.
20. Strohaver, R.A. Comparison of changes in vertical dimension between compression and injection molded complete dentures. *J. Prosthet. Dent*., 1989; **62**:716–718.
21. Kalipçilar, B., Karaagaçlioglu, L. and Hasanreisoglu, U. Evaluation of the level of residual monomer in acrylic denture base materials having different polymerization properties. *J. Oral Rehabil*., 1991; **18**:399–401.
22. Keenan, P.L.J., Radford, D.R. and Clark, R.K.F. Dimensional changes of dentures fabricated by injection molding and microwave processing. *J. Prosthet. Dent*., 2003; **89**:37–44.