

CERAMIC VENEERS IN GENERAL DENTAL PRACTICE.

PART THREE: CLINICAL PROCEDURES

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Abstract

The diagnostic process driving the decision to place (or not place) ceramic veneers was described in part one of this series and in part two thought was given to choosing the most appropriate restorative materials. Parts 3 and 4 describe the actual clinical procedures involved: shade selection, tooth preparation, impression taking, placement of provisional restorations, try-in, bonding and finishing.

Shade selection

The final shade of a veneer depends not only on the colour, opacity and thickness of the porcelain but also on the colour of the underlying tooth and the colour and thickness of the luting composite (Davis 1991, Mörmann 1996). In particular, the use of a thin porcelain veneer to match the colour of one discoloured tooth to the surrounding natural teeth is extremely difficult (Figure 1). As a general rule, shade selection should be completed prior to any tooth preparation, especially if any veneers are to match existing teeth or restorations - prolonged preparation time can lead to tooth dehydration and an altered shade. When multiple veneers are being placed to recreate the whole entire anterior segment then any decision regarding tooth shade should take into account the patient's age, existing tooth shade/discoloration and such factors then balanced against the patient's desires and your own experience in what is feasible and realistic. Once the preparation has been completed the shade of the remaining tooth structure should be noted and communicated to the laboratory so that the technician has a guide to the degree of any discoloration being masked. Clinical photographs are very useful in this respect (Figure 2).

Tooth preparation

Before embarking on tooth preparation it is clearly desirable to know just what sort of preparation one is aiming for. Down the years there have been various recommendations made regarding veneer preparations. Meijering et al (1998) followed 263 veneer cases and observed that because of the number of potential variables such as the dentist's skill, materials used, hard tissue substrate, occlusion, degree of tooth discoloration, outcome criteria and so on a definitive answer to which veneer design is most effective is very hard to provide. Various basic principles have, nevertheless, emerged:

1) Tooth preparation should remain wherever possible in enamel.

2) Sufficient thickness of porcelain should be present to allow masking of any underlying tooth discoloration without the

need to overbuild tooth contour.

3) The preparation should result in a smooth transition between tooth and restoration and in the gingival region should maintain the correct emergence profile.

4) Restoration margins should not be placed in positions where there is a high degree of occlusal loading.

5) Sharp line angles should be avoided to prevent the propagation of undesirable stress fractures in the bonded ceramic material.

Difficulties arise, however, when attempting to reconcile points 1) and 2) in the above list. It is widely accepted that the



Figure 1: It is almost impossible to use a ceramic veneer to mask the degree of discoloration evident in the upper left central incisor (i.e. so that it matches the adjacent teeth) and still keep the preparation within enamel. In situations such as this a full-coverage restoration is recommended



Figure 2: Although these teeth are discoloured, veneers are far more feasible than in the case shown in Figure 1 as all the anterior teeth will exhibit the same colour and degree of translucency. A photo of the prepared teeth helps the technician visualise the shading of the prepared teeth and is a useful guide to the degree of discoloration to be masked

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Figure 3: Depth cutting burs are useful when trying maintain a consistent depth and curvature to the preparation. They should be used with extreme care to ensure that adjacent teeth and soft tissues are not damaged

best veneer preparation is one that rests primarily in enamel since there is considerable concern over the levels of bond strength achieved when restorations are placed onto a dentine substrate. Some enamel reduction is required to improve the bond strength of the resin composite to the tooth surface (Stacey 1993). By doing so the aprismatic top surface of mature unprepared enamel, which is known to offer only minimal retention capacity, is removed.

Increasingly, however, veneers are being placed in more and more demanding clinical situations (in an attempt, for example, to mask deep discolourations and to correct malaligned teeth) and the resulting bulk of porcelain required results in increased dentine exposure during preparation. Although the results of the newest generation dentine adhesives are very promising, the bond strength of porcelain bonded to enamel is still superior when compared with the bond strength of porcelain bonded to dentine (Van Meerbeek 1998). As has been mentioned previously, there is therefore a considerable body of opinion therefore which sees veneer preparations placed predominantly in dentine as being undesirable and something which should be avoided wherever possible.

