

## The provisional crown



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The provisional crown is an interim restoration that is used for a variable time period while the definitive restoration is being fabricated. Although an interim treatment, the provisional is an extremely important restoration whose requirements differ only slightly from the permanent restoration it precedes.<sup>1,2</sup> A good provisional crown ensures optimal tissue health facilitating the subsequent management of the tissues.<sup>3</sup> It can also provide critical diagnostic information with respect to occlusion and aesthetics particularly in more complex treatment plans where occlusal and or aesthetic changes are planned.<sup>4</sup> When poorly made, they can hinder the prognosis of the definitive restoration, the periodontal health and final aesthetics. Objectives not achieved in the provisional are unlikely to be realised in the permanent restoration.

### Functions of the provisional restoration

The functions of the provisional restoration<sup>5</sup>

are summarised in **Table 1**. The most basic function of the provisional is to cover the tooth preparation, protect it from trauma (thermal, chemical and mechanical) and caries, and allow the tooth to function while the definitive restoration is fabricated.

Another important function is its diagnostic role. The provisional crown can be instrumental in developing optimal aesthetics particularly when changes are planned in the aesthetic zone. The proposed changes should always be made in the provisional so that the patient and dentist have the opportunity to evaluate the proposed changes. Any problems can then be addressed in the provisional prior to fabrication of the definitive restoration.

The effects of proposed changes in occlusal schemes (e.g. changes in vertical dimension, the development of canine guidance) should also be evaluated for patient acceptance in provisional restorations. This allows for evaluation of the effects on speech, function (swallowing and chewing) and aesthetics. Any necessary changes can be more easily made in the provisionals.

The provisional crown is also valuable in providing an indirect method of measuring the amount of tooth reduction made during preparation. An Iwansson gauge can be used to measure the thickness of a provisional crown (**Figure 1**).

From a periodontal perspective, properly fitting and contoured provisional crowns support the health of the periodontal tissues and facilitate impression making. When crown lengthening procedures are

**TABLE 1: Functions of the provisional crown**

Protection:	Protect the preparation from thermal, chemical and physical trauma. Protect the preparation from caries. Protect the periodontal tissues by facilitating good oral hygiene.
Positional stability:	Prevent migration of the tooth. Promote soft tissue stability with optimal contours.
Mastication:	Provide good masticatory function.
Aesthetics:	Improve aesthetics and allow patient evaluation of any proposed changes.
Diagnostic information:	Allows patient to evaluate proposed aesthetic changes, changes in vertical dimension, and effects on speech. Allows assessment of whether the patients expectations have been met. Limitations of treatment outcome can also be identified.



Figure 1: An Iwansson gauge used to estimate tooth reduction indirectly.

**TABLE 2: Desirable properties of an ideal provisional restoration material**

Biologic:	- Biologically acceptable to periodontal tissues or tooth structures - non irritating to pulp and other tissues	Aesthetic:	- Easy to repair or make additions - Acceptable shade selection - Highly polishable - Reasonable aesthetics for the duration of wear
Physical:	- Strong and durable - Non porous - Good surface hardness - Dimensionally stable - Wear resistant - Good marginal fit	Chemical:	- Colour stable and stain resistant - Low exothermicity during polymerisation - Low polymerisation shrinkage - Low residual monomer
Manipulation:	- Easy to mix - Easy to load - Short setting time	Economic:	- Relatively inexpensive

performed, a period of six weeks is advised before making the final impression for the definitive restoration.

**Classification of provisional crowns**

Provisional crowns may be classified in a variety of ways; including:

1. The material from which they are made;
2. Method of fabrication - direct or indirect methods; and,
3. The length of use.

**1. Provisional crown materials**

The ideal properties of a provisional crown material are listed in **Table 2**. No ideal material exists, but a variety of materials have been used successfully.<sup>6</sup> The selection of material should be based on a number of criteria, including; the length of time the provisional crown will be used, strengths and weaknesses of the particular material relative to the clinical situation, and personal preference and experience of the operator in using a material. The literature tends to favour the use of acrylic resin as the material of choice when making provisional restorations.<sup>7</sup>

Materials used for the fabrication of provisional restorations include:

- Polymethylmethacrylate resins (PMMA);
- Polyethylmethacrylate resins (PEMA);

- Urethane dimethacrylate resins; and,
- Bisacryl composites.

