

DENTURE BASE MATERIALS: CONVENTIONAL AND CONTEMPORARY PERSPECTIVES

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ABSTRACT

A denture base is the part of a removable dental prosthesis that rests on the oral mucosa and supports the artificial teeth. Denture base materials play a vital role in the success of complete and partial dentures because they influence esthetics, strength, comfort, fit, biocompatibility and longevity of the prosthesis. Over the years, significant advancements have occurred in denture base fabrication methods, ranging from conventional heat-cured Polymethyl Methacrylate (PMMA) to modern digital techniques such as injection molding, CAD-CAM milling and three-dimensional(3D)printing.

Keywords:-Denture base materials; Polymethyl Methacrylate (PMMA);CAD –CAM dentures; Three-dimensional (3D) printing; Injection molding; Digital dentistry; Additive manufacturing; Subtractive manufacturing; Denture fabrication; Prosthodontics.

INTRODUCTION

The rehabilitation of partially or completely edentulous patients requires a denture base material that is biologically acceptable, dimensionally stable, strong, lightweight and easy to repair. PMMA has remained the gold standard denture base material since its introduction because of its favorable esthetics, ease of manipulation, acceptable physical properties, and cost effectiveness. However, conventional PMMA dentures have limitations such as polymerization shrinkage, residual monomer release, porosity formation, and susceptibility to fracture.

Recent developments in digital dentistry have introduced alternative fabrication methods including injection molding and additive manufacturing (3D printing). These technologies aim to improve accuracy, reduce processing errors, and enhance patient comfort while decreasing laboratory time.

IDEAL REQUIREMENTS OF DENTURE BASE

MATERIALS

An ideal denture base material should possess:

Adequate flexural and impact strength

* Dimensional stability

* Low water sorption and solubility

* Biocompatibility

* Ease of fabrication and repair

* Good esthetics and color stability

* Lightweight nature

* Resistance to microbial colonization

* Accurate adaptation to supporting tissues

No currently available material fulfills all these requirements completely; therefore, clinicians select materials according to clinical needs and available technology.

CLASSIFICATION OF DENTURE BASE MATERIALS

Denture base materials can be classified into:

Metallic Denture Bases	Non metallic denture bases
Gold alloys	Acrylic resin
Cobalt-chromium alloys	Thermoplastic Resins
Stainless steel	Digital Denture Base Materials
Titanium	

Metal denture bases exhibit excellent strength and thermal conductivity but are expensive and less esthetic.

Acrylic resin denture bases	Thermoplastic denture bases	Digital denture bases
Heat-cured PMMA	Nylon	CAD/CAM milled PMMA
Self-cured acrylic resin	Polycarbonate	3D-printed photopolymer resins
Light-activated acrylic resin	Acetal resin	
Microwave-processed acrylic resin	Polypropylene	

Conventional Heat-Cured PMMA Denture Bases

Heat-polymerized PMMA remains the most commonly used

denture base material because of its ease of processing and acceptable clinical performance. It provides good esthetics and can be relined or repaired relatively easily.

Advantages	Disadvantages
Good esthetics	Polymerization shrinkage
Economical	Residual monomer irritation
Easy polishing and repair	Porosity formation
Acceptable strength	Fracture tendency under fatigue loading
Good patient acceptance	Dimensional inaccuracies during processing

Despite these drawbacks, conventional PMMA continues to be widely used due to its long clinical history and predictable results.

Injection Molding Denture Bases

Injection molding techniques were developed to reduce polymerization shrinkage and improve denture adaptation. In this technique, resin is continuously injected into the mold during polymerization, compensating for volumetric shrinkage.

Advantages	Disadvantages
Improved dimensional accuracy	Technique sensitive
Reduced processing errors	Increased laboratory cost
Better adaptation to tissues	Specialized equipment required
Increased flexural strength	
Lower porosity formation	

Injection-molded dentures have shown improved mechanical properties and fit compared with conventional compression-molded dentures.

CAD/CAM Milled Denture Bases

CAD/CAM milling involves subtractive manufacturing from

pre-polymerized PMMA blocks. These blocks are industrially polymerized under high pressure and temperature, resulting in reduced residual monomer content and improved material properties.

Advantages	Disadvantages
Excellent fit and accuracy	Material wastage during milling
Reduced residual monomer	High equipment cost
Improved mechanical strength	Limited modification after fabrication
High surface smoothness	
Better color stability	
Reduced chairside visits	

CAD/CAM dentures have gained popularity due to their precision and reproducibility.

3D-Printed Denture Bases

Three-dimensional printing is an additive manufacturing

technique where dentures are fabricated layer by layer using photopolymerizable resins. Technologies commonly used include stereolithography (SLA) and digital light processing (DLP).

Advantages	Diasadvantages
Reduced fabrication time	Lower flexural strength compared with milled PMMA
Digital storage of records	Layer-by-layer anisotropic structure
Less material wastage	Surface roughness
Simplified workflow	Limited long-term clinical evidence
Easy duplication of dentures	Challenges in relining and rebasing

Studies have shown that although 3D-printed dentures provide excellent accuracy and workflow efficiency, their mechanical properties may still be inferior to conventional heat-cured or milled PMMA dentures.

FUTURE TRENDS IN DENTURE BASE MATERIALS

Advancements in biomaterials and nanotechnology are expected to improve denture base performance. Current research focuses on:

- Nanoparticle reinforcement
- Antimicrobial denture resins
- Fiber reinforcement
- Improved printable photopolymers
- Artificial intelligence–assisted digital workflows

Future developments may overcome the present limitations of 3D-printed dentures and enable widespread adoption of fully digital prosthodontic workflows.

CONCLUSION

Denture base materials have evolved significantly from conventional PMMA to advanced digital fabrication systems. Conventional heat-cured PMMA remains the gold standard because of its proven clinical performance, ease of repair, and cost effectiveness. Injection molding improves dimensional accuracy and reduces processing defects, whereas CAD/CAM milling offers superior mechanical properties and precision. Three-dimensional printing has revolutionized denture fabrication by simplifying workflow and reducing production time; however, limitations related to strength, surface properties, and relining capability still require further

research.

Continued advancements in digital dentistry and material science are expected to improve the clinical performance and long-term success of modern denture base materials.

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