Evaluation of Marginal Misfit of Implant-Supported Fixed Prostheses Made Using Different Techniques

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Purpose: To evaluate the vertical marginal (VM) and horizontal marginal (HM) misfit of frameworks made using different techniques. ***Materials and Methods:*** A total of 30 frameworks were divided into three groups of 10 samples each based on manufacturing technique: nichrome cast (G1), milled in zirconia (G2), and milled in wax and fused to metal (G3). Marginal misfit was measured using a three-dimensional optical microscope. ***Results:*** The highest VM misfit was in G3 (83.5 µm), followed by G1 (55 µm) and G2 (42 µm). The highest HM misfit was in G2 (118 µm), followed by G3 (102 µm) and G1 (–85 µm). ***Conclusion:*** Frameworks milled in zirconia resulted in the lowest VM misfit, while frameworks filled in wax and fused to metal resulted in higher VM. The HM misfit was favorable in the lost-wax technique. *Int J Prosthodont 2019;32:345–348. doi: 10.11607/ijp.6073*

Better adaptation of implant-supported prostheses can be achieved using two strategies: addition of refinement steps[1] or elimination of manufacturing steps. The lost-wax technique involves several laboratory steps.[2] The use of computer-aided design/computer-assisted manufacturing (CAD/CAM) is simplified and saves time using different materials.[3]

This study aimed to evaluate the vertical and horizontal marginal misfits of implant-supported fixed prostheses made using three different techniques and materials. The two null hypotheses were: *(1)* There would be no difference in vertical marginal (VM) misfit among the groups; and *(2)* There would be no difference in horizontal marginal (HM) misfit among the groups.

MATERIALS AND METHODS

A total of 30 frameworks were fabricated using three different techniques: conventional technique (G1), milled in zirconia (G2), and milled in wax and fused to metal (G3). The groups (n = 10 each) are further described in Table 1. The methodology followed a previous study.[4]

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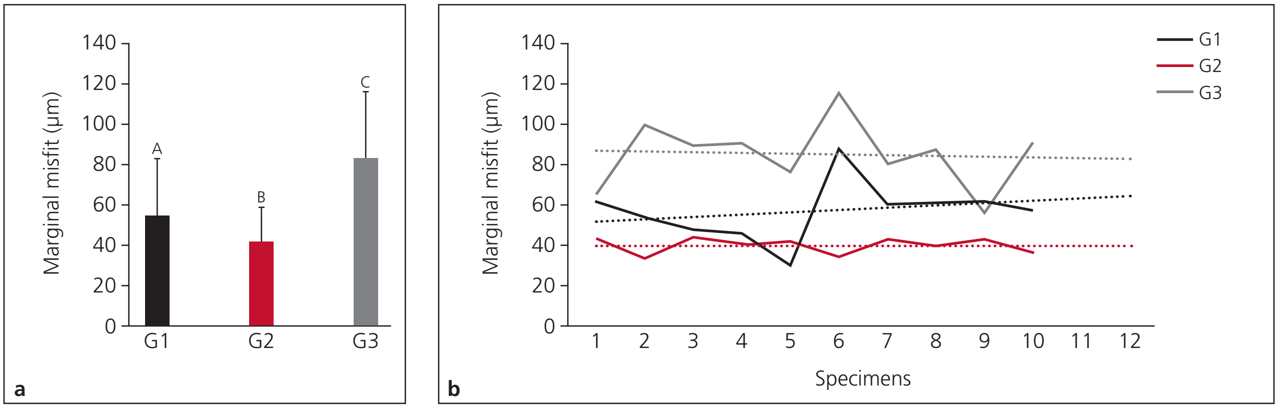

Fig 1 *(a)* Comparative analysis between G1, G2, and G3 for vertical marginal misfit. Different capital letters indicate $P < .001$ compared to the other groups. *(b)* Analysis of intra-group vertical marginal misfit.

