Flexural Strength of Provisional Crown and Fixed Partial Denture Resins

Sawsan Badr Sehaqi[1], Anfal Abdullah Almohammed Saleh[2], Dhay Abdullah a.al Tawi[1], Maha Salem Baaboud[1], Abrar Almarzouq[2], Maryam Alhaddad[2], Danh Abdullah Almalki[1], Marwah Radi Alnasser[2], Naif Abdullah Abu Rass[3], Mohsen Shinpir Mohsen[1]

1 Batterjee Medical college for science & technology,2 Riyadh Colleges of Dentistry and Pharmacy (RCsDP),3 Ibn Sina National College

Corresponding author: Sawsan Badr Sehaqi, dr.sawsan.rayan@hotmail.com, 0550445568.

Abstract

Purpose: The purpose of this study was `to appraise the fracture strength of provisional crown and fixed partial denture resins with an in vitro test system. **Materials and Methods:** Bar-type specimens were fabricated according to American National Standards Institute/American Dental Association specification number 27. Reinforcement materials; polyethylene fiber and glass fiber are compared. Provisional crown-bridge materials are autopolymerising Poly Ethyl Metacrylate (PEMA), autopolymerising Poly Methyl Metacrylate (PMMA), bis-acryl composite resin and light cured composite resin). A total of 150 specimens are arranged for the flexural strength test. The specimens are divided into 5 groups according to the type of resin used (Dentalon Plus, Tetric Ceram, Charisma, Protemp 3, TAB 2000) and then every group was distributed into 3 subgroups rendering to the type of fiber reinforcement (Construct, Fiber-splint ML). Unreinforcement specimens functioned as the control. Specimens were fractured in a universal testing instrument until the point of rupture. Mean flexural strengths were calculated in MPa. Comparisons were completed with analysis of variance and then Duncan's multiple range tests. **Results**: Mean flexural strengths ranged from 63.45 to 397.8 MPa. There are statistical difference between the groups (Fiber-splint ML, Construct and control). **Conclusion**: Flexural strengths were material- rather than classification precise. Several, but not all, bis-acryl resins validated expressively superior flexural strength over traditional methacrylate resins. There was significant difference between Fiber-splint ML, Construct and control group.

Keywords: Flexural strength, Bis-acryl composite resin, Provisional crown.

Introduction

Provisionalization of settled reclamations is a basic piece of the treatment before arrangement of the last rebuilding efforts. The quick defensive, utilitarian, and balancing out estimation of break rebuilding efforts are helpful for symptomatic purposes where the useful, occlusal, and stylish parameters are produced to distinguish an ideal treatment result before the culmination of conclusive techniques [1]. While choosing a material for a brief restoration, physical and machine-driven properties of the materials ought to be considered. Clinically critical properties incorporate quality of the material, its unbending nature and reparability, exothermic response following polymerization and ensuing polymerization shrinkage, peripheral uprightness and shading soundness. By and by there is no single material that meets the ideal necessities for every one of the circumstances [2]. Be that as it may, there are materials that have been effectively utilized for this reason. These are Poly Methyl Methacrylate Resins (PMMA), Poly Ethyl Methacrylate Resins (PEMA), vinyl ethyl methacrylate pitches, butyl methacrylate, epimine, preformed networks of plastic and cellulose shells, metals, polycarbonate materials, bis-acryl composites, bis-GMA composites, Urethane Di Methacrylate Resins (UDMA) [3].

Temporary materials for the most part show low break qualities, especially when the patient must utilize the temporary rebuilding for an amplified period, when the patient have parafunctional propensities, or when long-traverse prosthesis is arranged [4].

Imperviousness to useful load and expulsion powers which are mechanical variables must be considered while picking a temporary remedial material for clinical utilize. Temporary rebuilding efforts are manufactured

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utilizing gum based temporary crown and scaffold materials [5]. Break settled helpful materials can be separated into four gatherings as per creation: polymethyl methacrylate (PMMA), polyethyl or butyl methacrylate, microfilled bisphenol A-glycidyl dimethacrylate (Bis-GMA) composite tar, and urethane dimethacrylate (light-polymerizing tars) [6]. While ethyl methacrylates have poor feel and wear resistance, methyl methacrylates and bis-acryl gum composites are better with respect than those properties. Traditional methacrylate gums are monofunctional, low sub-atomic weight, straight particles that display diminished quality and unbending nature. Likewise, on the off chance that they are not polymerized underweight, the air pockets will be caught and diminish their quality [7]. The essential monomer decides a significant number of the material attributes, for example, polymerization shrinkage, quality, and exothermic warmth of response [6]. PMMA tar has a moderately poor imperviousness to worry under effect, twisting, and weakness modes. Past examinations have assessed the negligible fit, polymerization shrinkage, periodontal reaction, temperature rise, shading soundness, and crack resistance of different temporary materials. By and by, there is no temporary material that meets ideal necessities for all circumstances [8].

