Integrating posterior crowns with partial dentures

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This article outlines those considerations which are important in integrating posterior crowns with partial dentures. Planning the support and retention of the denture prior to crown construction will enhance patient treatment. Modification of the crown preparation to incorporate rest seats, retentive areas, guide planes and a planned path of insertion may be necessary.

Conventional or adhesive bridgework may be planned to reduce the number of saddle areas and simplify the denture. Where appropriate, single bounded saddles may be more effectively restored in many instances using bridgework and the need for a denture avoided. Where dentures must be used to restore the dentition, crowns may also be useful in improving denture performance. Large direct restorations in selected places may be replaced with crowns which incorporate rests, guide planes and undercuts. Unrestored teeth may also be chosen for modification with crowns, but the benefit in terms of denture performance must be weighed against the destruction of sound tooth tissue and the need for crown replacement at some future date.

What is needed for the treatment plan?

A prerequisite for prosthodontic treatment is that the patient has adequate oral hygiene and that the teeth are not mobile. Caries should be eliminated and the status of the existing restorations should be examined to ensure that they are sound. If the patient is wearing a denture, it should be examined for retention, support and aesthetics.

Study casts are essential for successful

In brief

- Planning of rest seats, path of insertion and retention of the denture are essential, before crown preparation takes place.
- The crown preparation may need modification to accommodate rest seats and guide planes.
- Prior planning with articulated, surveyed study casts aids denture aesthetics and function.

crown and denture treatment planning as they allow an examination of the occlusion and over-erupted teeth. A jaw registration may be necessary for the casts to be articulated, and as they are to be surveyed the casts should be split-cast mounted. Examination of the casts can show whether the posterior tooth can be prepared at the same angulation as the path of insertion of the

denture, and thereby contribute to denture retention. The tooth about to be crowned should be of suitable crown length to allow sufficient clearance from the opposing tooth. An examination of the periodontal status of the teeth is necessary, which would include periapical radiographs where necessary. Vitality tests may also be necessary. The author prefers to immediately root treat teeth with dubious vitality, rather than risk later intervention. Tooth preparation for the crown should not be started until after the denture has been designed, so that the crown can incorporate suitable rests, undercuts and guide planes. If a change in the orientation of the occlusal plane is required, due to over-eruption of teeth, it may be necessary to construct a wax trial denture prior to crown preparation to visualise the amount of tooth reduction required. Drifting and tilting of teeth are likely to necessitate a change in the path of insertion of the denture. When planning ahead, consideration should be given as to whether crowns should include rest seats, undercuts and guide planes which could later be used to optimise the stability and retention of a partial denture.

Planning the path of denture insertion

Using a surveyor allows the dentist to plan the path of insertion of a partial denture by

Fig. 1 An extreme tilt to the cast creates high survey lines, but these are 'undercut' surfaces that are not in undercut relative to the vertical path of displacement

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determining the severity and position of undercuts on individual teeth, which can be used for denture retention. Ideally, partial dentures should be able to resist the vertical displacement that occurs when a patient has bitten through sticky food and is now separating their teeth. The denture is displaced along the path of displacement, by convention a direction at right angles to the occlusal plane.

In the absence of prepared guide planes, the path of insertion must be close to the path of displacement. Patients tend to insert and remove their dentures in a vertical direction and if the planned path of insertion is far from the vertical it can cause difficulties, especially with old and infirm patients with little manual dexterity. In addition, extreme tilts of the cast create only 'false or fictitious' undercuts, which do nothing to resist displacement along the path of denture displacement (Fig. 1). Any clasps positioned in these false undercuts will not resist vertical displacement of the denture.

But the situation is different where guide planes are incorporated in the partial denture design, because then the denture can only be inserted and withdrawn along these parallel surfaces. Natural teeth can be adjusted to provide this additional retention, using a variety of devices. The simplest type use grooved, reflective metal surfaces,¹ while other more complex devices are limited by their bulkiness to preparations involving the anterior teeth. Guide planes, when incorporated into crowns, allow a single path of denture insertion, which can be different from the path of displacement (Fig. 2). Clasps need only resist movement away from the teeth in the only direction in which the denture can be removed or displaced, i.e. the direction opposite to the path of insertion.

Planning the crown preparation

Porcelain-fused-to-metal occlusal surfaces have a better appearance than metal alone, but require substantially more tooth reduction. Opposing crowns constructed in metal also allow optimum contacts.

The tooth preparation will need to be modified to accommodate a rest of 1.5

Fig. 2 Milled crowns provide guide planes that limit the path of insertion and removal of the denture. The length of the guide plane surfaces controls the denture retention provided

Fig. 3 The tooth preparation involves a chamfer finishing line (orange) and a lingual guide plane (blue) as well as box-shaped rest seat preparations (arrows pointing to yellow areas)

Fig. 4 The crown incorporates a lingual guide plane which wraps around the tooth

Fig. 5 Where two crowns have been constructed with parallel lingual guide planes, then the denture gains retention because it can only be inserted and removed along that plane

Fig. 6 Attrition has reduced the thickness of enamel available for rest seat preparation in the upper canine tooth

mm depth in the crown, so a countersink of 1 mm depth is made in the preparation. This allows sufficient thickness of metal crown between the preparation and the denture rest. The lingual surface of the tooth should also be prepared to allow sufficient room if a lingual guide plane is to be incorporated.

