

EVOLVING MATERIALS IN DENTAL TEMPORISATION: PROPERTIES, APPLICATIONS, AND CLINICAL IMPLICATIONS

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ABSTRACT

Temporary restorations, commonly referred to as provisional restorations, are indispensable components of restorative and prosthetic dentistry. Their primary role is to protect prepared teeth, maintain occlusion, preserve periodontal health, and provide esthetics and function until definitive restorations are delivered. The evolution of temporisation materials has been marked by innovations aimed at improving strength, esthetics, biocompatibility, and clinical handling. Traditionally, acrylic resins such as polymethyl methacrylate (PMMA) and polyethyl methacrylate (PEMA) were widely used; however, their limitations in terms of polymerisation shrinkage, heat generation, and marginal adaptation led to the development of bis-acryl composites, light-cured resins, and more recently, computer-aided design/computer-aided manufacturing (CAD/CAM) milled and three-dimensional (3D)-printed materials. Other adjunctive options such as polycarbonate crowns, glass ionomer-based provisionals, and resin-modified systems also play a role in specific clinical scenarios. This article reviews the spectrum of temporisation materials, their properties, comparative advantages, limitations, and clinical applications. Future directions such as nanofilled composites and bioactive provisionals are also discussed, highlighting the trajectory towards biologically integrative and technologically advanced solutions.

Keywords: Temporisation, provisional restoration, PMMA, bis-acryl composites, CAD/CAM, 3D printing, dental materials

INTRODUCTION

Temporisation refers to the fabrication and placement of provisional restorations that temporarily replace prepared teeth before final restorations are delivered. These restorations serve multiple functions: protection of dentin and pulp, maintenance of periodontal health, prevention of occlusal drift, restoration of aesthetics and phonetics, and patient comfort during the interim period [1,2].

Historically, acrylic resins such as polymethyl methacrylate (PMMA) dominated provisional dentistry due to their ease of use and affordability [3]. However, their limitations, particularly exothermic polymerisation and poor marginal adaptation, created the need for improved alternatives. The introduction of bis-acryl resin composites in the 1980s marked a significant advancement, providing improved mechanical and aesthetic properties [4]. The advent of digital dentistry has further expanded options, with CAD/CAM-milled PMMA blocks and 3D-printed resins increasingly being employed for provisionalization [5].

The choice of temporisation material directly influences clinical outcomes. Inadequate provisionals can lead to pulpitis, gingival inflammation, occlusal disturbances, and compromised aesthetics [6]. Thus, understanding material properties and indications is essential for optimal treatment planning.

This article critically reviews the different categories of

temporisation materials, compares their clinical performance, and outlines future directions in provisional dentistry.

REQUIREMENTS OF AN IDEAL TEMPORISATION MATERIAL

An ideal temporisation material should fulfil biological, mechanical, aesthetic, and practical requirements. These include [7,8]:

1. Biological requirements: Biocompatibility, non-irritant to pulp and gingiva, minimal heat during setting, and resistance to bacterial leakage.
2. Mechanical requirements: Adequate strength to resist fracture, wear resistance, dimensional stability, and good marginal adaptation.
3. Aesthetic requirements: Color stability, translucency, polishability, and shade matching with adjacent teeth.
4. Practical requirements: Ease of manipulation, rapid setting, repairability, affordability, and availability in various forms.

No single material currently satisfies all these criteria, necessitating material selection based on clinical circumstances.

CLASSIFICATION OF TEMPORISATION MATERIALS

Provisional materials can be broadly classified as follows [9]:

1. Acrylic resins
 - Polymethyl methacrylate (PMMA)

- Polyethyl methacrylate (PEMA)

2. Composite-based resins

- Bis-acryl composites
- Light-cured resins
- Fiber-reinforced composites

3. CAD/CAM and 3D printing materials

- Prefabricated PMMA blocks
- 3D-printed resins

4. Other systems

- Polycarbonate crowns
- Glass ionomer-based provisionals
- Resin-modified provisionals

Acrylic-Based Materials

1. Polymethyl Methacrylate (PMMA)

PMMA is one of the earliest and most widely used materials for temporisation. It is supplied as a powder-liquid system, polymerising via a free-radical exothermic reaction [10].