Clinicians regularly pick an item in light of the simplicity of control, feel, and cost. Autopolymerizing acrylic sap is normally the biomaterial for temporary rebuilding efforts. Nonetheless, when long haul temporary settled rebuilding efforts supplant a few teeth, the quality and steadiness of the prosthesis is basic [9]. The idea of utilizing fibers to strengthen an interval rebuilding seems to have a worthy rate of accomplishment. With the late presentation of enhanced fiber fortifying materials, this has turned out to be progressively advantageous. Be that as it may, light cured composite tars with fiber fortification are not normally utilized as a part of provisional crown and bridges [10]. Bis-acryl composite were acquainted with a point with defeat the negatives of the methacrylate [11]. They are accessible as preloaded syringes or cartridges and blended through an auto blending tip. This gives steady blend no air fuse into the last blend. Bis-acryl composites comprise of bi-utilitarian substrates to give cross linkage each other and shape monomer affix cross linkage prompting increment in affect quality and strength [12]. They likewise contain inorganic fillers to build their scraped spot resistance. Bis-acryl composite pitches have low polymerization shrinkage [11], low exothermic response, diminished tissue poisonous quality, great wear resistance and quality. In any case, these materials are costly, weak and have less clean capacity and their repair is troublesome. The motivation behind this investigation was to contrast the impacts of and without two unique sorts of fibers on the flexural quality of warm polymerising Poly Methyl Methacrylate (PMMA), auto polymerising Poly Ethyl Methacrylate (PEMA), auto polymerising Poly Methyl Methacrylate (PMMA), bis-acryl resins and light cured composite resin.

The aim of this study is to compare the effects of with and without two different types of fibers on the flexural strength of heat polymerising Poly Methyl Methacrylate (PMMA), auto polymerising Poly Ethyl Methacrylate (PEMA), auto polymerising Poly Methyl Methacrylate (PMMA), bis-acryl resins and light cured composite resin.

Materials and Methods

Ten bar-molded specimens with measurements of 25×2×2mm (American National Standards Institute/American Dental Association determination no. 27)[13]. were created for every material with the utilization of a split machined aluminium mould sandwiched between two glass chunks. The fiber-fortified examples were produced using pre-cut 23-mm–long filaments which were wetted utilizing the polymer monomer blend (PMMA, PEMA) and holding operator (bis-acryl), and afterward these were set in the base side of the shape pit with gum connected on top of strands. A weight of 2.5kg was connected. All materials were blended and polymerised by the producers' directions.

The examples were put away in refined water at 37 o C for 10 days. After this period, examples were situated on a flexural quality testing mechanical assembly with 10mm bolster detachment. A 3-point twist test was done in an all-inclusive testing machine (Instron; M12-13667-EN) with a 10kN load cell at a crosshead speed of 1mm/minute. The

drive was connected on examples to the tar side. The strength at fracture was recorded in MPa utilizing testing machine programming. The statistical examination was performed utilizing the SPSS 10.01 program. The data was statistically examined for contrasts utilizing one-path Analysis Of Variance (ANOVA) and different examinations were made utilizing Duncan's multiple range test.

