Original Article

Evaluation of Marginal Fit of Three Different Interim Restoration Materials - An In-vitro Study

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Abstract

Introduction: The aim of this experimental in-vitro study was to evaluate and compare marginal accuracy of interim restorations made with three chemically different interim materials one hour after fabrication and at one week interval. **Methods:** Twenty samples from each group with a total of sixty were fabricated on a customized metal die. The three test groups were as below; Group A - Protemp™ 4 (3M ESPE AG Dental Products, Germany), a bis-acrylic based self-cure temporary material; Group B - Revotek LC™ (GC Dental Products Corp., Japan), a urethane dimethacrylate based light cure temporary material and Group C - Tuff-Temp™ Plus (Pulpdent Corporation, U.S.A), a rubberized-urethane based dual cure temporary material. All samples were stored in artificial saliva and evaluated for marginal discrepancy using a stereomicroscope, one hour and one week after fabrication. Statistical analysis was done using one way ANOVA test and Tukeys Post-hoc tests. **Results:** Statistical significant difference existed between three groups after one hour ($p<0.001$) and after one week ($p<0.001$), Tuff-Temp™ Plus showed the least marginal discrepancy (at one hour =192.3± 0.75µm; at one week = 242.69 ± 5.64µm), while Revotek LC™ (at one hour = 232.52± 0.48µm; at one week = 293.68 ± 3.75µm) had the highest discrepancy. **Conclusions:** Tuff-Temp™ Plus showed higher marginal accuracy followed Protemp™ 4 and Revotek LC™ at one hour and one week interval.

Keywords: Marginal Accuracy, Provisional Restoration, Interim Crown

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Introduction

An interim or provisional restoration functions as a temporary prosthesis for the prepared tooth before final one is delivered (1). Success of provisional restoration depends upon good marginal adaptation as it promotes gingival health during the period between tooth preparation and placement of final restoration. It also prevents from any thermal, bacterial and chemical insults to the pulp. A poorly adapted provisional restoration induces plaque accumulation leading to periodontal disease ranging from gingival inflammation to periodontal support breakdown (2-11). Proper fit of provisional restoration and low solubility of cement are two factors that would reduce any discomfort for the patient during the interim period before permanent restoration delivery (8). The longer provisional restoration is on the tooth, the higher chance that its fit and contour will affect the health of gingival tissue. Various clinical situations may require a provisional restoration for an extended period such as surgical crown lengthening procedures, full mouth prosthetic rehabilitations and certain cases of immediate implant placement. Different interim restoration materials are used that can be divided into four groups according to their composition: polymethyl methacrylate (PMMA), polyethyl or butyl methacrylate, micro filled bisphenol A-glycidyl dimethacrylate (Bis-GMA) composite resin and urethane dimethacrylate (light polymerizing resins). The primary monomer determines many of material characteristics such as polymerization shrinkage, strength and exothermic heat of reaction (10). Bis-acryl composite resin-based materials are commercially popular because of their handling properties, ease of use and superior mechanical properties, including hardness, flexural strength, and modulus of elasticity (2, 12-15). However, polymerization shrinkage, exothermic setting reaction and irritation associated with monomer are amongst the material's disadvantages and relatively lower levels of finish and fine marginal adaptation have been reported (4,16-18). Moreover, working and resultant biophysical properties can be influenced by monomer to powder ratio. Recently, visible light cured resins have been introduced based on urethane dimethacrylate. These relatively expensive resins have good mechanical properties and because of light cure polymerization, the operator has more control over material's working time. Polymers made with low molecular weight urethane dimethacrylates have similar or slightly less water sorption than polymers prepared from bis-GMA (19, 20). Lately, a newer dual-cure material has been introduced as a provisional restoration material, i.e. rubberized urethane which provides a better marginal adaptation and ease of application compared to self-cure acrylic temporization materials. Further, it claims to have better strength and polishing characteristics that might serve as a promising evolution to the existing interim materials. Very limited literature exists on performance of dual cure rubberized urethane based temporary materials. Therefore, this study was undertaken to evaluate and compare the marginal accuracy of this material in comparison to already existing commercially popular interim restorative materials over two intervals: one hour after fabrication and after one week.

