GSAR Journal of Applied Medical Sciences ISSN: 2584-2323 (Online)

GSAR Journal of Applied Medical Sciences
ISSN: 2584-2323 (Online)
Frequency: Monthly
Published By GSAR Publishers
Journal Homepage Link- https://gsarpublishers.com/gsarjams-home/

PROVISIONAL RESTORATIVE MATERIAL IN FPD

By

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Article History

Received: 15/06/2025
Accepted: 27/06/2025
Published: 29/06/2025

Vol – 2 Issue – 6

PP: -08-11

Abstract

Provisional restorations play a pivotal role in fixed and removable prosthodontic treatment, acting as a functional and esthetic intermediary until the placement of definitive prostheses. These restorations not only protect prepared teeth and maintain occlusal relationships but also provide an opportunity to evaluate the form, function, and esthetics prior to final cementation. A wide range of materials is available for provisional restorations, including polymethyl methacrylate (PMMA), poly ethyl methacrylate (PEMA), bis-acryl composite resins, and light-cured resins, each with distinct physical and handling properties. The selection of an appropriate material depends on multiple factors such as duration of use, esthetic demands, mechanical strength, and biocompatibility. Recent advancements have introduced CAD/CAM fabricated provisional and nanotechnology-enhanced materials, offering improved performance and predictability. This review aims to provide an in-depth analysis of various provisional restorative materials, highlighting their properties, advantages, limitations, and clinical considerations, thereby guiding clinicians in making informed material choices for optimal patient outcomes.

INTRODUCTION

Provisional restorations play a vital role in fixed prosthodontics, serving as a temporary phase between tooth preparation and the placement of the final prosthesis. They are essential not only for maintaining esthetics and function but also for protecting the prepared abutments and supporting tissues. In fixed partial dentures (FPD), the importance of provisional restorations extends further to preserving occlusion, preventing tooth movement, and aiding in the evaluation of esthetic, phonetic, and functional parameters before final cementation.

An ideal provisional restoration should be biologically compatible, mechanically durable, and esthetically acceptable. It should protect the pulp from thermal, mechanical, and chemical trauma, prevent super-eruption or drifting of teeth, and support gingival contours to promote tissue healing. Over the years, advancements in materials have significantly improved the performance of provisional restorations, making them more user-friendly and clinically predictable.

Provisional materials used in FPDs are broadly classified into acrylic-based resins and composite-based resins. Each category offers specific advantages and limitations, and material selection often depends on the clinical situation, required duration of use, and operator preference. With innovations in direct and indirect fabrication techniques, these materials continue to evolve, enhancing the quality and efficiency of fixed prosthodontic care.

REVOLUTION IN PROVISIONAL RESTORATIVE MATERIAL

In 1965, stock crown was luted with thick consistency of zinc oxide and eugenol,[1] and Donald *et al*. in 1971[2] suggested an indirect technique for the construction of acrylic resin temporary restorations.

In 1988,[3] Triad visible light-cured (VLC) material has the same mechanical properties but the abrasion resistance and wear resistance are higher than the conventional PMMA acrylic resin provisional crown as well as fixed partial denture, and recommended Triad VLC material fixed partial denture for patients sensitive to PMMA.

Gegauff *et al*. in 1995 [4] found that the fracture toughness for the wet and dry test environment of light-initiated urethane dimethacrylate resin was similar and had superior higher fracture toughness than the unfilled PMMA resin.

Hazelton in 1995[5] proposed stainless steel orthodontic band for the reinforcement of provisional restorations for both short-span and long-span situations.

Lee *et al*. in 2002 [26] mentioned that the temperature used for polymerization of resin was the governing factor for improving hardness, but the water was the governing factor to

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reduce the residual monomer. The pressure used for flasking does not have any significant role on the properties of resin.

Neveen M. Ayad *et al*. in 2008 [7] mentioned that performance of fixed temporary prosthesis was improved after reinforcement of high-impact resin with zirconia powder.

Sodagar *et al*. in 2013 [8] suggested that the flexural strength of resin is grossly improved with the incorporation of nano-TiO_2 and SiO_2 particles.

However, nanoclay material had pessimistic effect on the properties.[9] The addition nano-ZrO_2 increase the tensile strength but the translucency of the PMMA resin was lessened,[10] but the dimensional accuracy was raised and the impact strength decreased.[11]

Oleiwi *et al*. in 2019 [12] concluded that the hardness and compressive strength were improved with concentrations of rice husk and bamboo powders.

PROPERTIES OF PROVISIONAL RESTORATI VE MATERIAL

1. It should be made up of a biocompatible material
2. It should not elicit any allergic reactions in the oral cavity
3. Easy to manipulate and should have adequate working time
4. Strength to withstand the forces
5. Color should match with the adjacent tooth structure
6. It should be of adequate color stability and translucency.[13]

FUNCTIONS OF RESTORATIVE MATERIAL

Provisional restorative materials serve a wide range of essential functions in prosthodontics and implantology. They are designed to temporarily restore esthetics, mastication, and phonetics while protecting the underlying structures until the placement of definitive restorations.

1. Pulp protection
2. Preservation of periodontal health
3. Structural support
4. Mechanical durability
5. Dimensional stability

CLASSIFICATION BASED ON TYPES OF MATERIAL

MATERIAL USED AS PROVISIONAL RESTORATIVE RESIN

CHEMICALLY ACTIVATED POLYMETHYL METHACRYLATE [PMM A]

In 1940, chemically activated PMMA resin was introduced. They have good wear resistance, good esthetics, good color stability, and cost-effective.