Table 1: Materials used in this study

Product name	Manufacturer	Composition type
Protemp 3	3M ESPE AG D-82229 Seefeld, Germany	Bisacryl resin
Dentalon plus	Heraus Kulzer Gmbh, Hanau, Germany	Poly Ethyl Methacrylate
TAB 2000	Kerr, 1717 W.Collins Ave. Orange, CA 92867 Italy	Poly Ethyl Methacrylate
Charisma	Ivoclar Vivadent AG, FL-9494, Schaan; Liechtenstein	Visible light curing composite
Tetric ceram	Heraus Kulzer Gmbh, Hanau, Germany	Visible light curing composite

Results

The mean flexural strengths and standard deviations are presented in Figure 1. The highest average flexural strength value was found in the Charisma with Construct fiber reinforcement (397.8 MPa). The lowest average flexural strength value was found in the Dentalon Plus without fiber reinforcement (63.5 MPa). The second highest average flexural strength value was found in the Tetric ceram with Construct fiber reinforcement (383.7 MPa). The second lowest average flexural strength value was found in the Dentalon Plus fiber reinforcement (79.3 MPa). A significant difference between the Fiber-splint ML, Construct and the control group in Figure 2 was observed. There was a significant increase in the specimens with reinforced fiber. Statistically, by using Duncan multiple range tests, the results revealed the flexural strength of Tetric Ceram and Charisma was significantly higher than Dentalon Plus and TAB 2000. However, there was no significant difference between the Protemp 3 and Tetric Ceram in Figure 3.

Figure 1. Mean flexural strengths and standard deviations

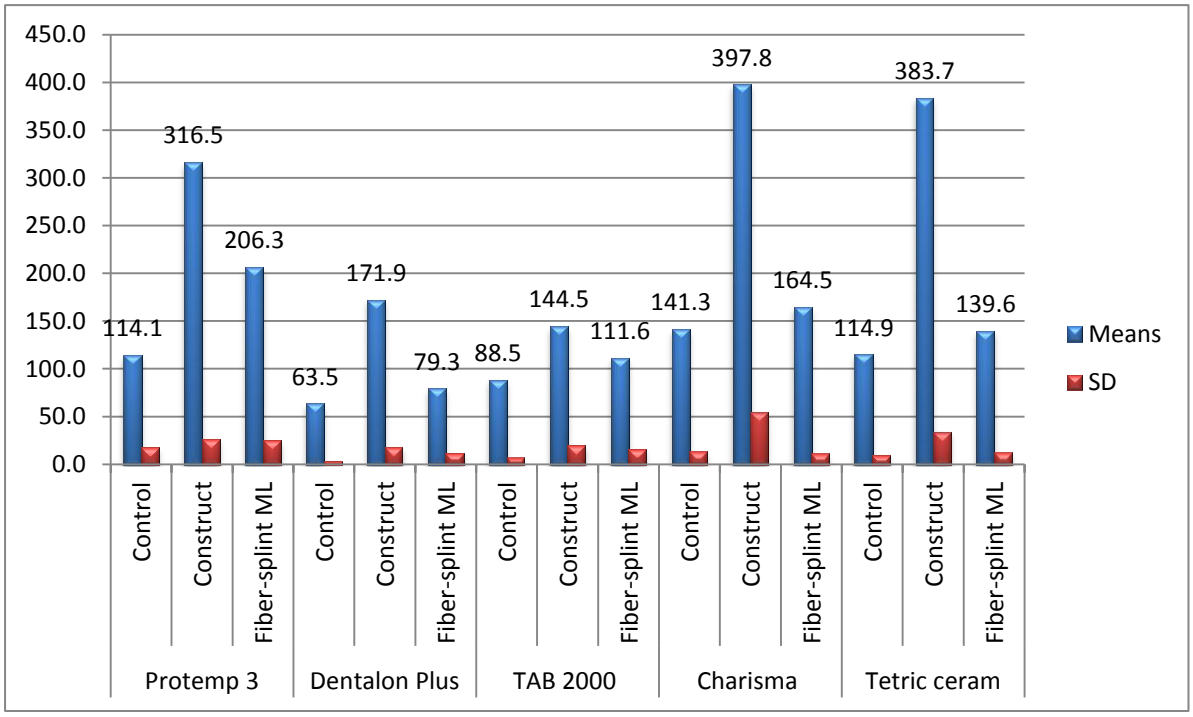
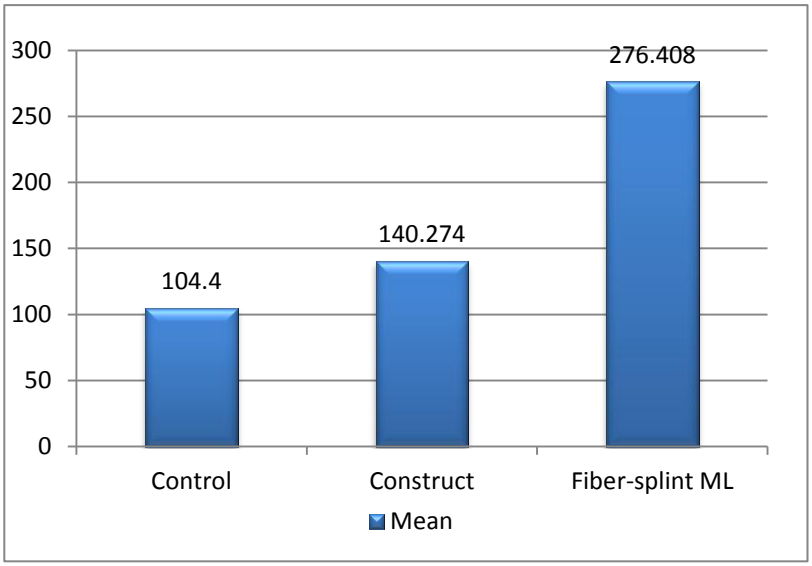