The differences between the various recommended preparation designs centre upon the following key areas:

1) Labial - The bulk of the labial preparation should, as has been discussed, be kept within enamel. Generally speaking it is important to maintain the natural curvature of the tooth surface (in both incisal/gingival and mesial/distal directions) wherever the post-treatment contour of the restored tooth remains essentially the same as the pre-treatment one i.e. when teeth are well aligned and with no facial enamel loss. Christensen (1991) states that 0.75mm is the optimum amount of enamel that should be removed. Depth-cutting burs (Figure 3) are useful in such situations but are less useful when veneers are being used to alter tooth contour and where a uniform reduction of the tooth surface is not required or even desirable and can result in unnecessary structural loss and weakened

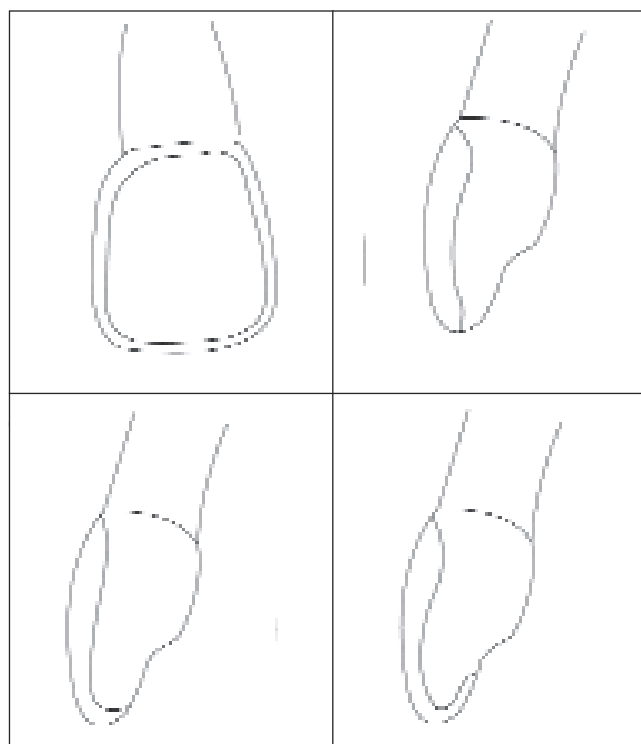


Figure 4: Various different veneer incisal edge preparation designs have been advocated. Of these the butt joint 4(c) currently appears to be the most favoured

tooth structure (Magne 2004). In such cases, it is usually necessary to perform a diagnostic wax-up to help visualise the final restoration(s) (Robinson 2003, Mizrahi 2005). This is then used to make a preparation/reduction splint which can then be used as a guide to preparation (Javaheri 2007) as well as a template for provisional restoration fabrication (Bloom 2006). Gurel (2003) has described the use of Aesthetic Pre-evaluation Temporaries (APTs) in providing an opportunity for both clinician and patient to evaluate the approximate final result. Once the desired contours have been agreed upon, veneer preparation can be performed according to the APTs regardless of existing tooth position.

2) Incisal - This is a critical area and variations (Figure 4) range from the very conservative window approach, through one in which the margin is sited on the incisal edge itself, to the overlap reduction which in turn can be finished either as a butt margin or as a palatal chamfer. Of these, incisal coverage preparations appear to be the preferred option. Various studies have been carried out to examine the effect of preparation design on veneer longevity. Smales and Etemadi (2004) for example, investigated long-term survival rates of veneer restorations after a seven year period and found a 96% cumulative survival rate when incisal coverage preparations were used compared to 86% survival without incisal coverage. Priest (2004) found that incisal butt joints provide the best solution, resulting in not only a relatively simplified tooth preparation but also stronger, longer lasting, restorations. This is good news because such restorations are easier to prepare,



Figure 5: In this case, the veneer preparation was not carried far enough around the tooth resulting in a highly unnatural appearance once the veneer is cemented

fabricate and bond in place.

3) Interproximal - The decision here is basically whether to break through the contact point or leave it intact. The chief advantage of breaking through is that the ceramic material can be ‘wrapped around’ and the junction with the tooth hidden. This is particularly useful when dark teeth are being masked, as when treating tetracycline discoloured teeth. On the downside are the degree of tooth destruction and the fact that should any drifting occur between preparation and cementation then the bonding procedure can be difficult because of the altered tooth position. Leaving contacts in place means less tooth destruction, less likelihood of drifting but paradoxically can once again make bonding difficult because of the tight space. If the contact is retained care must be taken to ensure that the preparation is taken far enough into the embrasure to hide the margin. Again ‘visible’ margins may not be a problem when the veneer is thin and when there is little need for masking discoloration but in many cases the safe choice is to take the margin out of sight to prevent an unsightly junction between veneer and tooth (Figure 5).