**Table 3** compares the various important properties of materials related to provisional restorations.

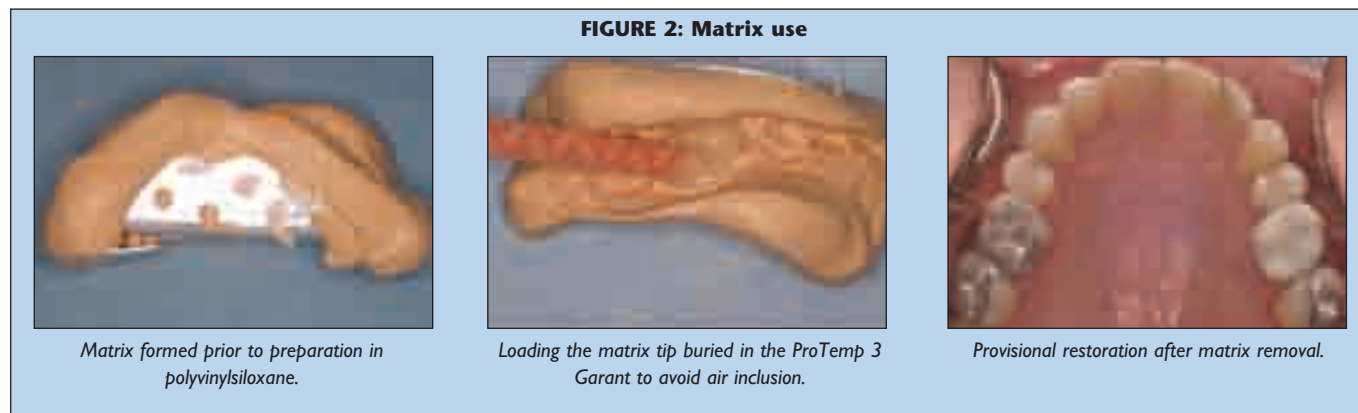
*Polymethylmethacrylate resins* (PMMA) e.g. Jet (Lang Dental) and Duralay (Reliance Dental), which were introduced in the 1940s and are probably the most frequently used materials. They have very good strength and high wear resistance.<sup>8</sup> However, these materials generate considerable heat when polymerising and ideally the provisional should be fabricated using an indirect technique. PMMA has a strong tendency to shrink with high residual monomer content. *Polyethylmethacrylate resins* (PEMA) e.g. Snap (Parkell) and Trim (Bosworth) were introduced in the 1960s. They generate less heat on polymerisation and experience less shrinkage than the PMMAs. Less residual monomer is released by PEMAs and this material is relatively well tolerated by the tissues. It is easy to make additions to the crown if necessary, and these materials are relatively inexpensive. Although the colour stability is not as good as PMMAs, PEMA may be a better choice when direct provisional prosthesis fabrication is considered (i.e. chairside).<sup>3</sup>

*Urethane dimethacrylate resins*, e.g. Triad (Dentsply), are visible, light-cured materials that usually have a filler to reduce the polymerisation shrinkage. The material is well tolerated by the tissues, is reasonably aesthetic but is a relatively expensive material.

*Bisacryl composites*, e.g. ProTemp II (ESPE), ProTemp Garant 3 (ESPE). Most of these materials consist of a bis-acryl resin mixed with an inorganic filler. These systems are available with an auto delivery system making them very efficient and easy to use but more expensive. Bis-acryls are compatible with other composite materials and additions can be made, but these can prove difficult and unpredictable.<sup>9</sup> These materials generate minimal heat during the polymerisation reaction. There is also less shrinkage than the acrylics, imparting good marginal fit.<sup>10,11</sup>

Bisacryl composites are well tolerated by pulpal and periodontal tissues and have good colour stability. It has been reported in the literature that some practitioners have found this material difficult to manipulate before setting because the handling properties are more technique sensitive.<sup>7,12</sup>

**FIGURE 2: Matrix use**



Matrix formed prior to preparation in polyvinylsiloxane.

Loading the matrix tip buried in the ProTemp 3 Garant to avoid air inclusion.

Provisional restoration after matrix removal.

**TABLE 3: Materials and some properties of materials used for provisional restorations**

<b>Acrylics e.g. PMMA self or heat cured</b>	<b>Acrylic e.g. PEMA</b>	<b>Urethane dimethacrylate e.g. Proviopont</b>	<b>Bisacryl Composites e.g. ProTemp Garant 3</b>
Great heat in polymerisation	Less heat than PMMA	Exothermic reaction	Generate minimum heating during polymerisation
Strong tendency to shrink	Less shrinkage than PMMA	Polymerisation shrinkage less of a problem Light curable-control of set	Shrinkage less than acrylics-imparting good marginal fit. <sup>9</sup>
High residual monomer as result of shrinkage	Some residual monomer	Less free monomer than methacrylates. <sup>7</sup>	No residual monomers
Unpleasant smell produced when in use over a long period of time	Colour stability not as good as PMMA	Monomer can cause pulp and gingival irritation. Marginal fit can be poor but additions possible	Rarely cause irritation of pulp or periodontal tissue. Good biological tolerance
Poor toughness and low colour stability		Colour reasonable	Good colour stability and good polishability
Easy to add to	Easy to add to	Additions possible	Additions difficult
Cheap	Cheap	Expensive	Expensive
PMMA good strength and high wear resistance. <sup>8</sup>	Strength reasonable for most purposes	Good mechanical properties	Reasonable strength

