



Review Article

PROVISIONAL RESTORATION: A LITERATURE REVIEW

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Abstract

Provisional restorations are an important phase in the treatment procedure for fixed restoration. Without a temporary the final treatment aspect cannot be judged as we can predict the design failures beforehand as the temporary restoration replicates the final restoration. A temporary also helps the patient as he does not need to compromise esthetically till he receives the final restoration. This review article describes various techniques and materials available for fabricating a provisional restoration.

Keywords: Esthetics, Composite, Prosthesis, Restoration

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INTRODUCTION

Interim prosthesis is defined as a fixed or removable dental prosthesis or maxillofacial prosthesis, designed to enhance esthetics,

stabilization and/or function for a limited period of time, after which it is to be replaced by a definitive dental or maxillofacial prosthesis.¹ These prosthesis are helpful in determination of the

therapeutic effectiveness of a specific treatment plan or the form and function of the planned for definitive prosthesis.² Fixed prosthodontic treatment, whether involving complete or partial coverage and natural tooth or dental implant abutments, commonly relies on indirect fabrication of definitive prostheses in the dental laboratory.³

The rationale for provisional treatment as stated by Fredrick and Krug^{4,5} include to protect pulpal tissue and sedate prepared abutments, protect teeth from dental caries ,to provide comfort and function, to evaluate parallelism of abutments, to provide method for immediately replacing missing teeth, to prevent migration of abutments and improve esthetics, to provide an environment conducive to periodontal health, to evaluate and reinforce the patient's oral home care, to assist with periodontal therapy by providing visibility and access to surgical sites when removed, to provide a matrix for the retention of periodontal surgical dressings, to stabilize mobile teeth during periodontal therapy and evaluation, to provide anchorage for orthodontic brackets during tooth movement, to aid in developing and evaluating an occlusal scheme before definitive treatment, to allow evaluation of vertical dimension, phonetics, and masticatory function and to assist in determining the prognosis of questionable abutments during prosthodontic treatment planning.

The ideal requirements for provisional restorations as stated by Fredrick and Krug^{4,5} are good marginal adaptation; adapts well to a tooth and matrix surface, adequate retention and resistance to dislodgment during normal masticatory function, strong, durable and hard, should be non irritating to

pulp and other tissues; low exothermicity, nonporous and dimensionally stable, should be comfortable and color stable, should be esthetically acceptable shade selection; translucent tooth-like appearance, should have physiologic contours and embrasures, should be easy to mix and load in the matrix, fabricate, relines, and repair; relatively short setting time, patient should have physiologic occlusion, should be conducive to routine oral home-care cleaning procedures, should finish to a highly polished, plaque- and stain-resistant surface, should be easy to remove and recement by the dentist, be relatively inexpensive and should have low incidence of localized allergic reactions

Biologic requirements⁶

Pulp Protection, Maintain periodontal health, Occlusal compatibility and protect against fracture.

Mechanical requirements^{7,8}

Resist removal forces, Maintain interabutment alignment and Resist functional loads

Materials used for provisional restorations⁹

Polymethylmethacrylate, Polyethylmethacrylate, Epimine and Hybrids⁹ are available to be used as provisional restorative materials.

Commercially available Preformed, Unfilled methacrylate and Composite material are listed in Table I,II and III respectively.¹⁰

Only linear chainlike polymers can be formed if a polymer matrix solely consists of monofunctional low-molecular monomers, as is the case with MMA/PMMA materials. Three-dimensional interlacing is only possible through physical

<i>Material</i>	<i>Manufacturer</i>	<i>Product Name</i>
Polycarbonate resin	Harry J. Bosworth, Skokie, III 3M Dental, St. Paul, Minn	Molar B and B-Crowns Polycarbonate Crowns
Nylon fiber reinforced metal	3M Dental, St. Paul, Minn	Iso-Form Crowns (tin/silver alloy), Gold Anodized Crowns (gold anodized aluminum) and Stainless Steel Crowns (nickel chrome)

Table I: Preformed materials and manufacturers for provisional fixed prosthodontics restorations

<i>Material</i>	<i>Manufacturer</i>	<i>Product Name</i>
Methyl methacrylate	GC America, Alsip, III Motloid, Chicago, III Reliance Dental, Worth, III Lang Dental, Wheeling, III L.D. Caulk, Milford, Del. Harry J. Bosworth, Skokie, III GC America, Alsip, III	Alike Coldpac Duralay Jet Temporary Bridge Resin Trim Plus, True Kit Unifast LC
Ethyl methacrylate	Lang Dental, Wheeling, III	Splintline III
Vinyl ethyl methacrylate	Parkell, Farmington, NY Harry J. Bosworth, Skokie, III	Snap Trim, Trim II
Butyl methacrylate	Ellman Int, Hewlett, NY	Temp Plus