4) Cervical - Veneer preparations should remain as much as possible in enamel even after the optimal 0.75mm reduction. Clearly, this can be almost impossible to achieve in the cervical region where enamel thicknesses are as low as 0.3mm (Cherukara 2005) and it is therefore almost inevitable that dentine will be exposed if an overbuilt restoration is to be avoided (Figure 6).

Beyond this, if it is not possible to remain within enamel then another form of treatment should be considered. Chamfer preparations are to be preferred and certainly shoulder-like shoulder preparations with sharp internal line angles are to be avoided. A decision has to be made about where to place the cervical margin relative to the gingival level. It is possible to leave margins supragingivally in many cases where thin veneers can be used and the original tooth colour allowed to show through and influence the shade of the ceramic material. As interproximally, where tooth discoloration requires masking,

the margin will most likely have to be placed out of sight, in this case subgingivally. Whichever design is chosen, the use of magnification will greatly enhance the quality of the final preparation. We would go as far as to say that without magnification it is very difficult to produce the fine margins needed for this type of restoration.

Other preparation considerations

Veneers are often prescribed to improve the appearance of heavily restored teeth. However, one of the most common reasons for veneer failure is bonding onto existing, old restorations. To ensure the best possible bond between ceramic and any underlying restorations, the latter should be replaced within a maximum of two weeks prior to veneer bonding. It also makes considerable sense to confirm the condition of the tooth beneath any existing restorations.

Once any underlying restorations have been replaced and the basic preparation completed, it will need refinement, smoothing, to remove any remaining sharp line angles and to

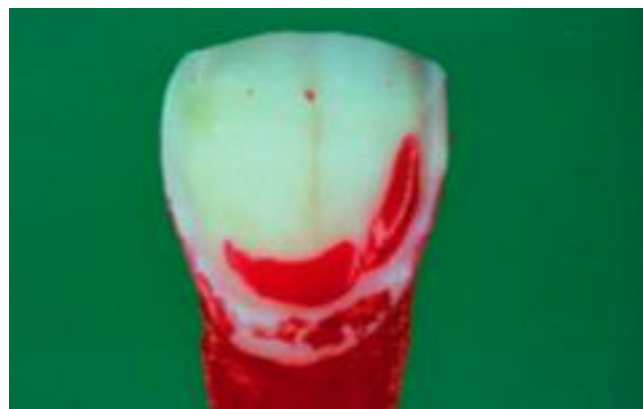


Figure 6a: A minimal veneer preparation was carried out on this extracted tooth and then stained to show the presence of exposed dentine. Clearly the cervical region is most at risk due to the extremely thin covering of enamel in this region



Figure 6b: Diamond burs featuring a less abrasive tip can go some way to preserving cervical enamel