Materials and Methods

An Ivorine® mandibular right first molar typodont tooth (Columbia Dentoform Corp, New York) was prepared for a full coverage crown with a 1- mm chamfer (SO-21, Mani, Japan) finish line and a taper of approximately 5 degrees. An impression of prepared crown extending up to the apex of the typodont was made using polyvinylsiloxane (PVS) (Affinis, Coltene, Switzerland). Type II inlay wax was poured into impression of the prepared crown. In laboratory, a metal die using base metal was fabricated from the wax pattern using lost wax technique. The metal die was called as master die. Die was finished and polished and four vertical reference points were marked on the buccal, lingual, mesial and distal sides respectively.

The metal die was lubricated with petroleum jelly and a wax pattern was made on the metal die with Type II inlay wax. Wax pattern was made to simulate anatomy of mandibular first molar. It served two purposes; 1) To make matrix for fabrication of crowns using interim material 2) To mark the proper orientation of crown matrix with master die. A putty matrix was essential to hold the provisional restorative material over the prepared tooth. PVS putty impression of the die was made along with crown analogue. For this, an equal amount of base and catalyst material of the putty impression material was mixed as per the manufacturer's directions with respect to proportioning and mixing and was placed over the die. The polymerized impression served as the matrix for making provisional restorations.

A total of sixty samples, twenty from each group were fabricated on prepared customized metal die following the manufacturer's instructions. Three test groups were Group A - Protemp™ 4 (3M ESPE AG Dental Products, Germany), a bis-acrylic based self-cure temporary material; Group B - Revotek LC™ (GC Dental Products Corp., Japan), a urethane dimethacrylate based light cure temporary material and Group C - Tuff-Temp™ Plus (Pulpdent Corporation, U.S.A), a rubberized-urethane based dual cure temporary material. (Figure 1)

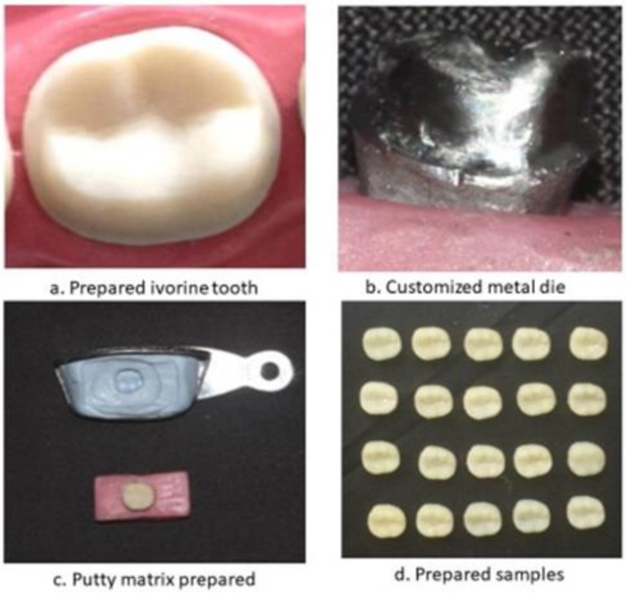

Figure 1 – Preparation of Samples

Group A; (Protemp™ 4) was mixed with the help of dispensing gun (10:1) and was loaded onto the putty matrix and adapted on the lubricated metal die. The interim restorations were removed and reseated once during the elastic phase of polymerization. Before complete polymerization, excess flash was trimmed from the margins of interim restorations with scissors. After polymerization was completed, the crowns were trimmed and finished as per the manufacturer's guidelines.

Group B; (Revotek LC™) interim restorations were made following the same protocol. Initial light curing (LED Woodpecker) was done for 10 seconds, to prevent possible deformation during removal. The interim restoration was removed and reseated once during the elastic phase of polymerization. Each of the buccal, proximal, occlusal and lingual surfaces were light cured for 20 seconds. After final curing was done, finishing and polishing was done by similar operator using a micromotor hand piece.

Group C; (Tuff-Temp™ Plus) interim restorations were also made following the same protocol. After two minutes from its initial stage of polymerization, crown was removed from the matrix and excess flash was trimmed. Before the final light curing, removal of oxygen inhibited layer on the surface was done by using alcohol. Final light curing was done at each of the buccal, proximal, occlusal and lingual surfaces for 20 seconds.

