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ORIGINAL RESEARCH

Assessment of flexural strength of two different provisionalization materials: An in-vitro study

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ABSTRACT:

Backgrounds: Provisional or interim restorations are commonly used in dentistry during the time between tooth preparation and placement of the definitive restoration. Fabrication of an ideal provisional restoration is crucial for gum health and to protect the pulp, for prosthetically-guided tissue healing to achieve an acceptable emergence profile, for minimizing the migration of dental abutments, and for assessing the prospective form and function of the definitive prosthesis. Hence; the present study was undertaken for assessing flexural strength of two different provisionalization materials. **Materials & methods:** Heat polymerizing PMMA & Self-polymerizing PMMA was used in the present study. Production of standard specimen of each material was done from a mold using dental stone as an investment material.10 specimens each of auto-polymerizing and heat polymerization PMMA were used. A Vernier caliper was used as a standard measuring device to measure the dimensions of each specimen. The whole unit was then mounted on the lower jaw of the Instron testing machine. The stress applicator pin was fixed on the upper jaw of the force testing machine & three point bent test was done for each specimen. Flexural strength was assessed and compared using SPSS software. **Results:** Mean elastic modulus among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 784.36 MPa and 397.11 MPa respectively. Mean force required to fracture the specimen among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 0.239 kN and 0.089 kN respectively. **Conclusion:** Heat polymerization PMMA was more resistant in comparison to auto-polymerization PMMA.

Key words: Provisional, Indirect, Direct

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INTRODUCTION

Provisional or interim restorations are commonly used in dentistry during the time between tooth preparation and placement of the definitive restoration. In view of the strong demand for good aesthetic results, provisional restorations have become a valuable tool for esthetic and functional diagnosis in dentistry. Dentists can gain their patients' confidence by handling this intermediate stage of treatment successfully, achieving the necessary predictability for a successful final restoration.[1-3]

Fabrication of an ideal provisional restoration is crucial for gum health and to protect the pulp, for prosthetically-guided tissue healing to achieve an acceptable emergence profile, for minimizing the migration of dental abutments, and for assessing the prospective form and function of the definitive prosthesis.[4] The provisional may be used as short term or long term restorations and in such cases the established clinical condition of tooth preparation, position and tissue need to be maintained. An ideal material should be easy to handle, high in strength and have good tissue compatibility.[5, 6] Hence; the present study was undertaken for assessing flexural strength of two different provisionalization materials.

MATERIALS & METHODS

The present study was conducted with the aim of assessing flexural strength of two different provisionalization materials. Heat polymerizing PMMA & Self-polymerizing PMMA was used in the present study. Production of standard specimen of each material was done from a mold using dental stone as an investment material. The materials were mixed according to the manufactures instructions. This was followed by packing of the materials into the mold and bench curing for 20 minutes under a constant pressure of 500 gm. 10 specimens each of auto-polymerizing and heat

polymerization PMMA were used. A Vernier caliper was used as a standard measuring device to measure the dimensions of each specimen. The whole unit was then mounted on the lower jaw of the Instron testing machine. The stress applicator pin was fixed on the upper jaw of the force testing machine & three point bent test was done for each specimen. Flexural strength was assessed and compared using SPSS software. Student t test were used for evaluation of level of significance.

RESULTS

In the present study, flexural strength of two different provisionalization materials was assessed. Heat polymerizing PMMA & Self-polymerizing PMMA was used. Mean elastic modulus among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 784.36 MPa and 397.11 MPa respectively. Significant results were obtained while comparing the mean elastic modulus among the specimens of the two study groups. In the present study, Mean force required to fracture the specimen among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 0.239 kN and 0.089 kN respectively. Significant results were obtained while comparing the mean force required fracturing the specimen of the two study groups.

