Research Article

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# Evaluation of the Flexural Strength of Interim Restorative Materials in Fixed Prosthodontics

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## ABSTRACT

**Aim**: The purpose of this study was to compare the flexural strength of two interim restorative materials.

**Materials and Method**: Twenty identical samples sized 25×2×2-mm were made from two interim materials (TempSpan and Revotek LC) according to ADA specification No. 27. The specimens were stored in artificial saliva for 2 weeks and then thermocycled for 2500 cycles (5-55°C). A standard three-point bending test was conducted on the specimens with a universal testing machine at a cross- head speed of 0.75mm/min. Data were analyzed by using one-way ANOVA tests to measure the flexural strength of temporary materials.

**Results**: Bis-acryl resin (TempSpan) showed the highest, and the light polymerized resin (Revotek LC) showed the lowest flexural strength. The mean values of flexural strength for the examined materials were as follow: Temp- Span=120.00MPa and Revotek LC=47.16MPa. The one-way ANOVA test showed a significant difference between the flexural strength of 2 temporary materials ($p < 0.05$).

**Conclusion**: Bis-acryl resins were statistically superior light-cured resins. Therefore, application of bis-acryl resins should be deliberated in patients with heavy occlusion and in cases that need long-term use of interim restorations.

**Keywords:** Flexural strength, Interim restoration, Prosthodontics.

## INTRODUCTION

One of the most important components of fixed prosthesis is temporary restorations. During tooth preparation and before the insertion of final prosthesis, interim restorations must be delivered to patients. In prosthodontic treatment, the importance of provisional restorations is often ignored, resulting in problematic prosthesis which cannot protect the prepared teeth and supporting tissues sufficiently. [1,2] The desirable restoration should provide essential mechanical, biological, and esthetic properties to become successful.[3] In order to achieve these purposes, some important characteristics including polymerization shrinkage, wear resistance, color stability, and strength of resin must be considered.[4,5] From a mechanical viewpoint, the temporary restorative material should be chosen according to resistance to functional loads and removal forces.[3] One of the important aspects of provisional restorations, especially in case of long-span interim prosthesis

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with short-height pontics and connectors, is their flexural strength.[3] The flexural strength of interim prosthesis also plays a critical role in patients with para-functional habits, bruxism, or clenching.[6] It causes much difficulty for both the patient and clinicians to keep the interim restorations intact. Any probable breakage of the prostheses leads to tooth movement as well as functional and esthetic problems. In addition, a repairing procedure may be boring and time consuming.[7]

In accordance to their composition, the interim restorative materials are categorized to 4 groups; polymethyl methacrylate, polyethyl or butyl methacrylate, microfilled bisphenol A-glycidyl dimethacrylate (Bis- GMA) composite resin, and urethane dimethacrylate (light-polymerizing resins).[8,9]

Poly (methyl methacrylate) (PMMA) resins are relatively inexpensive; they render good color stability, good marginal accuracy, and excellent polishability. However, the main drawbacks of this type of resins are high polymerization shrinkage, exothermic polymerization, low strength, low wear resistance, and pulpal irritation as the result of excess free monomers. In comparison to PMMA resins, poly R′ methacrylates have low polymerization shrinkage and low exothermic reaction. However, they have limitations in clinical use such as low strength, low wear resistance, and low color stability. Bis-acryl composite resins are superior to methacrylate base resins as the result of their low polymerization shrinkage, low exothermic reaction, good wear re- sistance, and good strength. Nonetheless, they are expensive, brittle, less polishable, and much more difficult to repair.[10]

There is no interim material which can fulfill all requirements for every situation.[11,12] Therefore, clinicians always select their product based on the determinant factors such as cost effectiveness, esthetic, strength, marginal adaptability, and easy manipulation.[6]

As mentioned before, flexural strength is one of the significant characteristics of the interim fixed restorations which should be considered in multiple-unit or long-span prosthesis. Most previous studies have evaluated the flexural strength of interim prosthesis after polymerization. Limited studies have evaluated the effect of thermocycling on the interim material and its flexural strength.[13]

The purpose of this study was to evaluate the flexural strength of two interim restorative materials which include TempSpan, and Revotek LC after thermocycling. The null hypothesis was that there are not significant differences in flexural strength of these temporary materials.