The test samples that were stored in artificial saliva were taken for testing under a stereomicroscope. A total number of sixty samples prepared from three groups of interim materials were evaluated for marginal discrepancy, one hour after fabrication. The marginal gaps were measured at four vertical reference points on buccal, lingual, mesial and distal sides respectively. Measurements extended from edge of the chamfer finish line vertically above the mid-point of die's score point to the inferior edge of the provisional crown using a stereomicroscope (Mode: XTL 3400E – Magnification:10X, Wuzhou New Found Instrument Co. Ltd., China) under 10x magnification. An image analyzing system (Chroma Systems PVT. Ltd, India; Model – MVIG 2005) was used to obtain numerical values in microns (µm). The readings thus obtained, were noted. The samples were stored in artificial saliva for a week and same tests were performed afterwards. (Figure2-7) Statistical results were drawn using one way ANOVA and Tukey's Post-hoc test to understand the multiple individual comparison among different interim restorative materials to assess marginal discrepancies at one hour and one week intervals for the three test materials.

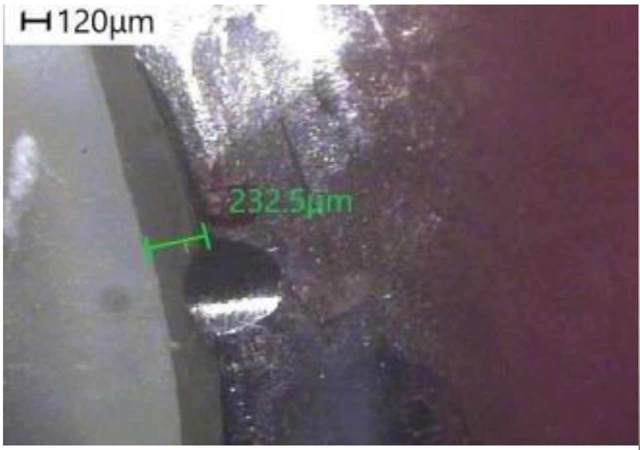

Figure 2 – Marginal Discrepancy Of 'Group A' After 1 Hour

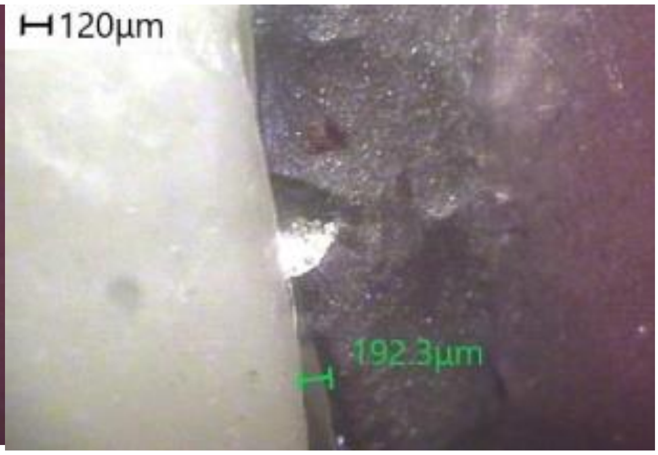

