Accuracy of Successive Casts for Full-Arch Fixed Prostheses

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This clinically simulated study examined the accuracy of full-arch impression materials using successive casts reproduced from single impressions. Materials tested included a polyether polyvinyl siloxane, medium viscosity material, and putty wash. Maxillary full-arch Dentoform models were created with four abutments prepared for complete crowns. Six impressions of each material produced successive first and second generation casts. Individual cast copings were then fabricated and assembled into full-arch fixed dental prostheses. Marginal discrepancies were measured on both the casts and Dentoform. Data analysis suggests insignificant differences between successive casts. However, among second generation casts, clinically similar marginal discrepancies were exhibited. Outcomes demonstrated that second generation casts enabled fabrication and assembly of full-arch restorations that were clinically equivalent to first generation casts obtained. *Int J Prosthodont 2010;23:446–449.*

Obtaining multiple accurate casts from a single dental impression is advantageous in generating duplicate dies, assembling multiple individual cast restorations on an intact cast, replicating the abutment-gingiva relationship, and enhancing the edentulous ridge anatomical architecture. Impression material properties and characteristics have been studied extensively using linear assessment methodologies; similar methods have been applied to assess the accuracy of materials in producing multiple accurate casts.[1]

The accuracy of impression materials was examined previously through indirect fabrication and assembly of full-arch fixed dental prostheses, which produced clinically applicable results.[2] The purpose of this study was to compare the relative accuracy of successive casts produced from a single impression. Subsequently, the results from the second generation casts were used to rank the accuracy of the materials.

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Materials and Methods

Methodology details are reported elsewhere.[2] Partially edentulous maxillary Dentoform (no. 567, Columbia Dentoform) models were fabricated with abutments at the left and right second molar and canine sites. These abutments were prepared to receive complete crowns with a 90-degree shoulder finish line (Fig 1). Six impressions of each material (polyether polyvinyl siloxane [PE], medium viscosity [MV], and putty wash single mix [PW]) were taken using custom trays. Impressions were poured twice with vacuum-mixed type V die stone (Die Keen, Columbus Dental). First generation casts were created as follows: PE was poured immediately, while MV and PW were poured within 20 minutes of impression taking. Second generation casts were created using longer time intervals: PE was poured within 60 minutes, while MV and PW were poured within 80 minutes of impression taking. Thirty-six (18 first generation and 18 second generation) successive stone casts were obtained.

Fig 1 Modified typodont (Dentoform) with abutment preparations used as the master model.

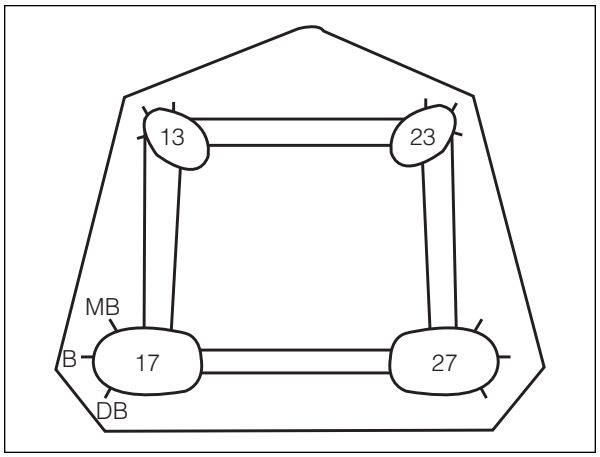

Fig 2 Measuring sites for each abutment tooth. MB = mesiobuccal; B = buccal; DB = distobuccal (FDI tooth-numbering system).

Fig 3 Assembled copings situated on the stone dies.

Fig 4 Assembled copings situated on the typodont (Dentoform).