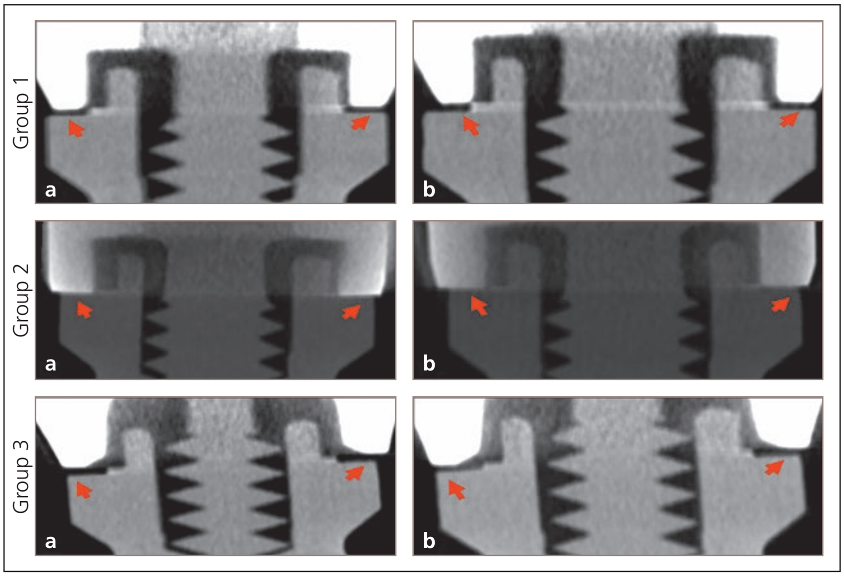

Fig 2 Internal analyses of the highest values of vertical mismatch between the analyzed infrastructures in the *(a)* premolar and *(b)* molar areas. G1 = 95.8 µm; G2 = 46 µm; G3 = 124 µm.

Table 1 Framework Group Designs

Groups	Fabrication method	Material	Samples (n)
G1	Conventional technique (UCLA with Co-Cr strap (Conexão)	NiCr	10
G2	Scanned and milled in CAD/CAM system (3Series)	ZrO_2	10
G3	Scanned and milled in wax (Amann Girrbach) and fused to metal (lost-wax casting)	CAD/CAM wax and NiCr	10

Co-Cr = cobalt-chromium; NiCr = nichrome; ZrO_2 = zirconium dioxide.

G1, G2, and G3 specimens that presented the highest mean HM and VM misfits underwent microcomputed tomography using a SkyScan 1272 microtomographer (Brunker) with the following the parameters: 100-kV/100-µA power source; 0.11-mm (Cu) filter; 10.5-µm pixel size; and 0.5 steps of rotation with 360 degrees. The images were generated at computed tomography (CT) Analyzer (Skyscan, Bruker).

RESULTS

In the analysis of VM misfit, a significant difference was observed among all groups ($P < .001$) (Fig 1a), with the highest median value observed for G3 (83.5 µm), followed by G1 (55 µm) and G2 (42 µm). In the intra-group analysis, VM presented a significant difference ($P < .001$) (Fig 1b). Microcomputed tomography was used to analyze the infrastructure with the highest VM misfit in each group (Fig 2).

In the HM analysis, G1 presented a negative value (–85 µm) and was significantly different compared to the other groups ($P < .001$) (Fig 3a). There was no significant difference between G2 (118 µm) and G3 (102 µm). When evaluating intra-group HM, a homogenization was observed (Fig 3a). The internal HM values in each group were also analyzed (Fig 4).