Guide planes are parallel surfaces on teeth, which rarely occur naturally; tooth reduction is usually necessary. When incorporated into crowns, guide planes increase denture retention by limiting the path of withdrawal of the denture. They

prevent denture rotation and consequently increase the efficiency of clasps. Where posterior gold crowns are to incorporate lingual guide planes, the crown preparation requires additional reduction to allow incorporation of parallel surfaces with milled shoulders in the castings (Fig. 3). The shoulders provide denture support along the long axis of the tooth. Lingual tooth reduction in the same plane as the path of insertion of the denture prevents a bulky, overcontoured crown (Fig. 4). The frictional resistance between the cobalt-chromium denture and the parallel surfaces on the crown will provide denture retention (Fig 5).

Planning rest seat preparation

Tooth support for the lower partial denture is essential to prevent gingival damage

(or 'gum stripping') and placing rests on the occlusal surface of the posterior teeth will provide support. In the anterior region the lower canine has a sloping lingual surface and if a cingulum rest is not provided, occlusal forces will tend to push the tooth labially and transfer high stress to the surrounding alveolar bone.² The depth of cingulum rests in natural anterior teeth is limited so that the preparation remains within enamel, no deeper than about 1.1–1.5 mm.³ Despite this, 30% of maxillary canine rest seats, prepared by highly trained prosthodontists in one study, were in dentine.⁴ If the dentine exposure is severe this may cause sensitivity. Some authors recommend using cast metal ledges or composite resin ledges to avoid the possibility of causing dentine exposure.

Clinically, the remaining thickness of enamel can be determined only approximately by examining the tooth contour and colour, occlusion and degree of enamel loss elsewhere in the dentition. In the reduced dentition, localised attrition can prevent the rest seat preparation remaining within enamel (Fig. 6). Non-destructive, ultrasonic measurement of the enamel thickness available for rest seat preparation is possible,⁵ but not routinely available. One simple solution is the use of trial depth cuts to minimize dentine exposure. With crown preparation of the teeth, the ideal depth of rest seat can be incorporated and firm location of the denture is possible.

Fig. 7 The rest extends about 4 mm onto the occlusal surface of the posterior tooth. The undulating fitting surface of the rest locks the denture and tooth together when load is applied to the rest

Fig. 8 Where the surveyed cast has been tilted, but no guide planes are present, cast cobalt chromium clasps must engage a depth of suitable undercut relative to both the path of insertion and the path of displacement (clasp A). Placing the clasp in deep undercut relative to the path of displacement (clasp B), for example, may result in clasp fracture or distortion, especially if the patient bites the denture into place

on the cast, one at right angles to the occlusal plane and the other at right angles to the path of insertion of the denture, where is the clasp placed? In this case the denture can be displaced vertically or along the angled path of insertion — there are no guide planes to help. The solution lies in placing the clasp in the correct undercut relative to both survey lines. If one of the survey lines is ignored, for example the line constructed at right angles to the occlusal plane, the clasp may be placed in undercut that is far too deep relative to vertical displacement of the denture (Fig. 8). If the patient is able to insert and remove it, the clasp may be distorted as it flexes over the excessive undercut.

Summary

The use of a surveyor in prosthodontic planning allows a consideration of guide planes, tooth undercuts and the path of insertion. In order to obtain improved function and aesthetics where crowns and dentures are to be provided, prior planning will allow improved retentive surfaces and optimally designed rest seats and guide planes to be incorporated into the crowns prior to denture construction.

The acute angle at which the metal rest contacts the tooth is important as it provides a bracing action, locking together denture and tooth when occlusal load is applied (Fig. 7). Providing a rest seat with the correct undulating occlusal surface is relatively easy to accomplish with a metal crown in the laboratory.

Planning undercut surfaces

When constructed in cobalt-chromium, the terminal third of occlusally approaching clasps engages the retentive undercut on the molar crown. However, the clasp tip should remain about 3 mm from the gingival margin of the teeth so that mechanical trauma from the clasp and plaque-induced gingival irritation are avoided. Clasps can also be constructed of more flexible wrought mate-

rials, such as gold or stainless steel, which are more easily adjusted.

Surveying the tilted casts

What happens when the cast is first surveyed with the occlusal plane horizontal, then with the cast tilted: which survey line do we use? It all depends on whether guide planes have been used.

If guide planes are present the denture can only be removed and displaced along the path of insertion, therefore any other survey lines not made in this direction can be ignored. In this situation the denture only has to resist movement in one direction — along the path of insertion (which is the same as the path of removal).

In the situation where there are no guide planes present and two survey lines drawn

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