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Original Article

Comparison of impression techniques and double pouring by dental cast's accuracy. Preliminary clinical-lab trial

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Aim: This study compared impression techniques and double pouring by means of cast's accuracy. **Methods:** For each patient (n=10), impressions from right maxillary canine to first molar were made with acrylic resin trays and vinyl-polysiloxane using one single-step, and four two-steps techniques: relief with poly(vinyl chloride) film; tungsten-carbide bur/scalpel blade; small movements of the tray; non-relief. Total visible buccal surface area of crowns was measured three times using photographs from patients (*Baseline*) and casts. Mean area values (mm^2) between *Baseline* and casts differences were analyzed by two-way repeated-measures ANOVA (α=.05; 1-β=85%). **Results:** No significant differences were observed for *Impression Techniques* (*P*=.525), *Double Pouring* (*P*=.281), and their interaction (*P*=.809). **Conclusion:** All impression techniques and double pouring produced casts with similar accuracy.

Keywords: Dental impression materials. Dental impression technique. Photography, dental. Dimensional measurement accuracy.

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Introduction

Dimensionally accurate impression is an integral step for fabricating well-fitting restorations. Among elastomeric materials, vinyl-polysiloxane (VPS) stands out due to its excellent chemical and physical properties[1]. Although impressions can be made with custom or stock trays, the optimum accuracy is obtained with the custom ones[2]. However, regarding the techniques, there is no consensus with respect to the best one.

To fabricate fixed prostheses, stone dies must be made for improving marginal fit of crowns. Although current techniques for making removable dies have become more accurate, cutting a stone die out may result in dimensional change between abutments[3]. Therefore, producing more than one cast from the same impression is an option for preserving marginal fit. This study aimed to compare impression techniques and double pouring by means of cast's accuracy.

Materials and Methods

For each recruited patient (n=10; Table 1), impressions from right maxillary canine to first molar were made (Chart 1) with partial trays (Figure 1) and VPS material

Table 1. Criteria used for patients' recruitment accepted by the Araraquara Dental School Research and Ethics Committee (#75/11-FOAr/UNESP).

Criteria of Inclusion	*Criteria of Exclusion*
Age between 18-80 years	Pregnancy
Absence of caries and/or periodontal disease in the maxillary right quadrant.	Allergic reaction known and informed of any material used.
Teeth of the right maxillary quadrant healthy or with satisfactory direct restorations.	Periodontal disease or impaired by caries / trauma / unsatisfactory restorations of the teeth of interest.
	Use of orthodontic braces.
	Concurrent or recent participation in another clinical study.

Chart 1. Impression techniques.

Impression Techniques	Codes	Descriptions
Single-step	SS	1) Putty and light body materials were used simultaneously.
Poly(vinyl chloride) (PVC) film	PVC	1) A sheet of PVC film covered the putty body material and it was removed after the impression has been taken off from the oral cavity. 2) Putty body material was relined with light body material.
Tungsten carbide bur / scalpel blade	BUR	1) After impression with putty body material, the axial region of the teeth was worn (5 s) with a slow-speed tungsten carbide bur (maxicut #1520; Edenta AG,). A scalpel blade (15C; Swann Morton Ltd.) was used to cut the inter-proximal embrasures. 2) Putty body material was relined with light body material.
Small movements of the tray	MOV	1) Putty body material was inserted in the oral cavity and compressed in the interested area. Buccal-lingual small movements of the tray were made (5 s) until material's polymerization. 2) After impression was removed from the oral cavity, putty body material was relined with the light body material.
Non-relief	NR	1) Putty body material was compressed in the interested area. 2) The impression was removed from the oral cavity and relined with the light body material.

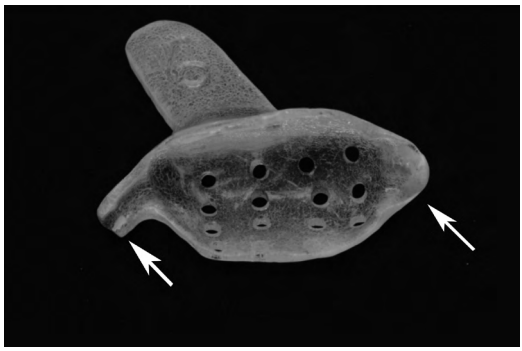

Figure 1. Custom acrylic resin partial tray. To standardize the thickness of the impression material (2.0-mm relief), the seating position, and to limit the pressure over the tray, extensions were made on the right maxillary lateral incisor and second molar (arrows). The trays were obtained and maintained in distilled water at 37ºC one week before impressions.