Figure 2: Mean flexural strengths for fiber-reinforcement groups

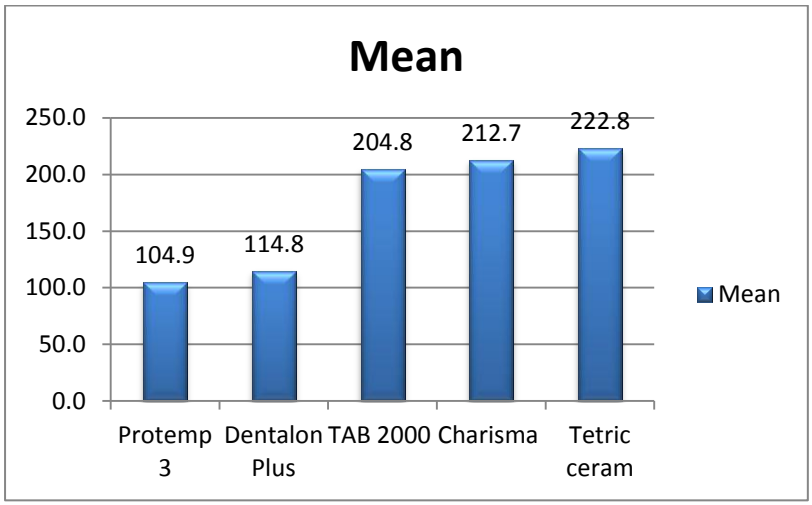


The standard deviation of flexural strength of Protemp 3 with control, construct and Fiber-splint ML were found to be 17.5, 26.4 and 25.2 respectively. The standard deviation of flexural strength of Dentalon Plus with control, construct and Fiber-splint ML were found to be 3.6, 18.1 and 12 respectively. The standard deviation of flexural strength of TAB 2000 with control, construct and Fiber-splint ML were found to be 7.3, 19.9 and 16.3 respectively. The standard deviation of flexural strength of Charisma with control, construct and Fiber-splint ML were found to be 13.4, 54.9 and 11.1 respectively. The standard deviation of flexural strength of Tetric ceram with control, construct and Fiber-splint ML were found to be 9.8, 34 and 12.3 respectively.

In this examination, five provisional crown materials and two fibers were assessed for flexural quality. While flexural quality esteems acquired in lab under static load may not mirror the conditions found in the oral condition, it is valuable to look at temporary materials tried in a controlled circumstance. Quality esteems might be a valuable indicator of clinical execution. The utilization of filaments to fortify a temporary rebuilding appears to have an adequate achievement rate [14]; as a result of the current advances in the creation of enhanced fiber-strengthening materials [15]. Various examiners have affirmed the fortifying impact of filaments on various polymer sorts [15, 16].

This is in concurrence with the after effects of this examination, which uncovered that the lion's share of tried strands expanded the flexural quality of temporary rebuilding gums. The clarification for this expansion was the exchange of worry from the powerless polymer grid to the filaments that have a high elasticity [14]. The more grounded bond between the fiber and the grid, the more noteworthy the reinforcing impact [17]. Truth be told, the nearness of ineffectively reinforced filaments, to which little load is exchanged, can be practically equal to voids [18].