Standardized 2-mm-thick cast copings (Olympia, J.F. Jelenko) were fabricated on 144 stone dies; the internal surfaces were assessed with a ×10 stereoscopic microscope. Minor imperfections were removed and the cast copings were seated on stone dies using light finger pressure, producing 144 clinically acceptable copings. Marginal integrity was measured using a traveling microscope (Gaertner Scientific) at an accuracy of 0.001 mm. Vertical marginal discrepancies were measured three times at predetermined fixed sites (mesiobuccal [MB], buccal [B], and distobuccal [DB]; Fig 2) on the stone dies and Dentoform abutments of individual and assembled copings. Individual copings were seated on the stone dies and luted to customized frameworks (Fig 3), which produced 18 first and second generation full-arch fixed prostheses (Fig 4). This determined the cast's horizontal dimensional accuracy.

Table 1 Mean Marginal Discrepancies (SD): Individual Copings on the Dentoform (μm) by Abutment Tooth

	No. of casts		Right second molar		Right canine		Left canine		Left second molar			
Material	Cast 1	Cast 2	Cast 1	Cast 2	Cast 1	Cast 2	Cast 1	Cast 2	Cast 1	Cast 2	F	*P*
PE (Impregum-F, 3M ESPE)	6	6	10 (8)	13 (7)	19 (8)	37 (8)	34 (10)	16 (7)	7 (5)	24 (10)	0.7267	.395
MV (Medium viscosity Extrude, Sybron/Kerr)	6	5	41 (18)	16 (9)	17 (7)	25 (10)	29 (12)	20 (10)	6 (5)	0 (0)	1.2096	.275
PW (Putty wash, single mix Extrude, Sybron/Kerr)	6	6	41 (11)	29 (9)	34 (10)	39 (9)	43 (15)	34 (10)	28 (9)	12 (6)	1.2969	.257

Cast 1 = first generation cast; Cast 2 = second generation cast; SD = standard deviation.

Table 2 Mean Marginal Discrepancies (SD); Assembled Copings on the Dentoform (μm) by Abutment Tooth

	Right second molar		Right canine		Left canine		Left second molar			
Material	Cast 1	Cast 2	Cast 1	Cast 2	Cast 1	Cast 2	Cast 1	Cast 2	F	*P*
PE (Impregum-F, 3M ESPE)	38 (13)	50 (18)	36 (9)	39 (9)	24 (8)	9 (4)	20 (8)	44 (13)	0.617	.433
MV (Medium viscosity Extrude, Sybron/Kerr)	40 (14)	44 (15)	8 (5)	31 (11)	34 (11)	5 (5)	10 (9)	7 (6)	0.048	.827
PW (Putty wash, single mix Extrude, Sybron/Kerr)	54 (11)	56 (11)	25 (9)	80 (8)	21 (8)	29 (9)	60 (14)	54 (14)	3.383	.068

Cast 1 = first generation cast; Cast 2 = second generation cast; SD = standard deviation.

Measurements (n = 5,184) were then collected. Abutment cumulative averages of the three measurement sites (MB, B, DB) were calculated. Repeated measures analysis of variance (ANOVA) was used to determine differences among the successive casts. The post hoc Scheffé analysis of means was used to determine any differences among the materials.

Results

Mean vertical marginal discrepancies of both individual and assembled copings on the stone dies were less than 25 μm.

Dentoform

Individual Copings. ANOVA and post hoc results revealed insignificant differences between successive casts and among the materials (Table 1).

Assembled Copings. ANOVA revealed insignificant differences among successive casts (Table 2). Post hoc results, however, showed an insignificant difference between MV and PE ($P > .05$), whereas PW and MV differed significantly. Two-tailed *t* test results indicated insignificant differences in marginal discrepancies among the abutments for each material.