Table 1: Comparison of elastic modulus

Elastic modulus (MPa)	Heat polymerizing PMMA	Self-polymerizing PMMA	p- value
Mean	784.36	397.11	0.00
SD	60.36	48.31	(Significant)

Table 2: Comparison of mean force require to fracture the specimen

Force required (kN)	Heat polymerizing PMMA	Self-polymerizing PMMA	p- value
Mean	0.238	0.089	0.00
SD	0.095	0.012	(Significant)

DISCUSSION

Fixed partial dentures have become a well-established treatment modality for many partially edentulous patients. Because these restorations are made indirectly in a dental laboratory, several days or weeks are usually required for their completion. Therefore provisional restoration is an essential step in fixed prosthodontics. The word provisional means 'established for the time being'.[6] During the prosthetic rehabilitation procedures, provisional restorations are commonly used to provide both pulpal and periodontal protection until the final restorations are placed. Such temporary restorations should have good marginal integrity, esthetics and sufficient durability to withstand the forces of mastication. Material strength is important when selecting resins for provisional restorations.[7, 8]

In the present study, flexural strength of two different provisionalization materials was assessed. Heat polymerizing PMMA & Self-polymerizing PMMA was used. Mean elastic modulus among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 784.36 MPa and 397.11 MPa respectively. Significant results were obtained while comparing the mean elastic modulus among the specimens of the two study groups. Borba M et al evaluated the flexural strength (sigma f) and hardness (H) of direct and indirect composites, testing the hypotheses that direct resin composites produce higher sigma f and H values than indirect composites and that these properties are positively related. Ten bar-shaped specimens (25 mm x 2 mm x 2 mm) were fabricated for each direct [D250 - Filtek Z250 (3M-Espe) and D350 - Filtek Z350 (3M-Espe)] and indirect [ISin - Sinfony (3M-Espe) and IVM - VitaVM LC (Vita Zahnfabrik)] materials, according to the manufacturer's instructions and ISO4049 specifications. The sigma f was tested in three-point bending using a universal testing machine (EMIC DL 2000) at a crosshead speed of 0.5 mm/min (ISO4049). Knoop hardness (H) was measured on the specimens' fragments resultant from the sigma f test and calculated as H = 14.2P/l(2), where P is the applied load (0.1 kg; dwell time = 15 s) and l is the longest diagonal of the diamond shaped indent (ASTM E384). The data were statistically analyzed using Anova and Tukey tests (alpha = 0.05). The mean sigma f and standard deviation values (MPa) and statistical grouping were: D250 - 135.4 +/- 17.6a; D350 - 123.7 +/- 11.1b; ISin - 98.4 +/- 6.4c; IVM - 73.1 +/- 4.9 d. The mean H and standard deviation values (kg/mm(2)) and statistical grouping were: D250 - 98.12 +/- 1.8a; D350 - 86.5 +/- 1.9b; ISin - 28.3 +/- 0.9 c; IVM - 30.8 +/- 1.0 c. The direct composite systems examined produce higher mean sigma f and H values than the indirect composites, and the mean values of these properties were positively correlated (r = 0.91), confirming the study hypotheses.[9]

In the present study, Mean force required to fracture the specimen among specimens of Heat polymerizing PMMA and Self-polymerizing PMMA was found to be 0.239 kN and 0.089 kN respectively. Significant results were obtained while comparing the mean force required fracturing the specimen of the two study groups. Kamble VD et al compared the flexural strength of polymethyl methacrylate (PMMA) and bis-acryl composite resin reinforced with polyethylene and glass fibers. Three groups of rectangular test specimens (n = 15) of each of the two resin/fiber reinforcement were prepared for flexural strength test and unreinforced group served as the control. Specimens were loaded in a universal testing machine until fracture. The mean flexural strengths (MPa) was compared by one way ANOVA test, followed by Scheffe analysis, using a significance level of 0.05. For control groups, the flexural strength for PMMA (215.53 MPa) was significantly lower than for bis-acryl composite resin (240.09 MPa). Glass fiber reinforcement produced significantly higher flexural strength for both PMMA (267.01 MPa) and bis-acryl composite resin (305.65 MPa), but the polyethylene fibers showed no significant difference (PMMA resin-218.55 MPa and bis-acryl composite resin-241.66 MPa). Among the