**2. Method of fabrication of provisional restoration-direct (chairside) or indirect (in the laboratory)**

Direct methods of fabrication

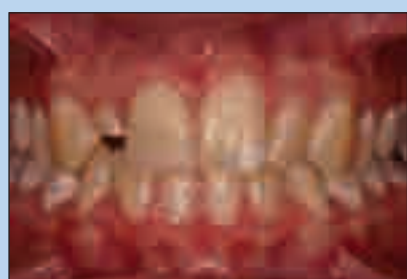
1. Matrix use

- A vacuum formed matrix of the diagnostic wax up, or an impression of the existing tooth can be used as a matrix for the provisional crown (see **Figure 2**).
- Petroleum jelly should be used to lubricate the tooth preparation

and the provisional crown material is placed into deepest part of matrix and seated on the prepared tooth.

- The matrix is removed when the provisional material is at the rubbery stage, and seated and resealed during the polymerisation reaction. Final set is accelerated by the use of hot water if a methacrylate is being used.
- The provisional crown is then trimmed and polished as described at a later stage in this article.

**FIGURE 3: Polycarbonate crown selection and modification.**



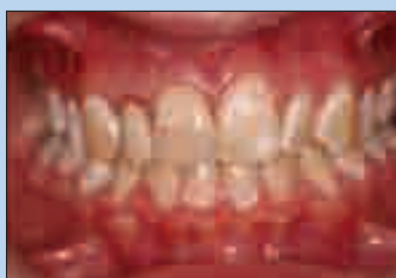
*Preoperative view in MIP.*



*Selection of correct mesiodistal width of polycarbonate crown to replace.<sup>12</sup>*



*Polycarbonate crown relined with Snap and markings made to adjust contours to achieve similar shape to 22.*



*Post-operative view in MIP post finishing and cementation.*

2. Proprietary crowns

Polycarbonate crowns or metal crowns (aluminium or stainless steel) can be relined with acrylic resin to provide a custom fit (**Figure 3**).

- A crown with a similar width to the tooth is selected and the cervical margins adjusted as necessary.
- The prepared tooth is lubricated with petroleum jelly.
- The prefabricated crown is loaded with resin and seated.
- The incompletely set excess is then removed and the crown removed and replaced to control the polymerisation reaction. Any adjustments and polishing procedures are then performed.

For posterior teeth, stainless steel crowns or aluminium shells may be used. Aluminium shells are very ductile and thus can be quickly adapted to the tooth. This can also result in rapid wear and perforations can occur during function resulting in tooth movement.<sup>13</sup> Some of these crowns, e.g. Iso-Form Crowns (3M Dental Products), have reasonable ductility with the occlusal table reinforced and are therefore more

resistant to wear related failure.<sup>13</sup> Stainless steel crowns can also be used but these can prove difficult to adapt to the prepared tooth.

Indirect methods of fabrication (provisional restorations made in the dental laboratory)

There are various techniques for making provisional crowns in the laboratory that have the advantage of preventing contact of monomer with the tooth preparation. An impression can be made of the actual tooth preparations, poured in stone and the provisional made on this working cast in the laboratory. This obviously necessitates having laboratory facilities available. An alternative technique is to have the provisional crown premade prior to cutting the crown preparation. The basic steps for fabrication include:

- a cast of the proposed restorations is duplicated and a matrix is made;
- mini preparations are made on the cast and a separating agent used; and
- acrylic PMMA is packed into the matrix and seated on the preparations. This can be cured under pressure and heat applied during the polymerisation reaction. This results in increased hardness, density, reduced porosity and a stronger provisional restoration.
- If necessary the shell crowns may be relined chair-side, after the preparation is made.

Another technique involves the use of denture teeth facings on the facial aspect with acrylic resin processed onto the lingual. The advantage of these provisional restorations include excellent aesthetics combined with strength due to the increased hardness and density of laboratory processed acrylic resin on the palatal.