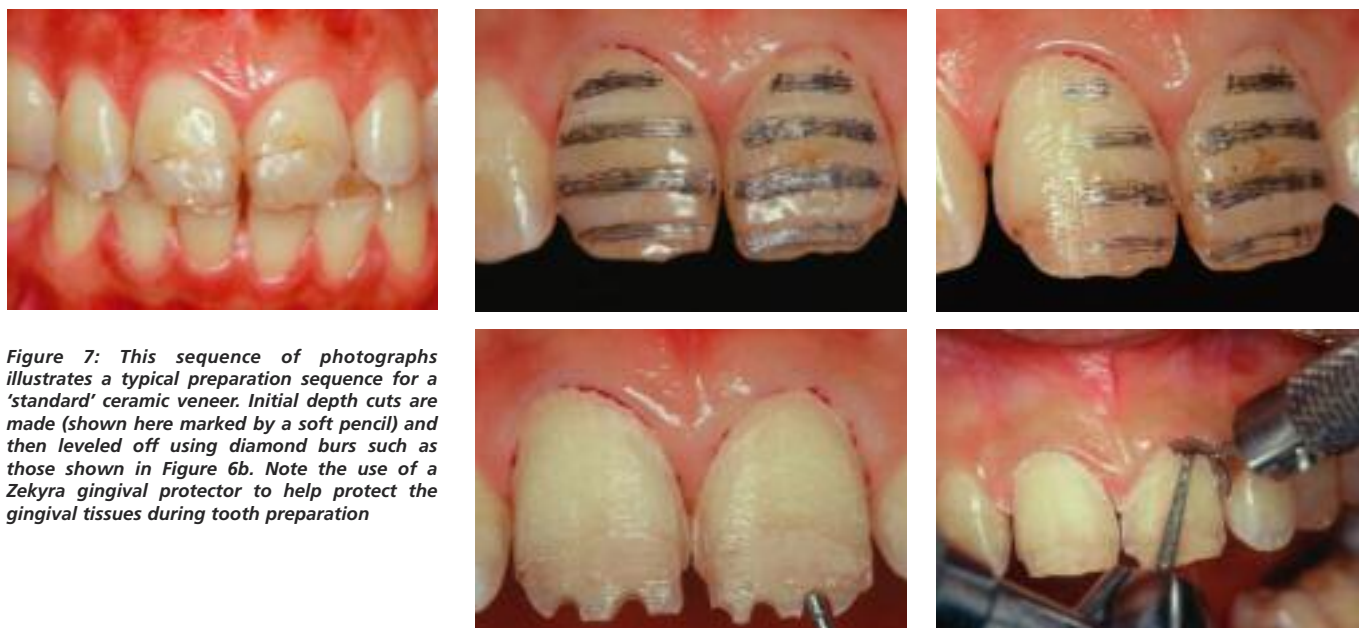


Figure 7: This sequence of photographs illustrates a typical preparation sequence for a 'standard' ceramic veneer. Initial depth cuts are made (shown here marked by a soft pencil) and then leveled off using diamond burs such as those shown in Figure 6b. Note the use of a Zekyra gingival protector to help protect the gingival tissues during tooth preparation

ensure that the margins are placed in the best position. This latter stage can usually be helped by a) placing retraction cord and b) use of specially-designed gingival protectors (Figure 7) so allowing a further lowering of the margin to a position just below the gingivae. Final checks should be made with regard to the occlusion but as has been stressed several times before in this series, if the occlusion is anything other than entirely favourable then ceramic veneers are unlikely to be the best treatment option – they are not the most forgiving of restorations.

Immediately after completion of the preparation any exposed dentine should be protected in order to prevent post-operative sensitivity and bacterial invasion (Olgart 1974, Brännstrom 1992). Provisional materials currently in use only partially seal the surface. More effectively, the exposed dentine can be protected by means of a primer, which is a hydrophilic reactive monomer in an organic solvent (Cagidiaco 1996). The use of these primers or desensitizers after preparation does not appear to deteriorate adhesion to dentine when the exposed dentine surface is adequately re-treated at the fitting appointment (Cobb 1997). Paul and Schärer (1997) proposed application of the dentine bonding agent immediately after completion of tooth preparation citing in-vitro improved bond strength.

Impression taking

Excellent impressions are a must. Without them the technician simply cannot produce aesthetic, well-fitting, veneers, time and money will be wasted as a consequence and all parties involved, the patient, technician and of course yourself, will be frustrated. Research has shown over and over again that the quality of many impressions produced by dentists fall short of widely-held standards (Winstanley 1999; Alhourri 2004; Christensen 2007). Ceramic veneers are especially susceptible

to inaccuracies caused by poor, distorted, impressions, some of which may be difficult to detect chairside. It is therefore vital that soft tissue control be achieved through the use of retraction cords, that there is excellent moisture control and that an appropriate impression material and tray are chosen and used properly.

1) Soft tissue control - The periodontal condition of the teeth undergoing preparation should be carefully managed prior to the preparation and impression stages. Use of dental floss and interproximal brushes is essential to minimise bleeding, crevicular fluid seepage and to ensure accurate recording of the preparations and soft tissues and to obtain stable gingival height after the veneers have been bonded. Use of 0.12% chlorhexidine gluconate (preoperatively, during the provisional restoration period and for two weeks postoperatively) helps reduce tissue inflammation and is therefore a major aid in producing more accurate impressions.

2) Retraction - Good impressions start with good retraction (Figure 8), but often the process is ignored or rushed and the impression compromised. Either single or double cord



Figure 8: Unless the decision is made to place the cervical margin of the veneer some way supra-gingivally, gingival retraction is necessary to ensure correct visualisation, placement and subsequent recording of the preparation margin



Figures 9a-c: Directly applied composite is a useful way to make provisional restorations when one or two veneers are being placed. The composite is tacked in place by spot etching the tooth surface

techniques can be used. A single cord is best used when preparing margins at, or above, tissue height, and where the gingivae are healthy and no bleeding occurs when the cord is packed. The double cord technique is best used when subgingival margins are required (most likely when deep discolouration is being masked) and/or if the tissue health is less than ideal in which case one should really question the decision to place veneers at all. In this technique, an extra thin cord such as a #0 is placed into the sulcus following initial tooth preparation. This provides a slight tissue deflection allowing more access and importantly, it serves as a depth gauge to prevent cutting epithelial tissue. Once the preparation is completed a thicker, braided cord is placed to achieve adequate tissue displacement. After a minimum of five minutes the upper braided cord is removed, leaving the initial cord in place and the impression taken.