(Express XT, 3M ESPE). A single operator randomly made the impressions following the CONSORT statement. After the waiting time (120 min) recommended by the VPS manufacturer, casts were poured using vacuum mixed (Turbo Mix, EDG Equipment and Controls Ltd) type-IV gypsum (GC Fuji Rock EP, GC Europe), following the recommended water/powder ratio by its manufacturer. After removal of the first cast, the second pouring employed these same parameters, waiting 120 min as an elastic recovery time.

Three intra-oral photographs (RAW extension, 300 dpi) of each patient were taken in lateral view with digital camera (D7000, Nikon Corporation) coupled to a ring flash (Sigma EM-140DG, Sigma Corporation) (Figure 2). The images (Figure 3) were imported into the *ImageJ* software, and the total visible buccal surface area of crowns were measured three times by a single and blind examiner to obtain the means and standard deviations. A tool of the software was used to contour the perimeter of the teeth. A maximum variance of 4% was established for the reliability use of the intra-oral images measurements (*Baseline*)[4]. These same procedures were performed to obtain experimental casts' images (Figure 4). The average area of each cast was compared with the *Baseline* values and the difference between them was expressed in mm^2.

Figure 2. View of the standardizing device/radiographic positioner with occlusal registration coupled to the camera lens to standardize the angle, focal length and framing. The occlusal registration (Pattern Resin LS, GC America) was made over the positioner, not compromising the area to be digitized.

Figure 3. Intra-oral photograph. Note the ends of the digital caliper (arrow) fixed with opening of 1.0 mm for the calibration of the *ImageJ* software (version 1.47a). Calibration was performed informing how 1.0 mm corresponded to pixels in each image, calculating the total visible surface area (mm^2) of the buccal surface through the perimeter contour of the teeth (clinical crowns).

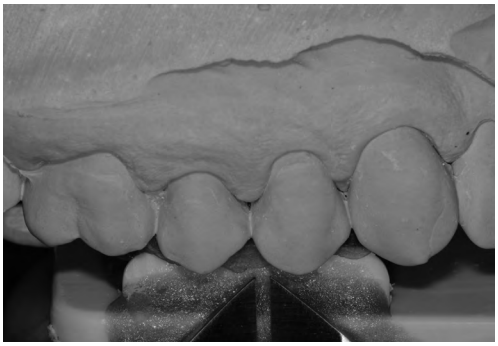

Figure 4. Cast photograph following the same standardization used intra-orally. The respective radiographic positioner was positioned over each cast. The area measurements from intra-oral photographs (*Baseline*) was compared with those obtained on the casts photographs of each respective patient.

Data were submitted to Shapiro-Wilk's and Levene's tests, followed by two-way repeated-measures ANOVA (α=.05).

Results

No statistically significant differences were observed for the *Impression Techniques* (*P*=.525), *Double Pouring (P*=.281), and their interaction (*P*=.809) (Table 2). For the nature of this investigation, since the power was 85%, the sample size was considered adequate.

Table 2. Mean area (mm^2) from the differences between *Baseline* and casts' values for each *Impression Technique* and *Pouring*.

Impression Techniques	*1st Pouring*	*2nd Pouring*
SS	1.18	-0.91
PVC	-2.68	-3.00
BUR	-2.33	-3.22
MOV	-3.77	-2.45
NR	-2.02	-3.24

Discussion

VPS material allowed double pouring without impairing cast's accuracy. Probably, the tray's rigidity and its positioning with controlled pressure reduced the bending and residual stresses in the tray's walls[2].

The proximity between *Baseline* and *SS* technique may be attributed to the thinner layer of the light-body material in comparison to that of two-step techniques. As higher as the viscosity of the material, smaller dimensional change would be expected[5]. However, a higher volume of filler content means that there is less elasticity and fluidity, resulting in lower detail reproduction[1]. Thus, it is highly recommended to use small thickness of light-body material in combination with putty-body one.

Despite correcting laboratory bias and minimizing often-clinical steps, multiple pouring can provide errors. However, in this study, there were no statistically differences between the casts, regardless of impression techniques and double pouring. Kumar et al.[6] also observed no dimensional changes between multiple casts when the elastic recovery time is respected.

One of the limitations of this study was to analyze only the buccal surface of the teeth by 2D-measurements. Conversely, this sort of evaluation is supported by authors[7], who observed no differences between 2D and 3D-analyzes. Although the major problem of most 2D-techniques is the limitation to single measurement points, both techniques (2D and 3D) can show comparable results and are in the range of the values of former studies[8,9], which used well-established methods like direct view technique used in this study. Impression techniques and double pouring did not influence the cast's accuracy. *SS* presented the closest absolute values to *Baseline* ones.

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