Table II: Unfilled methacrylate materials and manufacturers for custom fabricated provisional fixed prosthodontic restorations

<i>Material</i>	<i>Manufacturer</i>	<i>Product Name</i>
Bis-acryl composites (Auto-polymerized)	Lang Dental, Wheeling, III L.D. Caulk, Milford, Del Zenith/DMG, Englewood, NJ ESPE, Plymouth Meeting, Pa GC America, Alsip, III Parkell, Farmington, NY Kerr Dental, Orange, Calif Danville Materials, San Ramon, Calif Harry J. Bosworth, Skokie, III	Bis Jet Integrity Luxatemp Luxatemp ProtempII, Protemp Garant Provitec SmartTemp Temphase Turbo Temp Ultra Trim
Bis-acryl composite (Dual-polymerized)	3M Dental, St. Paul, Minn Zenith/DMG, Englewood, NJ, Ivoclar/Vivadent, Amherst, NY	Iso Temp Luxatemp Solar, Luxa-Flow (repair material) Provipont DC
Urethane dimethacrylate composite (Visible light-polymerized)	Dentsply Int, York, Pa	Triad

Table III: Composite materials and manufacturers for custom fabricated provisional fixed prosthodontic restorations

looping of the individual polymer strands and the resulting framework is not very stable.³

The situation is completely different for bisacrylate composites. Here, the monomers are bifunctional, i.e. they contain two double-bonds capable of reacting. Bisphenol- A-glycidyl methacrylate (bis-GMA), triethylene glycol dimethacrylate (TEGDMA) or similar monomer systems are frequently used.¹¹ 3M ESPE utilizes modified Bowen resins which correspond to derivatives of the bis-acryl compounds that have been rendered hydrophobic. The

dimensional stability while in place is also improved and discoloration is less frequent than with the other systems on the market.¹⁰

The multiple functionality of the monomers ensures the formation of a three-dimensional network, with the structure now being fixed by chemical bond. Fracture resistance of these materials still merits improvement. Unfortunately, high mechanical strength also comes hand in hand with brittleness.¹¹

Protemp Garant 3 was developed which clinically showed a marked reduction in the generation of heat during the setting. Protemp 3 Garant temporization material

formulation also includes new filler technology. The glass particles used are even finer than before and guarantee a smooth surface structure and good polishability (average particle size < 0.7 µm).¹² It has highest fracture resistance and the new sophisticated filler technology results in better abrasion stability. It shows excellent color stability, brilliant, natural gloss without polishing.¹⁰

Four basic ingredients are: Pigments, Monomer, Filler and Initiator¹³

Monomers¹³

Methyl methacrylate, Ethyl methacrylate, Isobutyl methacrylate, Bis-GMA(bis phenol A diglycidylether methacrylate), Urethane dimethacrylate and combinations.

Free Radical Polymerization

This process is alternatively called addition polymerization because a molecule is added to the polymer chain as the reaction proceeds. Most of the setting reaction yielded by a resin-based material, such as composite, adhesive, cement, sealant, and acrylic involved this type of polymerization. It comprises three stages; the first step is activation and initiation which requires an external agency, such as heat, chemical, or light to form a highly reactive single electron called free radical.^{13,14}

Initiation

Initiators: Camphoroquinone and Benzoyl peroxide are the initiators which liberate free radicals

Activators: Chemical (tertiary amine) more residual monomer, Heat shows greater contraction of restoration. Heating a recently set restoration in 100°C water promotes

greater polymerization efficiency-removes any unconverted monomer.

Advantages

Less porosity, Good working time, Longer exposure for darker material and all surfaces-towards centre of restoration.

Propagation

During this, polymerization continues and the material should not be jostled. There is increase density causing contraction, Exothermic heat of reaction and Increase rigidity, strength, resistance to dissolution.