Figure 3 – Marginal Discrepancy Of 'Group B' After 1 Hour

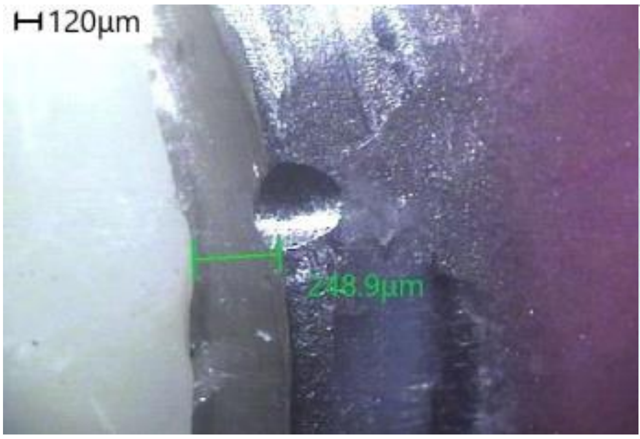

Figure 4 – Marginal Discrepancy Of 'Group C' After 1 Hour

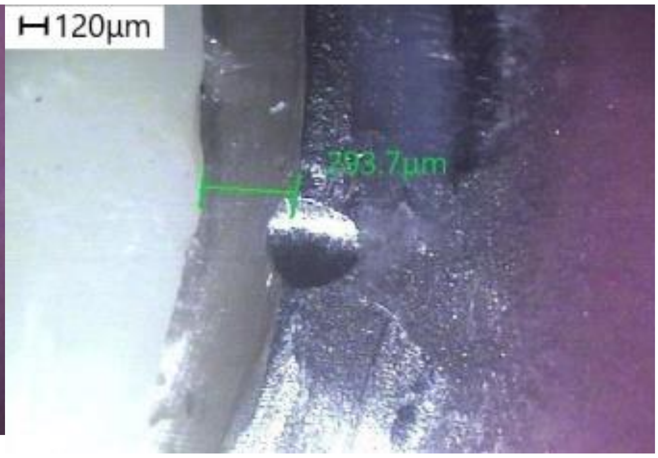

Figure 5 – Marginal Discrepancy Of 'Group A' After 1 Week

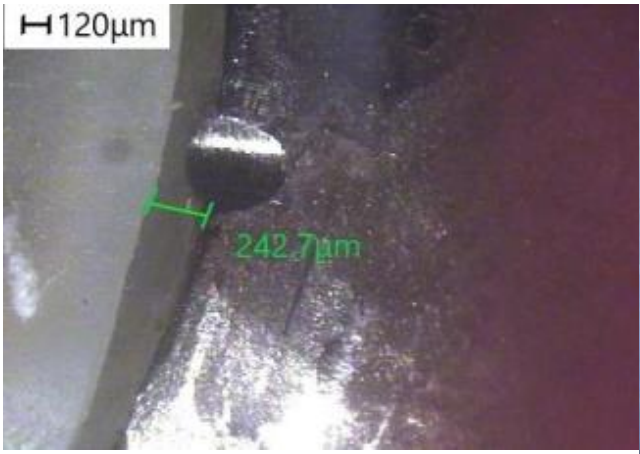

Figure 6 – Marginal Discrepancy Of 'Group B' After 1 Week

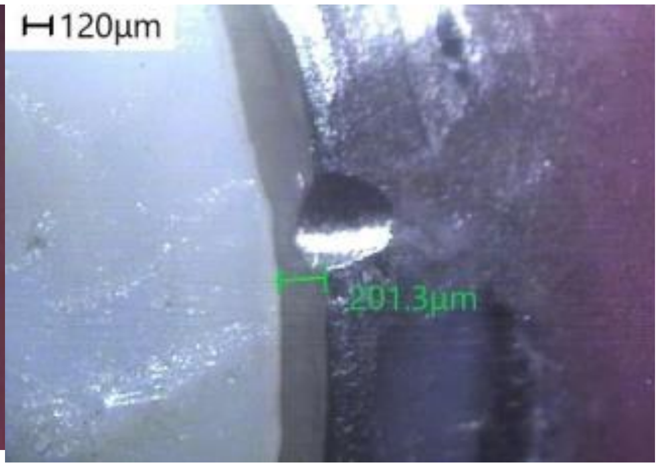

Figure 7 – Marginal Discrepancy Of 'Group C' After 1 Week

Results

One-way ANOVA test was used to determine which groups differ from each other, P-value < 0.05 was considered significant. It was found that there was statistical significant difference between the means of three interim restorative materials after one hour (f= 447.41, P<0.05). Among which, Tuff-Temp™ Plus showed the least marginal discrepancy, while Revotek LC™ had the highest discrepancy. Also, there was a statistically significant difference between three means of marginal discrepancy of same materials after one week (f=580.612, P<0.05). Among which, Tuff-Temp™ Plus had the least marginal discrepancy, while Revotek LC™ had the highest discrepancy. Comparison of mean marginal discrepancy after one hour and one week interval by one-way ANOVA is depicted in Table I. Also, the inter-group comparison is described in Table II and graphical summary of results is shown in Figure 8.