Advantages:

- Excellent aesthetics and translucency
- Ease of repair and adjustment
- Cost-effective and widely available

Disadvantages:

1. High exothermic reaction, risking pulpal injury
2. Polymerisation shrinkage leading to poor marginal adaptation
3. Low fracture toughness and brittleness
4. Residual monomer release causing tissue irritation

2. Poly-ethyl Methacrylate (PEMA)

PEMA was developed to address PMMA's shortcomings. It has a lower exothermic reaction and reduced polymerisation shrinkage [11].

Advantages:

1. Lower heat generation, safer for pulpal tissues
2. Less shrinkage, improved marginal fit
3. Flexible, reducing risk of fracture

Disadvantages:

1. Inferior aesthetics compared to PMMA
2. Weaker mechanical properties, limited to short-term use

Composite-Based Materials

Bis-Acryl Composites

Bis-acryl materials represent a significant advancement over acrylics. They are available as cartridge systems with

automixing tips, ensuring consistent proportions and minimal porosity [12].

Advantages:

1. Superior mechanical properties (flexural strength, hardness)
2. Minimal shrinkage and exothermic heat
3. Good aesthetics, shade selection, and polishability
4. Easy handling and reduced chairside time

Limitations:

1. Brittle, prone to fracture under high stress
2. Difficult to repair compared to acrylics
3. Higher cost
4. Light-Cured Resins

These are resin composites cured using visible light. They are primarily used in single-unit provisionals or small-span restorations [13].

Advantages:

1. On-demand curing with extended working time
2. Excellent aesthetics and polishability
3. Reduced polymerisation stress

Limitations:

1. Limited depth of cure
2. Not ideal for multi-unit provisionals
3. Fiber-Reinforced Composites

Glass fibers or polyethylene fibers can be incorporated into bis-acryl or PMMA provisionals to enhance strength [14].

Applications:

1. Long-span provisional bridges
2. Cases requiring enhanced fracture resistance

CAD/CAM and 3D Printing Materials

CAD/CAM-Milled PMMA Blocks

Digitally milled PMMA blocks are pre-polymerised under industrial conditions, reducing residual monomer and porosity [15].

Advantages:

1. Superior marginal fit and mechanical strength
2. High esthetic quality
3. Biocompatibility and reduced pulp irritation
4. Suitable for long-term provisionalisation

Limitations:

1. Requires digital impression and milling unit
2. Higher cost compared to conventional methods

3D-Printed Provisional Materials

Additive manufacturing has introduced printable resins for temporisation. Layer-by-layer polymerisation produces precise restorations with reduced waste [16].

Advantages:

1. Customisable designs and rapid production
2. High reproducibility
3. Suitable for complex or full-arch provisionals

Limitations:

1. Limited long-term data on mechanical performance
2. Potential for surface roughness and porosity

Other Novel Materials

1. Polycarbonate Crowns

Prefabricated crowns available in standard shapes and sizes. They are commonly used for anterior provisionals [17].

Advantages:

1. Time-saving and inexpensive
2. Good aesthetics for short-term anterior use

Limitations:

1. Limited shade range
2. Poor marginal adaptation without relining

Glass Ionomer-Based Provisionals

Glass ionomer and resin-modified glass ionomer cements are sometimes used as interim restorative materials [18].

Advantages:

1. Fluoride release, anticariogenic properties
2. Adhesion to tooth structure

Limitations:

1. Poor wear resistance and esthetics
2. Limited to temporary fillings, not crowns or bridges

Future Trends in Temporisation Materials

Emerging trends in temporisation focus on enhancing mechanical resilience, biocompatibility, and digital integration. Nanofilled resins with improved strength and polishability are under development [19]. Bioactive provisional materials capable of remineralising dentin and preventing caries are being investigated [20]. Smart polymers with antibacterial and self-healing properties may revolutionise future temporisation strategies.

CONCLUSION

Temporisation remains a cornerstone of restorative dentistry, ensuring biological protection, functional stability, and esthetic satisfaction during treatment. Material choice

depends on clinical scenario, treatment duration, and economic considerations. While PMMA and PEMA remain widely used, bis-acryl composites, CAD/CAM-milled PMMA, and 3D-printed provisionals are increasingly preferred for their superior properties. The future of temporisation lies in digital workflows, nanotechnology, and bioactive polymers, aligning with modern dentistry's emphasis on precision, esthetics, and patient-centered outcomes.

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