Termination

Some of the chains combine and terminate the growth process. Reaction with eugenol, hydroquinone, oxygen and the contact is minimized.¹⁵

Filler

Increased filler decreases exothermic heat and contraction and increases strength. Too much filler leads to inadequate handling characteristics- impedes mixing and shaping A mould cavity has to be fabricated that will occupied by temporary restoration which is bound by External and Internal surface form.¹⁵

External Surface form: It can be Custom made and Preformed¹⁵

Custom Made

Materials used for custom made are: Irreversible hydrocolloid, Silicone impression, Thermoplastic sheets and Baseplate wax¹⁶

Addition silicone (putty) is preferred because it can be reused at future appointment,

facilitate subsequent removal of polymerizable resin and trim thin areas of impression material interproximally.¹⁷

Thermoplastic sheets

It is heated and adapted to stone cast under vacuum/putty. It is a direct technique which minimizes occlusal interferences and is also helpful in evaluating adequacy of tooth reduction but it shows poor heat dissipation^{18,19}

Preformed

These are preformed crowns which need to be relined with autopolymerizing resin. It needs modifications like Internal relief, Axial recontouring and Occlusal adjustment but it is more time consuming and is suitable only for Single restorations only (not FDPs).²⁰

Materials for preformed crown²⁰

Polycarbonate, Cellulose acetate, Aluminium and Nickel chromium

Polycarbonate crowns

These are the most natural among all preformed materials. Available in incisor, canine and premolar tooth types.⁷

Crown Preparation²¹

Incisocervical measurement is transferred to crown. Incisal edge and labial surface should align properly with adjacent teeth. At this point, Occlusion is not seen and the Internal surfaces are being adjusted. When shell can be properly positioned without forceful gingival contact, it is ready to be relined with resin. Extraorally, lingual reduction is preferred. Parallel orientation of wheel to crowns axial surface is done and

the wheel should rotate from surface toward the margin.

Aluminium crown forms^{3,7}

These crowns are preferred for posterior teeth and has anatomic or cylindrical shells.

Procedure

Crown form is selected nearest the mesiodistal dimension of space and the cervical portion of crown is trimmed to proper length. Shell margins should not engage prepared tooth margins. Patient is asked to bite with moderate force and the soft aluminum will deform until normal intercuspation is reached. Now, fill the shell with resin and ask patient to close the mouth and the excess is removed immediately. After 2-3 min, the shell is removed. Then, a cup of warm water is placed and after 5 min, mark the margins. After that, establish the axial contours and replace the crown and adjust occlusion.

Tissue surface form (TSF): It can be Indirect, Direct and Combination³

Indirect: It is the interim restoration fabricated outside the mouth.²²

Advantages^{23,24}

Prevent tissue damage and allergic reaction, avoid prepared tooth to the heat evolved from polymerizing resin, better marginal fit, dimensionally stable and the patient can rest.

Disadvantages^{23,24}

Increased chair time and number of intermediate steps and possible damage of diagnostic casts

Alginate impression is taken and ESF is formed. Then, the cast is painted with separating medium and the cavosurface margins are being marked. Autopolymerizing resin is mixed and is loaded into a syringe. Fill it methodically starting at one end of restoration space and seat TSF into filled ESF. It is lightly held together by rubber band and placed in warm water (40°C/50-52 °C) at 20 psi for 5 min-10 min. After that, ESF is separated from cured resin restoration and the bulk of stone is removed. Resin flash is eliminated with an acrylic trimming bur and a fine garnet paper disk. Paper thin extension remaining at the margin indicates that contour is correct and cavosurface margin fully covered. Contour the pontic areas according to proper pontic design and finish the restoration with wet pumice and cleaned using appropriate infection control procedures.

Ring-Opening Polymerization^{25,26}

Two important ring-opening polymerizations in dentistry are: Epoxy and Ethylene imine reactions (epimine). The reactive terminal rings open under the influence of the cationic initiator of the catalyst paste and can then as a cation itself, attack and open additional rings. Whenever a ring is opened, the cation function remains attached, thus lengthening the chain.

Aziridines (ethyleneimine compounds) can be converted into highly molecular polyimine compounds by means of catalysts which introduce and thus initiate polymerization. As a result of these polymerization initiators, the amino nitrogen of the aziridine ring is cationized and a cation chain reaction is started which leads to the polymerization under formation of the corresponding polyamines.

Applied surface phenomenon¹⁵

Atoms or molecules at the surfaces of solids or liquids differ greatly from those in the bulk of the solid or liquid and neighbouring atoms may be arranged anisotropically. Such surface effects dominate the surface mechanical properties of:

Adhesion and friction, optical surface phenomena of the perception of color and texture, tissue reaction to materials, attachment of cells to materials, wettability and capillarity of surfaces, nucleation and growth of solids and many other areas of crucial interest in biomaterials

Direct procedure

Patient's prepared teeth and the gingival tissues directly provide the tissue surface form eliminating all the intermediate laboratory procedures.³

Soft wax technique²¹

In this technique, two layers of hard baseplate wax and a single layer of soft white wax are warmed in water and adapted over unprepared tooth/teeth. Then, Place soft white wax against tooth surface and use finger pressure to compress wax sandwich against palatal and lingual surfaces while maintaining occlusal pressure. Patient is guided to closure until slight contact occurs on occlusal surface of hard baseplate wax. Autopolymerizing resin of selected shade is flown and the wax sandwich is inserted over preparation and left 15-20 sec. After that, hardened resin is removed from wax and the provisional crown is relined. Then, the occlusion is equilibrated and finishing of provisional restoration is done.