Table I: Comparison of Mean Marginal Discrepancy after One Hour and One Week Interval by One-way ANOVA Test

Groups (N=20)	Mean (µm)	Standard Deviation	F Value	P-Value
		After 1 Hour		
Group A (Protemp™ 4)	201.3	7.67	447.412	<0.05, Significant
Group B (Revotek LC™)	232.52	0.48		
Group C (Tuff Temp™ Plus)	192.3	0.75		
		After 1 Week		
Group A (Protemp™ 4)	248.86	5.83	580.612	<0.05, Significant
Group B (Revotek LC™)	293.68	3.75		
Group C (Tuff Temp™ Plus)	242.69	5.64		

Table II: Inter-Group Comparison using Tukey's Post -Hoc Test

Groups (N=20)	Mean Difference (µm)	P -Value
	After 1 Hour	
Group A Vs Group B	31.22	<0.05, Significant
Group B Vs Group C	40.17	<0.05, Significant
Group A Vs Group C	8.95	<0.05, Significant
	After 1 Week	
Group A Vs Group B	44.81	<0.05, Significant
Group B Vs Group C	50.99	<0.05, Significant
Group A Vs Group C	6.17	<0.05, Significant

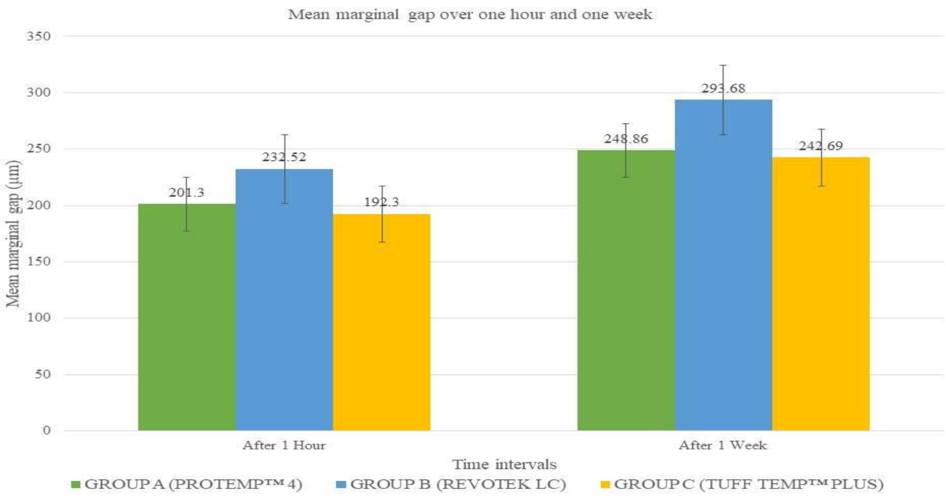

Figure 8 – Graphical Representation of Results

Discussion

Interim treatment promotes numerous adjunct benefits to definitive prosthodontic treatment and each of these benefits has a role to play in success of a fixed prosthesis (21). Traditionally, thermoplastic acrylic [PMMA and MMA] materials have been used as the provisional material of choice and have, to a certain degree, met many of the mechanical and physical requirements. However, they have their own shortcomings. The newer composite temporization materials have become an increasingly popular choice due to their improved mechanical properties, decreased exothermic release and ease of handling. With the advent of high density cross linked polymers, nanocomposites and visible light cure resins; newer temporary materials have become commercially available claiming to have superior properties. These materials usually incorporate filler such as microfine silica to improve physical properties (13, 22, 23). The choice of materials on which this study was conducted was determined by the fact that sufficient literature reports have advocated bis-acryl composites and light cure UDMA as promising interim materials; however, there is very limited data on the performance of dual cure temporary materials. To assess the nature of these dual-cure resins, Tuff Temp^{TM} Plus was chosen as a test material. A variety of techniques exist for fabricating provisional materials. While several studies have used both direct and indirect techniques and advantages and disadvantages cited for each one, it does not seem to have any indication in literature as to which technique is most accurate (24). In this study, provisional restorations were fabricated by indirect method and in particular by using the "on-off" technique described by Moulding et al, for which interim crowns are removed once from prepared tooth on initial polymerization and then reseated (25,26). Review suggests that aging of provisional restoration, temperature fluctuations and the moisture also accelerate discrepancy at margins. This is due to crack propagation in weaker areas as a result of contraction and expansion at the margins. Therefore, aging of samples in artificial saliva was performed in this study (27). The current study used direct view technique using a stereomicroscope. Nawafleh et al. (28) advocated this technique in their literature review that elaborates on accuracy and reliability of methods to measure marginal adaptation of crowns and FDPs. The statistical analysis of this study showed that there was a significant difference between mean values of three interim test materials, among which Tuff Temp^{TM} Plus (192.3± 0.75µm) which is a dual cure rubberized UDMA polymer showed least marginal discrepancy followed by Protemp^{TM} 4 (201.3±7.67µm), a bis-acryl, self-cure polymer. Revotek LC^{TM} (232.52± 0.48µm) which is a light cure UDMA polymer, shows maximum marginal discrepancy after one hour. Stereomicroscopic values obtained at an interval of one week, in the current study also showed similar results as obtained after one hour. It was noted that Tuff Temp^{TM} Plus (242.69 ± 5.64µm) had minimum marginal discrepancy and Revotek LC^{TM} (293.68 ± 3.75µm) had highest marginal discrepancy. The values of marginal discrepancy are higher than clinical acceptable range of 100-150µm for a provisional crown (29). These could possibly be an outcome of polymerization shrinkage and differences