However, they released a significant amount of exothermic heat during polymerization reaction. They have shrinkage of about 8%, objectionable odor, less working time, poor color stability, and difficult to repair.[14]

HEAT ACTIVATED POLYETHYL METHACRYLATE [PEMA]

This material offers good strength and fracture resistance, making it suitable for long-term temporary restorations.

However, the heat activation process causes greater shrinkage during cooling and involves a more complex laboratory procedure compared to other activation methods. As a result, heat-activated PMMA is generally not preferred for fabricating provisional restorations.[15]

BIS-ACRYL COMPOSITE RESIN

Bis-acryl composite resins are known for their excellent esthetics, ease of handling, and minimal shrinkage. They exhibit good strength and marginal adaptation, making them suitable for short to medium-term provisional restorations. However, they are more brittle than PMMA and may fracture under heavy occlusal load or during removal. During the polymerization of bis-acryl provisional restorative materials, a superficial film known as the oxygen-inhibited layer is often formed. Clinically, this layer is advantageous as it allows for chemical bonding with additional layers of bis-acryl material during relining, margin refinement, or occlusal adjustments. However, if left unpolished, the oxygen- inhibited layer can act as a plaque-retentive surface, compromising both esthetics and hygiene. Therefore, proper finishing and polishing are recommended to enhance the restoration's longevity and biocompatibility.[16]

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POLY-P METHACRYLATE

Poly(methyl methacrylate) (PMMA) is commonly used as a provisional restorative material in prosthodontics due to its ease of handling, affordability, and favorable esthetic properties. It is often selected for temporary crowns and bridges, especially in long-span cases. PMMA offers decent strength and durability; however, traditional heat-cured PMMA can undergo significant polymerization shrinkage and requires a time-consuming laboratory process. To address these limitations, advancements have been made through chemical modifications and the incorporation of reinforcing agents like fibers and nanoparticles, which enhance its thermal properties, flexural strength, and resistance to water sorption. These improvements make PMMA a reliable option for interim prosthetic solutions [17]

RESIN COMPOSITE

Resin composites are widely used for provisional restorations due to their favourable aesthetics and handling properties. Their mechanical performance is influenced by the type and amount of inorganic filler content as well as the composition of the resin matrix. In a comparative study of five commercial resin composites, variations were observed in flexural strength, wear resistance, surface hardness, water absorption, and staining behavior. Notably, all materials showed a reduction in flexural strength after water storage and thermal cycling, suggesting susceptibility to degradation under oral conditions. A positive correlation was found between flexural strength and dynamic hardness, while increased wear depth negatively affected strength. [18]

VISIBLE LIGHT CURED RESIN

It was introduced in the 1980s and they require urethane dimethacrylate resin where the curing is initiated with camphorquinone/amine photo. (400 and 500 nm) and activated with visible light. Light-cured composite resins are available in light- proof syringe single-paste system. The ingredients can be mixed by the manufacturer with little porosity, and working time is infinite because no setting occurs if the material is kept in a dark environment. But the depth to which visible light can penetrate (less for darker materials).[19]

DUAL POLYMERIZING COMPOSITE RESIN

Dual-polymerizing composite resin materials are combination of chemically polymerized bis-acryl and light-polymerized urethane dimethacrylate resins. The curing depth is better than light-cured resin, it is not used in cementation of bulky ceramic inlays and porosity are problems with dual-cure resins.[19]

RECENT ADVANCES IN PROVISIONAL RESTORATIVE MATERIAL

NANOPARTICLE INCORPORATION

Zirconium oxide, aluminum, and titanium nanoparticles were added to unfilled methyl methacrylate resin to facilitate strength of the resin matrix by interrupting crack propagation, which tends to increase the modulus of elasticity, transverse strength, toughness, and hardness. [20,21] The incorporation of SiO_2 nanoparticles into autopolymerized polymethyl methacrylate resin is helpful for improving the flexural modulus and strength.

DIGITAL INTERIM FIXED RESTORATION

Computer-aided design and computer-aided manufacturing (CAD-CAM) has emerged as a contemporary technique in the fabrication of interim fixed restorations, offering enhanced precision in anatomical detail reproduction.

These restorations are typically milled from pre-polymerized blocks or discs characterized by high density, significantly minimizing porosity and polymerization shrinkage when compared to conventional provisional materials. [22] The advantages of CAD-CAM systems are now broadly acknowledged, especially for their ability to offer reliable treatment solutions in complex clinical scenarios. These include cases requiring extensive rehabilitation, managing occlusal discrepancies in temporomandibular disorders, modifying vertical dimension, or allowing time for healing in implant or pontic areas.

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Additionally, the digital workflow enables patients to preview esthetics, functionality, and comfort prior to the final restoration fabrication.[23]

CONCLUSION

Provisional restorations play a vital role in protecting prepared teeth, maintaining function, aesthetics, and periodontal health during the interim period before final restoration placement. The choice of material whether preformed or custom-fabricated must be based on clinical requirements, patient needs, and the expected duration of use. Advancements in material science have improved the strength, aesthetics, and handling properties of provisional materials, ensuring better patient satisfaction and clinical outcomes.

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