## MATERIALS AND METHOD

Two interim restorative materials including TempSpan (**Pentron, SpofaDental a.s., Markova)** and Revotek LC (GC corporation, Tokyo, Japan) were used in this study. They were indicative of the two types of interim materials described previously. A aluminium split mold was used to make specimens of 25×2×2-mm dimensions according to ADA specification no. 27 (Figure 1).[6] The interim materials were prepared according to the instructions of the manufacturing company; then they were injected to the mold. TempSpan were mixed automatically by using dispenser tip. Revotek LC was put into the mold by hand and a spatula.

Fig 1: Aluminium split mold for making specimens.

A weight of 1.5 kg was fixed on the glass slab placed on the surface of the mold to remove the excess material from the mold, and to apply required pressure for complete polymerization. After the polymerization, samples were taken out of the mold and were precisely evaluated to detect any air bubbles. Problematic specimens were excluded from the study. Finally, the samples were polished according to the manufacturers' instructions.

For each material, 10 samples were made, and stored in artificial saliva at 37°C for 2 weeks. They were then thermocycled for 2500 cycles between 5°C and 55°C. To measure the flexural strength of specimens, they were taken under the three-point bending test and placed on a universal testing machine with 0.75 mm/min crosshead speed (Figure 2).[6]

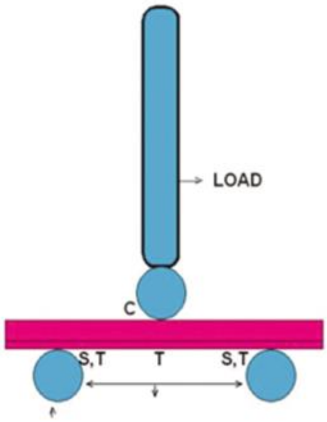


Fig 2: Schematic diagram showing the testing of flexural strength of specimens under the three-point bending test

The fracture force was recorded in Newton and calculated in MPa by the following formula:

S=3FL/2WH2

In this equation S=flexural strength, F=maximum fracture load, L=length of the specimen, W=width of the specimen, and H=height of the specimen.

Finally, data were analyzed by using one-way ANOVA test to measure the flexural strength of temporary materials. For all statistical analyses, the significance level of $P= 0.05$ was used.

## RESULTS

The one-way ANOVA test showed a significant difference between the flexural strength of two temporary materials ($p< 0.05$).The flexural strength in TempSpan (mean=120.00, max=124.00, and min=115.00) was more than Revotek LC (mean=113.00, max=119.00, min=106.00).

## DISCUSSION

In this study the flexural strength of two interim resin materials TempSpan (bis acryl based resin) and Revotek LC (PMMA based Resin) were evaluated. Laboratory values of flexural strength under static loading may not reflect intraoral conditions; however, these values can help us to compare materials under controlled situations. They can also be considered as a useful predictor of clinical performance.[14]

In order to partially simulate oral environment, the specimens were stored in artificial saliva for 2 weeks and thermocycled for 2500 cycles between 5°C and 55°C. Then, all samples were examined by using the standard three-point bending test.

According to the results of this study, TempSpan resins had the highest flexural strength. This result is similar to those of previous studies which proved that the flexural strength of bis-acryl resins was higher than other conventional interim restorative materials.[7,8,14-18] Revotek LC showed lower flexural strength than bis-acryl resins. Thus, the null hypothesis was rejected and significant differences were observed between flexural strength of the interim materials under examination.

Differences between flexural strength of methacrylate base and bis-acryl resins is due to different monomer compositions. Multifunctional monomers of bis- acryl resins (such as Bis-GMA or TEGDMA) increase the strength of a resin as a result of cross-linking with other monomers.[19] Additional inorganic fillers of these materials can also improve the strength and microhardness.[17,18] Besides all these virtues, the physical properties of composites and polyacid modified composites may be enhanced by a protective layer over the surface of these restorative materials. [19]

On the other hand, conventional methacrylate resins are of low molecular weight, mono-functional, and have linear molecules which can reduce the strength and rigidity of restorations. Additionally, if they are not polymerized under pressure, their strength will decrease due to the trapped air bubbles.[5,16, 20]

One of the limitations of this study was the weak correlation between monotonic flexural strength and resistance to fatigue loading. The fatigue tests proved to be more pertinent than monotonic flexural strength. Therefore, testing materials under one consistent load may be inadequate to provide relevant information for long-term clinical performance.

## CONCLUSION

According to the present study, it can be concluded that bis-acryl interim materials present higher flexural strength than methacrylate-based resins. Therefore, application of bis-acryls in patients with heavy occlusion can be considered. It seems that these interim restorations might work in long-term use. According to our results, we can also suggest the application of dual curing temporary materials when high mechanical strength is needed.

## CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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