in testing conditions. Tjan et al. (26) checked marginal fidelity of six provisional materials and concluded that crown fabricated with EMA and bis-acrylic composite recorded the least marginal discrepancy followed by bis-GMA and MMA and then by UDMA and highest by MMA. Another study by Verma R et al. (30) recorded least marginal discrepancy with provisional restorations made from bis-GMA. From the study conducted by Koumijan and Holmes, it was concluded that light cure polymers have a lesser marginal discrepancy as compared to bis-acryl self-cure polymers immediately, in air and in water media; which is similar to results of our study (31). Results of our study differed from a study conducted by Gudapati et al. (32) which suggests that light cure polymers have a higher marginal accuracy as compared to auto-polymerising bis-acryl composite because of difference in their thermal expansion coefficient which alters polymerization shrinkage. The disparities in these results may be attributed to variations in study configurations and difference in commercial brands of test materials (33).The marginal superiority of light cure provisional materials has been reported by Nivedita S and Prithviraj DR using scanning electron microscopy.(34) The results of this study show that for light cure materials (Revotek LC™), the initial marginal discrepancy was lesser as compared to one week. It can be hypothesized that the initial marginal error of light cured materials may be associated with controlled setting reaction and prolonged working time available before beginning the light curing. Furthermore, better primary outcomes with light cure materials may be attributed to its physicochemical properties and filler content. These factors contribute to less shrinkage and better primary outcomes. On the other hand, since self-cure materials (Protemp™ 4) undergo rapid auto-polymerisation, they provide a limited working time (35, 36). Degree of conversion (DC) also affects the polymerization shrinkage over and above the chemical composition of materials. DC in a polymer structure is the ratio of single carbon-carbon bonds to double carbon-carbon bonds among monomers (2, 37-39). In dual cure rubberized UDMA (Tuff-Temp™ Plus), the marginal accuracy was superior as compared to the other two test groups. This could be due to the rubber filler in the matrix which serves as cross linking agent that delays the degree of conversion and provides adequate time until light curing is complete. This minimizes polymerization shrinkage and provides a favorable marginal accuracy. Since, Bis-GMA materials have high molecular weight, there is only a partial conversion of double bonds of bis-acrylate to single bonds. This is possibly associated with loss of mobility and reduced reactivity of free polymer radicals in dense polymeric network after setting (37, 39). These materials still show acceptable mechanical properties, despite their low degree of conversion, since these are multifunctional monomers with more than two reactive double bonds per molecule. Hence, resulting in a higher density of cross-links in a decreased degree of conversion (37). Similarly, monomethacrylates show higher polymerization shrinkage compared to composites due to lower molecular weight of monomers involved (6,36,40). Moreover, the differences in fabrication procedures of these samples might account for the variation in results. Mechanical properties are attributed to proper initiation or mature termination of polymerization process.(36) The control during the preparation of photo-polymerized materials might be greater than self-cured ones due to void entrapment , residue of poorly blended materials and deviations from the optimum proportions required for consistent mix (6,38). Furthermore, additional contraction may occur due to the exothermic polymerization reaction on cooling of self-curable material, unlike. light-curable composites (36). Although in the current study, dual cure materials have shown superior marginal accuracy compared to self-cure and light cure materials; these findings cannot be generalized for all commercially available temporary materials. More research including a variety of test materials with special emphasis on their chemical reaction and polymerization processes can provide a better insight on clinical performance of these materials.