reinforced groups, silane impregnated glass fibers showed highest flexural strength for bis-acryl composite resin (305.65 MPa). Of two fiber reinforcement methods evaluated, glass fiber reinforcement for the PMMA resin and bis-acryl composite resin materials produced highest flexural strength. On the basis of this in-vitro study, the use of glass and polyethylene fibers may be an effective way to reinforce provisional restorative resins.[10] Karaokutan I et al evaluated the effect of the fabrication method and material type on the fracture strength of provisional crowns. A master model with one crown (maxillary left second premolar) was manufactured from Cr-Co alloy. The master model was scanned, and the data set was transferred to a CAD/CAM unit (Yenamak D50, Yenadent Ltd, Istanbul, Turkey) for the Cercon Base group. For the other groups, temporary crowns were produced by direct fabrication methods (Imident, Temdent, Structur Premium, Takilon, Systemp c&b II, and Acrytemp). The specimens were subjected to water storage at 37°C for 24 hours, and then they were thermocycled (TC, 5000×, 5-55°C) (n=10). The maximum force at fracture (Fmax) was measured in a universal test machine at 1 mm/min. Data was analyzed by non-parametric statistics (α=.05). Fmax values varied between 711.09-1392.1 N. In the PMMA groups, Takilon showed the lowest values (711.09 N), and Cercon Base showed the highest values (959.59 N). In the composite groups, Structur Premium showed the highest values (1392.1 N), and Acrytemp showed the lowest values (910.05 N). The composite groups showed significantly higher values than the PMMA groups (P=.01). Composite-based materials showed significantly higher fracture strengths than PMMA-based materials.[11]

CONCLUSION

From the above results, the authors concluded that heat polymerization PMMA was more resistant in comparison to auto-polymerization PMMA. However; further studies are recommended.

REFERENCES

1. Burns DR, Beck DA, Nelson SK, Committee on Research in Fixed Prosthodontics of the Academy of Fixed Prosthodontics. A review of selected dental literature on contemporary provisional fixed prosthodontic treatment: report of the Committee on Research in Fixed Prosthodontics of the Academy of Fixed Prosthodontics. J Prosthet Dent. 2003;90: 474–97.
2. Urrútia G, Bonfill X. [PRISMA declaration: a proposal to improve the publication of systematic reviews and meta-analyses]. Med Clin (Barc). 2010;135: 507–11.
3. Ramamoorthi M, Bakkar M, Jordan J, Tran SD. Osteogenic Potential of Dental Mesenchymal Stem Cells in Preclinical Studies: A Systematic Review Using Modified ARRIVE and CONSORT Guidelines [Internet]. Stem Cells International. 2015. p. 378368
4. Borba M1, Della Bona A, Cecchetti D. Flexural strength and hardness of direct and indirect composites. Braz Oral Res. 2009 Jan-Mar;23(1):5-10.
5. Uzun G, Hersek N, Tinçer T. Effect of five woven fiber reinforcements on the impact and transverse strength of a denture base resin. J Prosthet Dent. 1999;81:616–620.
6. Gutteridge DL. The effect of including ultra-high-modulus polyethylene fibre on the impact strength of acrylic resin. Br Dent J. 1988;164:177–180.
7. Koumjian JH, Nimmo A. Evaluation of fracture resistance of resins used for provisional restorations. J Prosthet Dent. 1990;64:654–657.
8. Okubo SR, Kanawati A. Evaluation of visual and instrument shade matching. J Prosthet Dent. 1998;80:642–48.
9. Geerts GA, Overturf JH, Oberholzer TG. The effect of different reinforcements on the fracture toughness of materials for interim restorations. J Prosthet Dent. 2008;99:461–467.
10. Kamble VD, Parkhedkar RD, Mowade TK. The effect of different fiber reinforcements on flexural strength of provisional restorative resins: an in-vitro study. J Adv Prosthodont. 2012;4(1):1–6.
11. Karaokutan I, Sayin G, Kara O. In vitro study of fracture strength of provisional crown materials. J Adv Prosthodont. 2015;7(1):27–31.