Modified direct technique²¹

In this, grooves have been made buccally and palatally..

Advantages¹²

Excess acrylic material will flow out into the grooves, appropriate morphologic form with minimal marginal adjustments and trimming, adjustment and trimming of bulky excess material minimum voids and less time consuming

Limitations¹²

Inability to withstand normal occlusal forces and consequently, fracture of the pontic.

Indirect-direct reline(eggshell) procedure

It is a custom made preformed ESF. “Shell” is fabricated as lab procedure and “Reline” procedure is performed after tooth preparation.²⁴

Procedure^{22,27}

Abutment tooth is prepared on diagnostic cast and alginate impression of prepared cast is taken. Impression is poured with quick set plaster to obtain indirect TSF and the stone is coated with separating medium. Then, the diagnostic waxing procedures are performed on articulated casts and the custom preformed ESF is made. If thermoplastic sheet is used, then the waxed up cast is duplicated in the stone. Then, it is checked for proper relationship between ESF and TSF and the resin is applied into ESF. The completed interim restoration is seated (ESF) on diagnostic cast(wax removed) and occlusion is refined by using articulator. At last, preformed ESF is finished and cleaned for try in after tooth preparation in patient's mouth.

Completed custom preformed ESF³

Procedure

Patient's teeth is prepared and ESF tried in and evaluated. If there is incomplete seating, teeth is checked for reduction. If teeth is adequately reduced, internal surface is relieved until acceptable occlusion. After that, prepared teeth, gingival tissues and external surface of ESF are lubricated. Interim restoration is placed in warm water to hasten polymerization for 3-5 min, mark the margins and eliminate excess resin is eliminated.

Onlays and Partial veneer crowns

Inlays²⁸

It is small and difficult to handle especially during trimming and while applying matrix band and wedges. One end of unwaxed dental floss is placed in cavity preparation to make handle. Small amount of polyethyl methacrylate is mixed and mould a small cone of it on the end of amalgam condensor when it reaches dough consistency. Resin is condensed lightly and occlusal excess is removed immediately. Restoration is removed when it reaches rubbery stage by tugging floss handle along path of withdrawal. It is then placed in a cup of warm water (37°C) and the margins are marked. Cured resin is returned to cavity preparation and the occlusion is adjusted. After that, the impression of cavity is made and the provisional restoration is cemented and cut off the floss handle after the cement sets.

Laminate Veneers^{29,30}

In this, appropriate resin shade or combination is selected before tooth preparation. Direct technique is used if light

cured resin is used. After completion of light curing, resin is removed from tooth surface. After that, enamel etching is done in three 1 mm diameter areas to form an equilateral triangle. Rinse after 20 sec and dry. Autopolymerizing unfilled resin is filled and small amount is placed on 3 etched areas. Veneers are placed and hold it in place till resin sets. In the next visit, veneer is removed with spoon excavator and the porcelain laminate veneer is finally fitted and bonding gets affected by cement remained after the removal of the provisional restoration.

Provisional restoration for post and core restorations^{3,7,21}

If custom made post and core is to be used, the post and core portion can be instantly built and temporary crown be fabricated on it.

If cast post is to be placed in the final restoration, the following measures may be taken.

A ball pin may be placed into the post space and an alginate over impression made that would pick up the ball pin and then the restoration fabricated on the cast.

Instead of placing the ball pin directly into the post space, it may be placed into the impression and the restoration fabricated.

In an alternative technique, a ball pin may be placed into the post space and the restoration fabricated intraorally using acrylic resin block technique. A tooth trimmed in the form of a labial veneer can also be used to serve the purpose.

Provisional luting cements

The ideal requirements³¹ for luting cement include adequate seal should be provided between the provisional restoration and prepared tooth, good mechanical properties and low solubility and adequate tooth adhesion to resist bacterial and molecular penetration

Various provisional luting cements used are³¹

Calcium hydroxide, Zinc-oxide and eugenol and Noneugenol materials (contains various Carboxylic acids). All of these possess poor mechanical properties.