Conclusions:

The comparison of marginal accuracy of three different interim restorative materials showed statistically significant differences. It was concluded that dual cure rubberised UDMA polymer (Tuff-Temp™ Plus) had the highest marginal accuracy followed by bis-acrylic based material (Protemp™ 4) and UDMA based light cure temporary material (Revotek LC™) at one hour and one week intervals.

Conflicts of interest:

There are no conflicts of interest in this study.

Acknowledgement:

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References

1. Gratton DG, Aquilino SA. Interim restorations. Dent Clin N Am. 2004;48(2):487-497.

2. Balkenhol M, Knapp M, Ferger P, Heun U, Wo¨ stmann B. Correlation between polymerization shrinkage and marginal fit of temporary crowns. Dent Mater. 2008;24(11);1575–1584.

3. Abouelatta O, El-Bediwi A, Sakrana A, Jiang X, Blunt L. Surface integrity of provisional resin materials. Meas Sci Technol. 2006;17(3):584–591.

4. Robinson FB, Hovijitra S. Marginal fit of direct temporary crowns. J Prosthet Dent. 1982;47(4):390–392.

5. Michalakis K, Pissiotis A, Hirayama H, Kang K, Kafantaris N. Comparison of temperature increase in the pulp chamber during the polymerization of materials used for the direct fabrication of provisional restorations. J Prosthet Dent. 2006;96(6): 418–423.

6. Ehrenberg D, Weiner G, Weiner S. Long-term effects of storage and thermal cycling on the marginal adaptation of provisional resin crowns: a pilot study. J Prosthet Dent. 2006;95(3):230–236.

7. Ehrenberg D, Weiner S. Changes in marginal gap size of provisional resin crowns after occlusal loading and thermal cycling. J Prosthet Dent. 2000;84(2):139–148.

8. Strassler HE. In-office provisional restorative materials for fixed prosthodontics: part 1 – polymeric resin provisional materials. Inside Dent. 2009;5(4):70–74.

9. Shillingburg HT, Hobo S, Whitsett LD, Jacobi R, Brackett SE. Fundamentals of fixed prosthodontics. 3th ed. Quintessence Publishing Company; 1997

10. Rosenstiel S, Land M, Fujimoto J. Contemporary fixed prosthodontics.4th ed. Mosby Elsevier Health Science; 2006.

11. Nejatidanesh F, Lotfi HR, Savabi O. Marginal accuracy of interim restorations fabricated from four interim autopolymerizing resins. J Prosthet Dent. 2006;95(5):364–367.

12. Ireland MF, Dixon DL, Breeding LC, Ramp MH. In vitro mechanical property comparison of four resins used for fabrication of provisional fixed restorations. J Prosthet Dent. 1998;80(2):158-162.

13. Young HM, Smith CT, Morton D. Comparative in vitro evaluation of two provisional restorative materials. J Prosthet Dent. 2001;85(2):129-132.

14. Haselton DR, Diaz-Arnold AM, Vargas MA. Flexural strength of interim crown and fixed partial denture resins. J Prosthet Dent. 2002;87(2):225-228.

15. Lang R, Rosentritt M, Behr M, Handel G. Fracture resistance of PMMA and resin matrix composite-based interim FPD materials. Int J Prosthodont. 2003;16(4):381-384.

16. Grajower R, Shaharbani S, Kaufman E. Temperature rise in pulp chamber during fabrication of temporary self-curing resin crowns. J Prosthet Dent. 1979;41(5):535-540.

17. Wang RL, Moore BK, Goodacre CJ, Swartz ML, Andres CJ. A comparison of resins for fabricating provisional fixed restorations. Int Prosthodont. 1989;2(2):173-184.

18. Barghi N, Simmons EW Jr. The Marginal Integrity of the temporary acryclic resin crown. J Prosthet Dent. 1976;36(3):274-277.