Figure 3: Mean flexural strengths and standard deviations for resins



Discussion

One way to deal with increment the grip of strands to a polymer framework is tar impregnation of filaments before application. A compelling impregnation prepare enables the sap to come into contact with surface of each fiber. Wetting the filaments with a monomer has been a regularly utilized technique. Be that as it may, in spite of the fact that the monomer expands the grip of filaments to the framework, it might impede different properties in view of the leftover monomer. The pre-impregnated fiber-build utilized as a part of the present investigation was created to beat this issue and contrast and the non-pre-impregnated e-glass fiber. The level of fiber grip to the polymer lattice likewise contrasts as per the kind of fiber utilized. A few surface medications of polyethylene filaments have endeavored to take care of this issue, including plasma showering, compound, fire, and radiation medicines. Build comprises of pre-impregnated silanized plasma treated polyethylene strands. The present examination demonstrated that there was a noteworthy distinction between the strengthening impact of construct polyethylene strands and Fiber-prop ML glass fiber. The enhanced execution of the construct item might be because of the utilization of silane, and also plasma treatment to expand the level of bond of the polyethylene strands to the pitch. The outcomes uncovered better fortifying impacts for all tars tried with construct instead of with Fiber-support ML. The present investigation demonstrated that there was a distinction in the consequences of the flexural quality test. This distinction might be caused by Fiber-brace ML glass fiber that is not pre-impregnated. When utilizing fortified temporary gum materials clinically, it might be gainful to pick a blend that, albeit inclined to breaking, is held together by in place filaments. This may avoid calamitous disappointment and may diminish tolerant distress and unscheduled arrangements. Both unreinforced and Fiber-brace ML fortified examples indicated undesirable finish partition. With the rest of the gatherings, the strands were in place, and the crack ceased at the fiber area, proposing that utilization of these filaments might be valuable in fortifying settled temporary rebuilding efforts, which might be utilized for developed periods[18].

PMMA resins are generally reasonable, with great shading soundness, astounding polish ability, and great minor adjustment. The significant disadvantages of this gathering of pitches incorporate exothermic polymerization, high polymerization shrinkage, low quality and wear resistance, and pulpal bothering related with abundance free monomer. Poly (R′ methacrylates) have low polymerization shrinkage and low exothermic response when contrasted with PMMA gums; however low quality, low wear resistance, and low shading solidness constrains its use. Bis-acryl composite resins have low polymerization shrinkage, low exothermic response, great wear resistance, and great quality; be that as it may, these

materials are costly, fragile, have less polish ability, and their repair is troublesome. Unmistakable light-cured urethane dimethacrylates have controllable working time, great wear resistance, low temperature changes, and great shading strength. Their hindrances incorporate poor peripheral fit, weak nature, and high cost. Choice of a material should think about every one of the properties of the material notwithstanding its flexural quality and hardness. It ought to be specified that flexural quality is just a single of various variables impacting the achievement of a between time prosthesis. A solid material may have different less attractive qualities. For instance, a remedial material might be hard to control, have inclination to recolor effectively, need polish ability, or not be tastefully satisfying [12]. There are no distributed investigations with respect to precisely which measured mechanical properties may best guide the clinician in foreseeing in vivo execution of temporary remedial materials. The clinician must know about all properties of different materials and pick the between time material suitable for every patient [19].

Rendering to **Lang R *et al.* [20],** PMMA materials presented water absorption up to 32µm/mm, mainly due to the polar properties of the resin molecules, which might act as a plasticizer and consequently decrease the fracture strength of the material. **Rawls *et al.*** [21], specified that when water breaches into the space between the polymer chains and pushes them more separately, the Van der Waals forces between the polymer chains decline. This adds weight and effects volume to intensify. The bigger the absorption of water by the material, lower the strength. Additional purpose might be the degree of polymerization which is low for these materials leading to higher residual monomer content 3%-5%, which acts as an internal plasticizer [22]. **Anusavice [23]** specified the residual monomer is solvable and leaches out for the period of storage, more decreasing the strength and hardness.

Conclusion

Within restrictions of this *in vitro* contemplate, it may be concluded that the flexural strength of provisional restorative materials are not meaningfully influenced by storage in different solutions. Bis-acryl provisional materials exhibited higher flexural strength than the methacrylate resins. The accompanying focuses were found: Obvious light curing composites show higher flexural quality than other provisional restorations and the utilization of strands is a successful strategy for expanding flexural quality of temporary reclamation resin.

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