Discussion

Successive casts from tested materials produced clinically acceptable individual and full-arch fixed prostheses. Marginal discrepancies of second generation individual copings found in this study are similar to a study comparing titanium computer-aided design/computer-assisted manufacture, wax/computer-assisted manufacture, and wax/cast high noble restorations. Wax/cast restorations resulted in smaller marginal discrepancies than titanium and within the clinically acceptable range of 39 to 120 μm.[3]

Previously, PE demonstrated the smallest marginal discrepancies. However, in this study, MV demonstrated even smaller discrepancies, yet still was statistically equivalent to PE.[2] PE's continued polymerization and hydrophilic properties resulted in a smaller die diameter (0.01%), whereas polyvinyl siloxane produced a larger diameter die (0.02%) that partially compensated for the fine-grain cement.[4]

The marginal discrepancies of second generation full-arch copings are acceptable clinically. Preservation of a full-arch solid cast and use of custom trays may have contributed to the results seen in this study. Statistical differences between MV and PW height variations related to a larger concentration of the inert filler

(plasticizers present in the putty that lower the polymerization shrinkage, producing a slightly shorter die). Second generation PW dies may require additional relief to compensate for the vertical change in magnitude.

The dental stone used in this study may exhibit high delayed setting expansion (0.35%). However, it did not influence the results.[5] Die hardener and die relief were not used in this study.

Conclusion

Within the parameters of this study, the following conclusions can be drawn:

- First and second generation casts poured from a single impression were identical clinically.
- Individual copings from second generation MV, PE, and PW materials were acceptable clinically.
- MV and PE second generation full-arch prostheses were equivalent clinically, with PW being statistically different yet also acceptable clinically.

References

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Literature Abstract

Comparison of classic endodontic technique versus contemporary techniques on endodontic treatment success

The aim of this retrospective clinical study was to evaluate and compare the survival rates of endodontic treatment performed by an experienced endodontist using classic treatment techniques versus a group using more contemporary techniques. Patient records from four different treatment locations were identified and data were collected by chart review. Of the nearly 8,000 charts reviewed, 857 patients presenting with 984 endodontically treated teeth met the inclusion criteria and were included in the study. There was only one inclusion criteria: a clinical or radiographic follow-up of 12 or more months after endodontic treatment was available. The classic group consisted of 414 patients with 459 teeth, while the contemporary group comprised 443 patients with 525 teeth. The classic group was treated by a single endodontist who was trained in the early 1970s. Techniques used included instrumentation with stainless steel hand files, alternating 5.25% NaOCl and 3% hydrogen peroxide irrigation, multiple treatment visits, placement of intracanal medicaments, obturation short of the radiographic apex, lateral condensation, and frequent placement of definitive restorations at completion of endodontic treatment. The contemporary group of patients were treated by three endodontists trained within the past 15 years. Techniques used included both hand and rotary instrumentation, frequent single-visit treatments, use of surgical microscopes, electronic apex locators, digital radiography, and placement of provisional restorations. Survival was defined as radiographic evidence of the treated tooth still present in the mouth at least 12 months after the initial treatment. A tooth was deemed a failure if extracted at any time after treatment. Failure rates were compared between the two groups using a mixed-model Poisson regression analysis. The number of treatments performed in a single visit was significantly different between the classic group and contemporary group ($P < .0001$). In the classic group, 9 teeth were extracted, presenting with a 98.0% survival rate; 7 of those teeth were molars. The contemporary group presented with 21 extracted teeth, yielding a 96.0% survival rate. In this group, 13 premolars and 8 molars failed. There was no statistical difference in failure rates between the two groups. There was a significantly greater number of teeth requiring posttreatment interventions in the classic group (6.7%) compared to the contemporary group (0.9%, $P = .0141$). The most frequent posttreatment intervention performed in the classic group was re-treatment, while apicoectomy was marginally more frequent in the contemporary group. It is noteworthy that despite the limitations of having variations in abilities and treatment philosophies and the differences in the time to patient recall between the two various endodontist groups, very high tooth survival rates can still result from endodontic treatment. This study also lends support to the recent movement towards single-visit endodontics.

Fleming CH, Litaker MS, Alley LW, Eleazer PD. *J Endod* 2010;36:414–418. **References:** 26. **Reprints:** Dr Paul Eleazer, University of Alabama at Birmingham Department of Endodontics, 1530 3rd Avenue South, SDB 406, Birmingham, AL 35294, USA. Email: eleazer@uab.edu—*Elvin W.J. Leong, Singapore*