The placement of prefabricated ceramic inlays as aesthetic obturations was described as early as 1856 (Dietschi et al, 1994). In 1882, Herbst developed a fired ceramic inlay (Bruce, 1891), prior to the use of amalgam in 1895. A technique for fabricating fired ceramic inlays over platinum foil was developed by Land in 1888 (Ernsmere, 1990). However, these restorations were abandoned until the last decade because of clinical shortcomings such as restoration fractures, cement failures and interfacial leakage (Brunton et al, 1991). Conventional restorative dentistry previously relied on the use of amalgams and gold inlays to recreate form and function for intracoronal restorations of posterior teeth.

Conventional restorative dentistry previously relied on the use of amalgams and gold inlays to recreate form and function for intracoronal restorations of posterior teeth. The evolution in the development of adhesive dental technology, with newer adhesive materials and techniques has dramatically changed the way restorative dentistry is practised in the contemporary dental practice. The fundamental advantages of an adhesive restoration are restoration retention, reduction or elimination of marginal microleakage, and reinforcement of remaining tooth structure. Modern adhesive restorative materials and techniques have provided clinicians more conservative treatment avenues that preserve tooth structure while improving the longevity and aesthetics of the restoration (Touati and Aidan, 1997).

Laboratory processed inlays fabricated with porcelain or composite resin restore mechanical and biological function while achieving optimal aesthetic results with minimal tooth reduction. A conservative preparation design can be used because the adhesive procedure strengthens the cusps and provides additional support for the prepared tooth. Additionally, these two systems provide precise marginal integrity, ideal proximal contacts, wear resistance similar to tooth structure, reduced polymerisation shrinkage, excellent anatomical morphology and optimal aesthetics (Dietschi et al, 1994; Touati and Aidan, 1997). The first part of this article discussed the consideration factors and clinical attributes for the use of direct composite systems as intracoronal restorations. The second part will discuss the consideration factors for the use of indirect systems. A comparison of the attributes and capabilities of porcelain versus processed composites will provide a guide for proper treatment selection by the patient, technician and restorative dentist.

Consideration factors for the use of indirect systems
The clinical success of a bonded restoration requires accomplishing function, aesthetics, biocompatibility, and longevity (Pameijer et al, 1980). The attainment of these four criteria begins at the adhesive interface. A restorative material properly bonded to the enamel and dentin substrate will reduce the potential for marginal contraction gaps, microleakage, marginal staining and caries recurrence. In addition, it can improve retention, reinforce tooth structure and dissipate and reduce functional stresses across the entire restorative - tooth interface while improving the natural aesthetics and wear resistance (Goracci and Mori, 1999). Several clinical factors that can influence this adhesive joint include: the thickness of the resin cement, the restoration fit, stabilisation of the hybrid layer, strength and durability of the interface between the resin cement and the processed restoration and the wear of the luting cement.

Consideration factors for the use of laboratory processed inlays in medium to larger restorations include: polymerisation shrinkage, anatomical morphology, and cavity preparation and dimension. Since laboratory processed inlays are fabricated on a model, the only effects of polymerisation shrinkage are attributed to the minimal composite resin cement shrinkage at cementation. The anatomical morphology details and occlusion can be controlled to a higher level on the laboratory model and with the use of a microscope. In addition, the surface finish of the proximal surfaces can be polished to a higher degree and can provide an ideal contour and a positive contact. The cavity preparation requires the removal of tooth structure (i.e. undercuts) for proper path of insertion and adaptation of the restoration to the cavity walls and for ease of insertion and removal during fabrication. The cavity dimension includes medium to larger preparations and provides an alternative solution consideration for cuspal coverage (i.e. onlay) when the isthmus preparation exceeds one half of the distance from the central fossa to cusp tip. Since both of these restorative systems can provide predictable clinical results, a comparison of the attributes and capabilities of porcelain versus processed composites will allow for proper treatment option by the restorative dentist and laboratory technician.
Porcelain versus processed composites

The factors for determining favourable clinical case selection of processed composite resin or porcelain intracoronal restorations include:

**Intraoral polishability**
Since occlusion is equilibrated after cementation, the processed composite resin offers an advantage over porcelain because of its ability to be polished intra-orally. It is more difficult to establish a highly polished surface intra-orally on porcelain after the glaze has been removed (Miller, 2001). This unpolished surface has been shown to increase wear of the opposing dentition (Jagger and Harrison, 1994).