3) Haemostatic agents - Once again if these are required, the decision to provide veneers in the first place should be reviewed. While it is easier to respect tissue whilst preparing a tooth than to try and stop iatrogenically produced bleeding, there are occasions when gingival bleeding is an unexpected problem. Products containing ferric sulphate do not damage the tissues whereas commonly-used aluminium and zinc chloride products can be caustic to gingival tissues. While these solutions have not, perhaps surprisingly, been shown to effect impression setting significantly (de Camargo 1993), it seems prudent to wash the teeth before placing the impression material. In addition, all astringents negatively affect the bond strengths of adhesives to dentine and use of cleaners such as a chlorhexidine (O'Keefe 2005), two percent glycolic acid or an EDTA-based cleaning gel may help return the bond strength to normal values as well as eliminating set inhibition of polyvinyl siloxane impression materials.

Tray selection

Selecting an appropriate tray for the desired technique and materials used is an extremely important, yet often overlooked, part of successful impression taking. Full arch, perforated metal, rigid plastic or custom trays are recommended for multiple (say three or more) veneers. Traditionally we have been taught to take opposing arch impressions using alginate with bite registrations in a very accurate material which is usually a

polyvinyl siloxane. However, inaccuracies may arise when we take an occlusal registration in a material which is more accurate than the model produced from an alginate impression resulting in hyperocclusion of the final restoration.

For all cases involving only one or two veneers such problems can be avoided by using small double arch impression trays to capture the preparations, opposing dentition/occlusion and bite registration all at once. This method is often easier for the patient, since there is less material, a smaller tray and hopefully less risk of gagging. There is also the advantage of shorter chair time, since a bite registration and a separate opposing impression are not required. For such a technique to be successful the impression tray must be rigid to resist distortion and equally the impression material should have a high rigidity when set so that it becomes an integral part of the system. It must also have sufficient fluid viscosity to move the light body beyond the preparation margins without displacing it from the preparation. It has been shown that restorations fabricated from dual-arch impressions are equivalent in marginal accuracy and yet superior occlusally to restorations made from complete arch impressions (Cox 2005).

4) Impression materials - A large majority of dentists currently use polyvinyl siloxane impression material. The material is easy to use, produces excellent results and exhibits essentially zero dimensional change during the setting reaction along with good tear strength and wettability Mandikos (1998). Most manufacturers supply heavy, medium and light body materials along with a very-heavy body material (putty) which is usually used to convert a stock tray into a custom tray for use with the wash technique. Three impression techniques can be employed with the addition polymerizing silicones: the single mix (a medium body material is used in both the syringe and the tray); the double mix (light body in the syringe, medium or heavy body in the tray); and putty/wash (light body in the syringe and very heavy body in the tray). The latter is very popular but prone to error as the putty invariably records critical areas of the preparation. Asking your assistant to place a finger indentation in the area of the preparation(s) helps alleviate this problem and all the margins should then be recorded with light body.

5) Complications from latex gloves - Some compounds used in the vulcanisation of latex surgical gloves may interfere with



Figures 10a and b: When more larger numbers of teeth are being prepared the simplest way to make temporaries is by means of a clear splint made from the diagnostic wax-up

the polymerisation of polyvinyl siloxanes (Kimoto 2005) and thus contact should be avoided. For example, if mixing putty by hand, sulphur residue from the gloves contaminates the platinum catalyst and decreases the polymerisation reaction. Vinyl or nitrile gloves can be used to eliminate the problem.

Provisional restorations

Several factors need careful thought when considering provisional restorations including the need for them at all, technique and importantly the way the prepared surface is treated, especially if there has been any dentine exposure. As a rule, it is recommended that provisional restorations be placed for aesthetic and functional reasons. Aesthetically because teeth are often darker following tooth preparation and are reduced in size; functionally because interproximal and occlusal contacts need to be maintained and fragile margins need protection.

Provisional restorations can be made either by the direct application of composite resin onto the tooth following spot etching at the centre of the preparation (Figure 9). This is somewhat time-consuming and most clinicians prefer to use provisional restorations made using a clear splint fabricated on a study cast of either the original dentition or, more likely, a diagnostic wax up (Figure 10). The splint is filled with temporary material and placed over the prepared teeth for two minutes. The stent is peeled off and the temporaries polishes and tacked to the teeth again with spot etching.

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