TempBond™

TempBond™ was developed in 1961 based on zinc oxide-eugenol chemistry. Then in 1989, Kerr introduced TempBond NE™ with eugenol-free zinc oxide, substituting carboxylic acids in place of eugenol. TempBondClear™ with Triclosan incorporates a unique redox initiator system and low refractive index fillers for excellent color stability and high translucency. It offers a dual cure for added security and flexibility.³²

NexTemp™³³

It is a Non-eugenol containing, resin-matrix formulation. Combines the multiple benefits of fluoride release to protect tooth structure, potassium nitrate for patient comfort and chlorhexidine as an anti-bacterial agent. Two-stage curing is another benefit. Being eugenol-free, it is non irritating to soft tissue and will not inhibit permanent. Presence of potassium nitrate helps reduce sensitivity and act as a sedative to the pulp. Chlorhexidine provides anti-bacterial action

The Resin-Matrix helps achieve good marginal seal with no wash-out. It has two-Stage Curing: Initial gel-set stabilizes temporary, allowing easy removal of excess

It is also available in an Automix Syringe that saves application time and guarantees a consistent mix. The neutral Shade blends esthetically with temporary restoration, hence no show-through

Eugenol Free Temporary Cement¹⁶

Sensitemp Nezo, Sensitemp Resin, Sensitemp ZOE and TempoSIL.

TempoSIL® Coltene Whaledent

The addition-cured, silicon-based, zinc-oxide cement with silane reportedly provides optimal adhesion and superior marginal integrity. TempoSIL® purportedly is a firm, yet elastic temporary cement that can easily be removed from the tissue and the restoration. It has a working time of 50 seconds and a setting time of 2 minutes.¹⁶

Removal of Provisional Restoration

Horn described the use of selected instruments for prying at margins of temporarily cemented fixed prosthesis. Ewing suggested the use of a copper band filled with cement to remove crowns. Garver described the use of autopolymerizing acrylic resin copings for a mechanical purchase when using a percussion instrument. Others have suggested the use of jack-screws, mallet and chisels, forceps, pliers, clamps, claws, and a screwjaw combination for removing cast restorations.³⁴

Influence of material properties on treatment outcome

Marginal Accuracy

Barghi and Simmons indicated that from their qualitative assessment, autopolymerizing acrylic resin provisional restorations routinely did not have adequate marginal adaptation but its accuracy could be significantly improved by relining the restoration after the initial polymerization. After the reline procedure, 80% of restorations did not fully reseat because of hydraulic pressure which could be improved by venting a provisional restoration before reline.³⁵

Color Stability

Modern provisional materials use stabilizers that decrease chemically induced color changes.¹⁰ Most provisional materials are subject to sorption, a process of absorption and adsorption of liquids that occurs relative to environmental conditions.^{36,37} When provisional materials contact pigmented solutions such as coffee or tea, discoloration is possible.¹⁰ Porosity and surface quality of provisional restorations, as well as oral hygiene habits, can also influence color changes.^{37,38}

Hypersensitivity

Due to greater residual monomer, autopolymerizing methacrylate materials have greater potential for producing allergic contact stomatitis than similar heat-polymerized materials.³⁹

Features¹⁰:

Previous exposure to the provisional material, reaction conforms to a known allergic pattern such as redness, necrosis or

ulceration, reaction resolves when a provisional restoration is removed, reaction recurs when a provisional restoration is replaced, a patch test for the material is positive

Patch testing show less response with light-polymerized materials relative to autopolymerizing acrylic resin.¹⁰

Indirect material processing methods are recommended for individuals showing evidence of hypersensitivity.^{40,41} After complete polymerization, the polymerized acrylic resin usually does not induce allergic reactions. Unpolymerized monomer can be substantially removed by placing an autopolymerized provisional restoration in a pressure pot with warm water for 20 minutes.⁴⁰

Strengthening Provisional Materials

Failure often occurs suddenly and probably as a result of a crack propagating from a surface flaw. The strength and serviceability of any acrylic resin, especially in long span interim restorations, is determined by the material's resistance to crack propagation. Failure may be because of inadequate transverse strength, impact strength or fatigue resistance.^{10,42}

CONCLUSION

Provisional restorations form an important part of dental treatment. Various materials and techniques used in fabrication of provisional restoration are described. Dentist can choose on the basis of his or her requirement. Clinical techniques and indications are reasonably well characterized, but future research activities will need to focus on technological advancements to provide improved materials

that demonstrate improved biocompatibility, ease of use and modification, and physical properties

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