Evaluation of the Precision of Three Implant Transfer Impression Techniques Using Two Elastomeric Impression Materials

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A master cast representing a completely edentulous mandible was fabricated in polyurethane resin and had four implants secured to the anterior interforaminal area. Impressions were made using six technique-material combinations. Ten definitive casts were fabricated for each technique. Linear distances between implants were measured using a traveling microscope. There was no statistically significant difference between the direct unsplinted and splinted techniques (P > .05), while the indirect technique was statistically significantly different from the other two techniques (P < .05). There was no statistically significant difference between the two impression materials. Int J Prosthodont 2010;23:525–528.

Numerous scientific studies have cited the passive fit of a framework as an important prerequisite for the long-term osseointegration of implants.¹⁻⁵ Although absolute accuracy of the implant framework does not appear to be attainable, it has been suggested that the distortion of the implant framework can be minimized by controlling several steps involved in constructing an implant superstructure, especially the management of the impression material and the impression technique itself.¹ The value of using different impression techniques and materials has been reported in the literature with a high degree of controversy; while some reports support certain techniques, others have shown no preference.¹⁻⁵ The aim of this study was to evaluate the accuracy of three different impression techniques using two impression materials.

Materials and Methods

A master cast of a completely edentulous human mandible had four implants (13-mm long, 4.2-mm diameter; Microdent Implant System, Microdent) secured to the anterior interforaminal area. Sixty impressions were then made using six technique-material combinations: the indirect transfer technique with a polyvinyl siloxane impression material (PVS) (group 1), the indirect transfer technique with a polyether impression material (PE) (group 2), the direct unsplinted transfer technique with PVS (group 3), the direct unsplinted transfer technique with PE (group 4), the direct splinted transfer technique with PVS (group 5), and the direct splinted transfer technique with PE (group 6).

In group 1, the impression transfer copings were secured onto the implants and remained attached throughout the impression procedures with the PVS material (Imprint II Garant Monophase, 3M ESPE). After removal of the impression, the copings were removed from the mouth and connected using the appropriate implant analogs. The coping-analog assemblies were then transferred into their corresponding positions in the impression, with an audible "click" verifying that the assemblies had seated fully. The technique used for group 1 was also used for group 2, but with the PE impression material (Impregum F, 3M ESPE).

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Fig 1 Six measurements were made and repeated on the master cast and the 60 fabricated casts (*yellow;* AB, AC, AD, BC, BD, and CD).

Table 1	Two-way ANOVA Test Results for the
Six Measu	irements

	Two-way ANOVA					
Measurement	f	Р				
AB						
Technique	1.590	.213				
Material	0.001	.975				
Interaction	0.237	.790				
BD						
Technique	0.630	.537				
Material	1.440	.235				
Interaction	1.790	.177				
AC						
Technique	70.700	< .001*				
Material	10.600	.002*				
Interaction	7.910	.001*				
AD						
Technique	20.400	< .001*				
Material	11.700	.001*				
Interaction	15.800	< .001*				
BC						
Technique	27.800	< .001*				
Material	2.210	.143				
Interaction	3.140	.051				
CD						
Technique	1.660	.200				
Material	7.480	.008*				
Interaction	1.220	.304				

*Statistically significant.

For group 3, custom trays were made with access holes for the impression coping screws. The transfer impression copings were sandblasted with 50-µm aluminum oxide powder to roughen their external surfaces, brushed with impression material adhesive (as described previously¹), and secured to the implants. An impression was then made with the PVS impression material. Once set, the impression was removed with the transfer impression copings embedded in the impression. Implant analogs were then connected to the embedded transfer copings by fastening the screws to the master casts. The technique used for group 3 was also used for group 4, but with the PE impression material.

Splinting of the impression copings for group 5 was done using ready-made prefabricated autopolymerizing acrylic bars, according to a previously published technique.⁶ The resin bar was cut to the appropriate length, using a cutting disk, to fit between the impression copings to bridge the spaces between the adjacent transfer copings. The ends of the resin bar were luted to the transfer copings by applying autopolymerizing acrylic resin around the transfer copings with a fine brush using an incremental application technique. The technique used for group 5 was also used for group 6, but with the PE impression material.

Cast Measurement

Sixty casts were fabricated (10 for each technique) and poured using American Dental Association-certified type IV dental stone. A traveling microscope (Carl Zeiss) with an accuracy of \pm 0.002 mm, according to the manufacturer, was used to measure the interimplant distances.

Six measurements were made between the center of the four gingival healing formers and were referred to as AB, AC, AD, BC, BD, and CD (Fig 1). Each distance was measured three times on the master cast and the 60 fabricated casts by the same operator, and their means were calculated. These means were considered to be the distances measured and were used for statistical analysis.

Results

For comparison between the techniques and the master cast, the Student *t* test was applied for the six groups (Figs 2a to 2f), while comparisons between the different techniques and materials were done using two-way analysis of variance (ANOVA) and the Tukey test (Tables 1 and 2). For casts in which the two-way ANOVA interaction term was significant (the effects of the impression technique and impression material were not concluded directly from two-way ANOVA

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Fig 2 Results of the Student *t* test between the six groups and the master cast at distances (a) AB, (b) AC, (c) AD, (d) BC, (e) BD, and (f) CD. Test value = the master cast; Tec 1 = group 1; Tec 2 = group 2; Tec 3 = group 3; Tec 4 = group 4; Tec 5 = group 5; Tec 6 = group 6.

	Mean difference	Standard error	Р	Lower bound	Upper bound
Direct unsplinted technique					
Direct splinted technique	-8.10e-03	1.63e-02	.873	-4.74e-02	3.12e-02
Indirect technique	0.101	1.63e-02	< .001	6.17e-02	0.140
Direct splinted technique					
Direct unsplinted technique	8.10e-03	1.63e-02	.873	-3.12e-02	4.74e-02
Indirect technique	0.109	1.63e-02	< .001	6.98e-02	0.148
Indirect technique					
Direct unsplinted technique	-0.101	1.63e-02	< .001	-0.140	-6.17e-02
Direct splinted technique	-0.109	1.63e-02	< .001	-0.148	-6.98e-02

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Fig 3 Profile of mean (a) AC and (b) AD distances of the two factors (material and technique). PVS = polyvinyl siloxane; PE = polyether.

test results), profile plots of mean measurements in different study groups were inspected visually to help explain the two-way ANOVA results (Fig 3).

Discussion

It is essential that implant prosthodontic work be done on a master cast that reproduces, as accurately as possible, the position of the implants in the patient's mouth.⁴

In this study, there was no statistically significant difference between PVS and PE regarding accuracy, especially when used with the direct unsplinted and splinted techniques, which is in agreement with previous studies.^{2,4} The superior behavior of PVS over PE, as shown in Fig 3, suggests that PVS gives more accurate impressions with the indirect technique, similar to the conclusions of Valle et al.⁵

The results of this study agreed with other studies that the direct unsplinted and splinted techniques provide comparable accuracy (mean difference: 8 µm) and are both more accurate than the indirect technique (mean difference: \geq 100 µm).^{1,3}

Conclusions

Due to the limitations of this study, repeated measurements were taken to assure the accuracy of the measurements from the master cast and the 60 fabricated casts. Both direct splinted and unsplinted techniques are more accurate than the indirect technique for multiple implant impression transfer procedures. PVS and PE provide comparable accuracy, but PVS is more accurate when used with the indirect technique.

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