Base metal alloy provisional crowns may also be fabricated. In this case, the crown is waxed up in the normal fashion and cut back for an acrylic facing. Retention beads are used to facilitate retention of the acrylic facing. Acrylic resin is then processed to the facial surface. Metal provisional restorations are normally used if the anticipated length of time of wear is long.

### 3. Length of use

- Short-term - several days to week
- Medium-term - several weeks
- Long-term - several months

Where an extended time of use of a provisional restoration is anticipated, physical properties such as hardness, strength and density are more important. Low strength and crack propagation are the commonest causes of failure of acrylic restorations. Studies that tested methods to improve longevity of indirect acrylic restorations found that polymerisation with pressure was the variable that produced the greatest effect in increasing strength and reducing porosity.<sup>14,15,16</sup> Indirect methods of fabrication increased wear resistance, increased density, reduced porosity, ensured more colour stability and resulted in a crown that was more resistant to fracture.<sup>15</sup>

For long-term provisional crowns, base metal alloys, with or without acrylic facings, can also be used where necessary.<sup>17</sup> These provisional restorations are useful where a long period of wear is anticipated,



FIGURE 4: Armamentarium for polishing and finishing.

where occlusal forces dictate, or where diagnostics are being assessed. Increased laboratory costs also arise and should also be considered. Fibres may also be used to increase rigidity and enhance fracture resistance. Materials such as Ribbond, (Ribbond Inc, Seattle, Wash), which is a plasma-treated polyethylene fibre, can be used as a substructure and a composite material such as Belleglass can be used to fabricate the provisional restoration. Other materials such as stainless steel wire, ultra thin stainless steel bands and stainless steel mesh have been reported in the literature as appropriate for use when increasing strength and fracture resistance of provisional restorations.<sup>2,18</sup>

### Importance of finishing a provisional restoration

Rough surfaces promote plaque accumulation, which can cause aesthetic and periodontal problems.<sup>19</sup>

As with any polishing and finishing procedures, a stepwise approach is recommended using the coarser material first and gradually working to the finest. This decreases the number of scratches on the surface of the restoration and ensures that a highly polished surface with a good appearance results. Tungsten carbide burs in a slow or straight hand piece can be used for gross reduction of excess, followed by Soflex discs of varying roughness and KY gel as a lubricant. **Figure 4** shows some of the equipment that can be used for polishing and finishing provisional restorations. Provisional restorations can be finished using pumice on a wheel or a rubber cup for a high polish. Staining kits (e.g. Candulor) can be used to characterise the provisional restoration by incorporating some heterogeneity into the shade of the restoration so that a more natural result can be achieved (**Figure 5**). These stains tend to wear off with time.

Overcontouring of provisional crowns is a significant causative factor of gingival inflammation<sup>20,21</sup> but under contouring has little if any effect on gingival health.<sup>20</sup> It is important to bear this in mind when shaping the provisional crown.

### Provisional luting materials

The luting material for provisional restorations is primarily used for its sealing ability.<sup>22</sup> The type selected depends on the length of time the

**FIGURE 5: Candolor kit for customising and staining provisional crowns***Indirect provisional crown prior to staining.**Staining with Candolor in cervical one third.**Staining with blue stain in incisal one third to provide translucent effect.*

restoration is to remain in place, for example, Temp bond (Kerr) is useful if the provisional is to be of short duration, whereas polycarboxylate cement, e.g. Ultratemp (Optident), is useful if a longer period of wear is anticipated. The retentive requirement for a provisional luting material is that it is strong enough to retain the

restoration during the course of treatment while allowing easy removal of the restoration when required.<sup>22</sup>

The importance of removing all excess provisional luting material cannot be overemphasised to avoid damage or adverse response of the periodontal tissues.

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Some of the commonly used provisional luting materials contain eugenol, which has a plasticising effect on composite material. As a result, eugenol-free materials have gained increasing popularity, particularly where dentine bonding is considered with the definitive restoration.<sup>23</sup> Surface hardness and bond strength of resin to resin can be affected by eugenol.<sup>24,25,26</sup> However, resin bond strengths to enamel and dentine are not affected if the eugenol residue is removed with pumice and water before conditioning.<sup>27,28,29</sup>

### Conclusion

In conclusion, the provisional crown should be considered a template of the final restoration in all aspects except the material from which it is fabricated, its longevity and the colour and translucency achievable. A good provisional crown saves time and expense at subsequent appointments and proper fabrication of the provisional restoration facilitates the production of better definitive restorations and a healthy periodontium. It is also critical to accomplish all treatment objectives with the provisional prior to replacing it with the definitive restoration.

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