DISCUSSION

The first null hypothesis was rejected. In the comparison between G1 and G2, the frameworks fabricated using the CAD/CAM system showed lower VM values. The CAD/CAM technique provides better standardization, speed, and

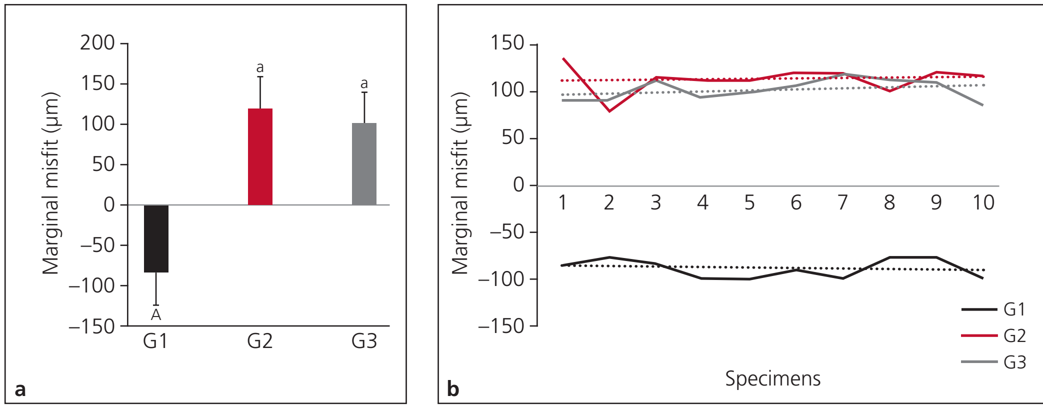

Fig 3 *(a)* Comparative analysis between G1, G2, and G3 for horizontal marginal misfit. Capital letters indicate $P < .001$ compared to the other groups, and lower-case letters indicate $P > .005$. *(b)* Analysis of intra-group horizontal marginal misfit.

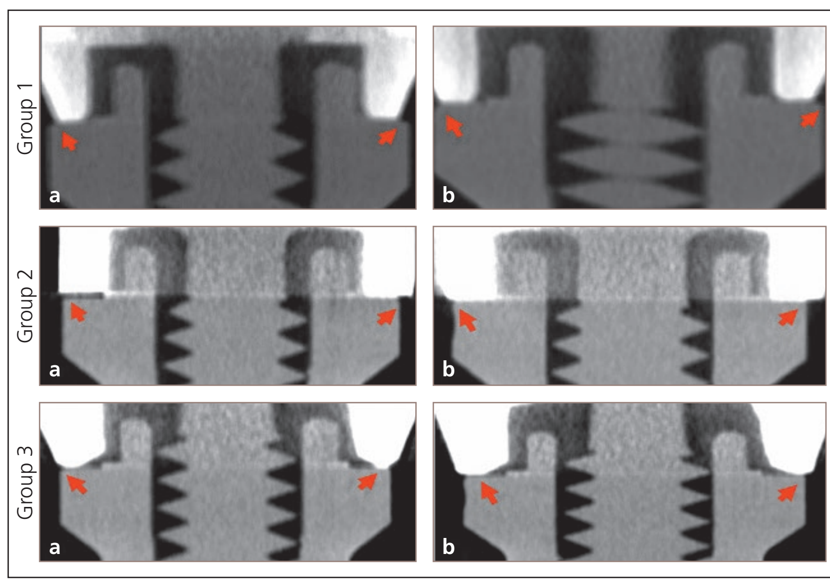

Fig 4 Internal analyses of the highest values of horizontal misfit between the analyzed infrastructures in the *(a)* premolar and *(b)* molar areas. G1 = −100 µm; G2 = 148 µm; G3 = 119 µm.

precision, as well as lower cost, as corroborated by a previous study.[3] A lower VM in G1 may be attributable to the use of a prefabricated abutment, as the presence of the metal strap minimizes distortions in the base of the cylinder during the casting process.[4] The G3 technique has been described by Ortorp et al[5] on teeth. The wax used for the CAD/CAM systems is solid and less sensitive to temperature conditions.[5]

The second null hypothesis was partially accepted. In G1, the metal strap of the UCLA may suffer distortion; however, another study[1] affirms that casting does not interfere in the misfit. Moreover, there is a possibility that the strap at the factory already presented an undercontour. G3 resembled G1 in the casting process with a positive HM value, which may be attributable to the expansion of the coating material or to the milling of the infrastructure in a larger size. G2 overcontour is related milling in presintered zirconia. The infrastructure is milled 20% larger for posterior contraction during the sintering.[4] However, this mechanism could not be observed.

