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ORIGINAL ARTICLE

Effect of three investing materials on tooth movement during flasking procedure for complete denture construction

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KEYWORDS

Maxillary complete denture;
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Tooth movement

Abstract *Problem statement:* Tooth movement has been shown to occur during and after the processing of complete dentures. An understanding of this phenomenon may permit one to construct functional complete dentures that require less occlusal adjustment in the articulator and in the patient's mouth.

Purpose: The purpose of this study was to examine the effects of three different investing methods on tooth movement occurring during the processing of simulated maxillary complete dentures.

Material and methods: Forty-five similar maxillary dentures were made using heat-polymerized acrylic resin, and assigned randomly to three experimental groups (n = 15 each) according to investing method: plaster–plaster–plaster (P–P–P), plaster–stone–stone (P-S-S), and plaster–mix (P–M). Specimens in all experimental groups were compression molded with denture base resin. Transverse interincisor (I–I) and intermolar (M–M) distances, and anteroposterior incisor–molar (LI–LM and RI–RM) distances, were measured with digital calipers at the wax denture stage (pre-polymerization) and after denture decasting (post-polymerization). Analysis of variance and Tukey's test were used to compare the results.

Results: M–M, LI–LM, and RI–RM movement was significantly greater in the P–P–P group than in the P–S–S and P–M groups; no significant difference in I–I movement was observed among groups. Transverse movement along M–M and I–I was significantly greater than anteroposterior movement in the P–P–P group; no significant difference among measurements was observed in the other two groups.

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Conclusion: The study results indicate that the use of dental stone or a 50:50 mixture of plaster and stone for investing of dentures is an important factor in efforts to control the magnitude of tooth movement.

1. Introduction

Acrylic resin remains the most commonly used material for denture base construction (Zarb et al., 2004). It has good physical, mechanical, and esthetic properties, and it is easy to use with low-cost equipment (Arora et al., 2011a). However, this material does not fulfill all requirements for an ideal denture base material (Arora et al., 2011b; Zarb et al., 2004). Many researchers have shown that acrylic resin can undergo deformation when processed dentures are removed from the cast; this processing deformation is considered to be a major disadvantage (Becker et al., 1977a; Chen et al., 1988).

The quality of a complete denture is affected by several processing variables that may cause base distortion and consequent alteration of tooth position (Kimoto et al., 2005; Skinner and Cooper, 1943; Teraoka and Takahashi, 2000; Wong et al., 1999). These factors include acrylic and investing medium types, method of resin introduction, and temperature used to activate polymerization (Skinner and Cooper, 1943). In efforts to overcome these undesirable processing effects, various flasking and polymerization techniques and materials have been studied (Shibayama et al., 2009). Rudd (1969) indicated that the use of artificial stone as an investing medium can significantly reduce tooth movement. Another study showed that the use of a silicone investment layer when flasking complete dentures resulted in the smallest changes in artificial tooth position, regardless of polymerization technique (Shibayama et al., 2009).

Differences in denture base thickness have also been found to lead to variation in tooth movement (Jamani and Moligoda Abuza, 1998). Flask closure method and post-pressing time were reported to be important factors affecting tooth displacement (Negreiros et al., 2009). However, reported data on investing materials and methods are very inconsistent (Baydas et al., 2003; Wong et al., 1999; Zakhari, 1976). The objective of this in vitro study was to compare movement of teeth during the processing of simulated complete maxillary dentures using three different investing methods and the compression molding technique. The study hypothesis was that tooth displacement would not be affected by investing method.

2. Material and methods

After performing a power analysis using G*Power version 3.1.5 to determine the required sample size, 45 identical maxillary stone casts were prepared using a silicone mold (Vertex Castil 21; Vertex Dental, Zeist, The Netherlands) of a master edentulous maxillary cast with no irregularity on the alveolar ridge surfaces. The casts were made of artificial stone (Durguix hard natural stone; Protechno, Gerona, Spain) and the water: powder ratio was 28 ml:100 g. A record base (thickness = 2 mm) was made of auto-polymerizing acrylic resin (Vertex Dental) on the master cast, according to a previously described method (Reeson and Jepson, 1999; Winkler et al., 1971). An occlusal wax rim (height = 20 mm) was created in the buccal sulcus of the cast, and the height was reduced gradually to 10 mm in the second molar area.

Acrylic resin denture teeth (MAJOR-DENT; Major Prodotti Dentari S.P.A., Moncalieri, Italy) were arranged on the cast. The arrangement of the left anterior teeth began with the carved wax rim serving as a guide for the positioning of the central and lateral incisors and canine. The same procedure was applied on the right side. The posterior teeth were arranged starting with the first premolar and continuing through the second molar. The same procedure was applied in the right arch. A wax-up was used to form the polished surfaces of the upper dentures. Replicate dentures were made using a silicone matrix (Fig. 1). Two sprue holes were prepared in the resulting mold.

After the placement of artificial teeth and prepared stone casts in the matrix, molten pink base-plate wax (modeling wax; Vertex Dental) was poured into the matrix and allowed to cool before removal. All sets of teeth were from the same mold. Simulated metallic reference pins were placed in the artificial teeth at the mesial aspects of the central grooves of the first molars, and upright on cingula of both central incisors (Molligoda Abuzar et al., 1995) (Fig. 2). Intermolar (M–M) and interincisor (I–I) transverse distances, and anteroposterior distances from the incisors to the molars (LI–LM and RI–RM), were measured with digital calipers (Mitutoyo Corporation, Kanagawa, Japan), which can record changes as small as 0.01 mm (Barbosa et al., 2002) (Fig. 3). The measurements were made at the wax denture stage (pre-polymerization) and after denture decasting (post-polymerization). Differences between the final and initial measurements indicated tooth movement.

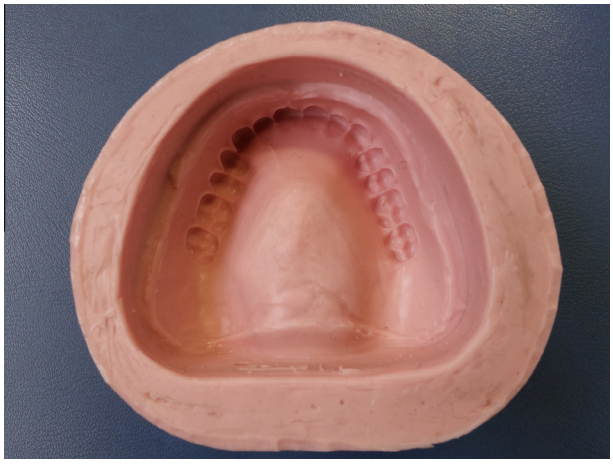

Figure 1 The silicone matrix.