19. Venz S, Dickens B. NIR-spectroscopic investigation of water sorption characteristics of dental resins and composites. J Biomed Mater Res. 1991;25(10):1231-1248.

20. Braden M, Davy KW. Water sorption characteristics of some unfilled resins. Biomaterials. 1986;7(6):474-475.

21. Burns DR, Beck DA, Nelson SK. 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(5):474-497.

22. Ana M, Arnold D, Dunne JT, Jones AH. Microhardness of provisional fixed prosthodontic materials. J Prosthet Dent. 1999;82(5):525-528.

23. Michele F, Donna L, Dixon, Breeding LC, Ramp MH. In- vitro mechanical property comparison of four resins used for fabrication of provisional fixed restorations. J Prosthet Dent. 1998;80(2):158-162.

24. Monday IJ, Blais D. Marginal adaptation of provisional acrylic resin crown. J Prosthet Dent. 1985;54(2):194-197.

25. Moulding MB, Loney RW. Marginal accuracy of provisional restoration fabricated by different techniques. Int J Prosthodont. 1994;7(5):468-472.

26. Tjan AH, Castelnuovo J, Shiostu G. Marginal fidelity of crowns fabricated from six proprietary provisional materials. J Prosthet Dent. 1997;77(5):482-485.

27. Ferracane JL. Hygroscopic and hydrolytic effects in dental polymer networks. Dent Mater. 2006;22(3):211-212.

28. Nawafleh,Mack evans,Mackay. Accuracy and Reliability of Methods to Measure Marginal Adaptation of Crowns and FDPs: a literature review. J Prosthodont. 2013;22(5):419-428.

29. Al Rifaiy MQ. Evaluation of vertical marginal adaptation of provisional crowns by digital microscope. Niger J Clin Pract. 2017;20(12):1610-1617.

30. Verma R, Nagpal A, Verma PR, Chadda AS. Marginal Accuracy Of Provisonal Restoration Material Used In Fixed Partial Dentures An In-Vitro Study. Indian J Dent Sci. 2012;4(3):24-29.

31. Koumjian JH, Holmes JB. Marginal accuracy of provisional restorative material. J Prosthet Dent. 1990;63(6):639-642.

32. Gudapati S, Jagadish HG, Alla RK, Sajjan S, Ramya K, Naveen D. Evaluation and comparison of marginal fit of provisional restoration fabricated using light cureacrylic resin with other commercially available temporary crown resin materials. Trends Biomater Artif Organs. 2014;28(2):47-51.

33. Khosravanifard B, Nemati-Anaraki S, Nili S, Rakhshan V. Assessing the effects of three resin removal methods and brackets and blasting on shear bond strength of metallic orthodontic brackets and enamel surface. Orthod Waves. 2011;70(1):27–38.

34. Nivedita S, Prithviraj DR. A comparative study to evaluate the marginal accuracy of provisional restorations fabricated by light polymerized resin and autopolymerized resin: a scanning electron microscope study. J Indian Prosthodont Soc. 2006;6(3):122–127.

35. Givens EJ, Neiva G, Yaman P, Dennison JB. Marginal adaptation and color stability of four provisional materials. J. Prosthodont. 2008;17(2):97-101.

36. Nejatidanesh F, Lotfi HR, Savabi O. Marginal accuracy of interim restorations fabricated from four interim autopolymerizing resins. J Prosthet Dent. 2006;95(5):364–367.

37. Rastogi A, Kamble V. Comparative analysis of the clinical techniques used in evaluation of marginal accuracy of cast restoration using stereomicroscopy as gold standard. J Adv Prosthodont. 2011;3(2):69–75.

38. Kim SH, Watts DC. Polymerization shrinkage-strain kinetics oftemporary crown and bridge materials. Dent Mater. 2004;20(1):88–95.

39. Jafarzadeh-Kashi TS, Mirzaii M, Erfan M, Fazel A, Eskandarion V, Rakhshan V. Polymerization behavior and thermal characteristics of two new composites at five temperatures: refrigeration to preheating. J Adv Prosthodont. 2011;3(4):216–220.

40. Wassell RW, George GS, Ingledew RP, Steele JG. Crowns and other extra-coronal restorations: provisional restorations. Br. Dent. J. 2002;192(11):619-630.

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