The overcontour is more damaging to the peri-implant tissues, as the presence of spaces acts as a reservoir for microorganisms, resulting in bone loss and consequent implant failure.[4] The manufacturing technique used in G3 has been a trend in laboratories to save time and costs, but this technique presented the worst values of misfit in the present study.

CONCLUSIONS

Prostheses milled in zirconia resulted in the lowest VM misfit, while those filled in wax and fused to metal resulted in higher VM. The HM misfit was favorable in the lost-wax technique.

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Literature Abstracts

Bond Strength Durability of Self-Adhesive Resin Cements to Zirconia Ceramic: An In Vitro Study

How contamination, cleaning, and artificial aging affect the bond strength of self-adhesive resin cements to zirconia ceramics is unclear. The purpose of this in vitro study was therefore to assess the durability and bond strength of different self-adhesive resin cements to zirconia ceramics subjected to contamination, cleaning, and aging. A total of 192 zirconia ceramic squares were airborne particle abraded with 50-μm aluminum oxide at a pressure of 100 kPa. The specimens were then divided into four main experimental groups (n = 48 each) according to the type of self-adhesive resin. Specimens were further divided into subgroups (n = 16) and exposed to three different treatment methods: alcohol bath cleaning only; contamination with saliva and alcohol bath cleaning; and contamination with saliva and cleaning with Ivoclean followed by alcohol bath cleaning. Bonded specimens were stored in distilled water (37°C) either for 3 days with no thermocycling or for 150 days interrupted by 37,500 thermocycles between 5°C and 55°C. After storage, the bond strength was determined using a universal testing machine. Results were analyzed statistically using nonparametric tests. After saliva contamination, the tensile bond strength for all specimens decreased significantly ($P < .001$). Furthermore, after saliva contamination and during 150 days of water storage with thermocycling, all specimens debonded spontaneously. However, use of the cleaning medium (Ivoclean) significantly increased the tensile bond strength for almost all specimens ($P < .05$). Saliva contamination significantly negatively influenced bond strength and durability. Ceramic cleaning using Ivoclean significantly improved the bond strength to saliva-contaminated zirconia ceramics.

Samran A, Al-Ammari A, El Bahra S, Halboub E, Wille S, Kern M. *J Prosthet Dent* 2019;121:477–484. References: 36. Reprints: Abdulaziz Samran, asamran@proth.uni-kiel.de —*Carlo Marinello, Switzerland*

A 10-year Follow-up Study of 119 Teeth Treated with Apical Surgery and Root-end Filling with Mineral Trioxide Aggregate.

The objective of this clinical study was to assess the long-term outcomes (clinical signs/symptoms and radiographic healing) of teeth treated with apical surgery and mineral trioxide aggregate (MTA) for root-end filling. A total of 195 patients were recalled 1, 5, and 10 years after apical surgery for clinical and radiographic examinations. Three calibrated observers evaluated the periapical radiographs independently, and the evolution of the cases over time was analyzed. Healing classification of teeth was divided into healed vs not healed using well-established clinical and radiographic healing criteria. The potential influences of sex, age, type of treated tooth, type of MTA, and first-time vs repeat surgery were statistically analyzed. The inception cohort included 195 teeth. The dropout rate after 10 years amounted to 39% (n = 76). Of the 119 teeth available for the 10-year analysis, 97 teeth were classified as healed (81.5%). No significant differences were found with regard to the rate of healed cases for the subcategories of the parameters age, sex, type of MTA, and first-time or repeat surgery. Concerning the type of treated tooth, the rate of healed maxillary molars (95.2%) differed significantly ($P = .035$) from the rate of healed maxillary premolars (66.7%). The predictive value of the cases classified as healed at 1 year and remaining so over the 10-year observation period was 86.8%. This 10-year follow-up study of teeth treated with apical surgery and MTA as root-end filling material showed an acceptable rate of healed cases. Many of the lost teeth had been extracted because of longitudinal root fractures during the observation period.

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