**Properties**
Porcelain is not as elastic as processed composite resin, and therefore does not tolerate elastic deformation (Touati and Aidan, 1997). This can result in fracture of the ceramic margins at try-in. Porcelain has a high resistance to compression and has a low resistance to flexion and traction, and hence is fragile when subjected to tensile stresses (Dietschi et al, 1990). This presents a challenge for some inlay preparations, as not all preparations provide the compression required for the ceramic material. The flexural strength of newer generation composite

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**INTRACORONAL RESTORATIONS (LABORATORY PROCESSED)**

<table>
<thead>
<tr>
<th>PORCELAIN</th>
<th>COMPOSITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult to establish a highly polished surface intra-orally</td>
<td>Ease of intra-oral polishability</td>
</tr>
<tr>
<td>High compression strength and low flexural strength</td>
<td>High flexural strength</td>
</tr>
<tr>
<td>Porcelain is harder than tooth structure and has the potential to abrade natural teeth at an accelerated rate</td>
<td>Wear compatibility with opposing natural dentition</td>
</tr>
<tr>
<td>Potential for microgaps at tooth restorative interface</td>
<td>Can be fabricated with smaller marginal gaps</td>
</tr>
<tr>
<td>Porcelain modifications cannot be restored chairside</td>
<td>Can be modified at chairside</td>
</tr>
<tr>
<td>No potential for impact absorption</td>
<td>Greater capacity to absorb compressive loading forces</td>
</tr>
<tr>
<td>Dissimilar coefficients of thermal expansion to resin luting cement</td>
<td>Similar coefficients of thermal expansion to resin luting cement</td>
</tr>
<tr>
<td>Advanced CAD/CAM technology available</td>
<td>CAD/CAM technology not as common</td>
</tr>
<tr>
<td>Unsurpassed in stability of colour, gloss and wear resistance</td>
<td>Long-term wear resistance and strength still in question, polish and surface texture fade with time</td>
</tr>
<tr>
<td>Technicians familiar with systems</td>
<td>Technicians not as familiar as with porcelain systems</td>
</tr>
</tbody>
</table>

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Figure 1: Comparison of the attributes and capabilities of porcelain versus processed composites for intracoronoral restorations
resin is in the range of 120 MPa to 150 MPa, which is higher than that of feldspathic ceramic (65 MPa). This slight elasticity of the composite resin helps to absorb some of the strains and thereby protects the adhesive bond at the tooth-restorative interface (Touati and Aidan, 1997).

**Wear compatibility**
Porcelain is harder than tooth structure and when not polished properly has the potential to abrade natural teeth at an accelerated rate, whereas second-generation systems composite resins are softer and have a more favourable wear compatibility with the opposing natural dentition (Miller, 2001).

**Cavo-surface margins**
Porcelain restorations have the potential for microgaps at the tooth restorative interface; second-generation composite restorations can be made with relatively small gaps. These cavo-surface margins are a weak point of the ceramic restoration (Miller, 2001).

**Chairside modifications**
Porcelain modifications (e.g. contacts, fractured margins) are time consuming at chairside, whereas indirect resin restorations can be easily modified chairside (Jackson, 1993).

**Monochromatic versus polychromatic**
Injectable ceramics are monochromatic and colour can be altered with external stains, which can be removed with occlusal adjustment or occlusal wear. Newer generation composite resins can be internally layered for a polychromatic effect.

**Impact absorption**
Composite materials have shown a greater capacity to absorb compressive loading forces and reduce the impact forces by 57% more than porcelain. Therefore, composites transmit less of the applied load to the underlying tooth structure (Gracis et al, 1991).

**Thermal expansion**
Composite inlays have excellent marginal integrity because of the similar thermal expansion rate as the luting cement. Conversely, the variation in coefficients of thermal expansion for porcelain inlays and the composite luting cement can result in an increased width of luting gap (Fuhrer, 1997). Although laboratory-processed composite resins provide important clinical advantages in many situations, there are several factors that should be considered for the use of porcelain intracoronal restorations. Those factors include the efficiency and ease of fabrication in the laboratory as a result of advanced technology (e.g. injectable ceramics and CAD/CAM systems), the availability of these systems in laboratories, and the technician’s expertise with this technology. Composite systems for CAD/CAM technology are not as common. In addition, porcelain systems are unsurpassed in stability of colour, gloss, and wear resistance (see Figure 1).

**Conclusion**
The demand for tooth-coloured restorations for the posterior region continues to increase. Combined with the declining use of traditional materials for these indications, indirect restorative systems broaden the scope of restorative modalities that are available to assist the patient, the technician, and the dentist in making informed decisions for different clinical situations (Touati and Aidan, 1997).

**References**