

A Clinical Overview of Removable Prosthesis: 4. Technological Considerations when Designing Removable Partial Dentures

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Abstract: This fourth article in a series concerning the prescription of removable partial dentures is a précis of the technical aspects of RPD construction, commencing with the definitive or 'working' impressions, although all impressions ought to be considered as 'working' impressions.

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Clinical Relevance: Design and construction of partial dentures is a team effort in which clinician and technician work together.

For the dental team to design a removable partial denture (RPD), there are two basic requirements:

- a model surveyor and
- a set of study casts, which should have been mounted on an appropriate articulator via an interocclusal record (where the occlusion is not obvious)

in addition to the information noted at the clinical and radiographic examinations.

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For the intended RPD to be successful, the design and construction should be practised as a team effort and the clinician should ascertain the patient's preferences, desires and expectations. The third element of the team is the dental technician, and his/her technical advice should be sought when the design is being finalized, particularly if it is unusual or complex.

DEFINITIVE IMPRESSIONS

When irreversible hydrocolloid has been used, such impressions should be cast within 10 minutes, or the impressions stored in such a way as to avoid distortion and at the correct humidity. Polyvinylsiloxane impression materials may be condensation cured or addition cured. The latter types are more stable and may be cast more than once, although they should be left for 24 hours to allow for elastic recoil and gas liberation; the former release alcohol from the setting reaction and

are therefore liable to distortion and should be cast within one hour. For maximum strength and abrasion resistance, Class 4 die stone is preferred.

After the blocking out of unwanted or unusable undercuts on the master model, the casts are duplicated (using either reversible hydrocolloid or a laboratory silicone rubber material) so that a working model may be made. The purpose of this is two-fold:

- The working model may be copied to make a refractory model where cast metal bases are being planned.
- The process of removing the processed denture from the flask will ruin the working cast and, after polishing, the completed dentures may be seated on the master model to verify correct fit.

The working casts should be mounted onto an adjustable articulator, using a split-cast mounting technique to allow repositioning of casts after processing for occlusal adjustment.

POLY(METHYL) METHACRYLATE-BASED RPDS

Identification of the periphery of the denture on the study cast will help with the waxing up of the denture base. With complete dentures the peripheral roll should be indicated automatically by the location of the desired commencement of the 'land' area by



Figure 1. The RPD design has been clearly drawn on the surveyed primary cast.

indicating this on the definitive impression. In the case of RPDs, however, this cannot always be easily recorded.

If a wrought stainless-steel bar major connector has been prescribed, this is now fabricated, along with any wrought clasps. If an accurate recording of the occlusion has been made previously, it may not be necessary to prepare occlusal wax rims and the denture base can therefore have the teeth placed and be made ready for a trial insertion. However, if the occlusion has not been registered unambiguously, or if the level of the occlusal plane is unclear, a definitive registration should be recorded before proceeding to trial insertion. In patients with a history of denture fracture, or when the design is fragile (e.g. if the denture is opposed by natural teeth and the occlusion is heavy), it might be useful to provide a denture-base resin made from high-impact resin or by using resin with fibre reinforcement. In addition, in patients with a history of fracture of resin, if a metal-based denture is ruled out, then there may be merit in using a radio-opaque acrylic resin. This might make good sense from a medicolegal point of view.

METAL-BASED RPDs

Such devices will usually be in a chromium cobalt alloy, and the denture base waxed up on a duplicate of the master cast (the working model). In this case, and for cobalt-chromium alloys, the refractory model is made of phosphate-bonded investment material. Wax clasps, as specified in the design,

are also waxed up at this stage and joined to the wax base. Cobalt-chromium cannot be cast to less than 0.5 mm with any degree of confidence, therefore any prepared teeth should have been adequately reduced by at least 0.5 mm, although for occlusal rests to be adequate they should have a thickness of 1 mm. The framework may have a spaced meshwork in the saddle areas for attachment of the acrylic resin; alternatively, retention 'tags' or loops may be used. Where anterior teeth are retained via the framework, they should be located with an index to facilitate waxing up of tags or backings. Thereafter the whole framework is cast in the chosen alloy.

As with acrylic resin dentures, it may not always be necessary to prepare wax occlusal rims for a registration stage if the occlusion has already been accurately recorded. If this is not the case, then wax rims are added and the metalwork tried in the mouth and the occlusion (ICP) recorded. Many clinicians prefer to try-in the metalwork by itself after it has been polished, without any wax additions. This enables the dental team to verify that the fit and the occlusion are acceptable before proceeding to a full trial insertion. Once fit and occlusion have been confirmed, the metalwork may be tried-in with the teeth added in wax, as with acrylic dentures.

TRY-IN AND FINISH OF THE RPD

When the try-in is satisfactory to both clinician and patient, the dentures may be processed and, after confirming that the occlusion has not altered by remounting on the split casts, finally polished.

POINTS TO NOTE

A design drawn on the study cast, as well as on the design card, will enable the technician to see exactly where each component of the denture should be placed (Figure 1). This should include the placement of the anterior edges of the upper major connector between the rugae, and the posterior extension in the palate. The positions of the clasps should also be identified relative to the degree of undercut and the material of choice. Rest seats may be placed on areas of the teeth other than mesial and distal marginal ridges, for example, and these should also be indicated.

It is helpful to the technician if the path of insertion of the denture, if not at right angles to the occlusal plane, is indicated on the study cast with a series of parallel lines drawn on the base while the cast is on the surveyor at the required tilt (Figure 2). Unwanted undercuts can then be blocked out to fit this path of insertion. For example, a downward tilt of the anterior part of the cast may enable a

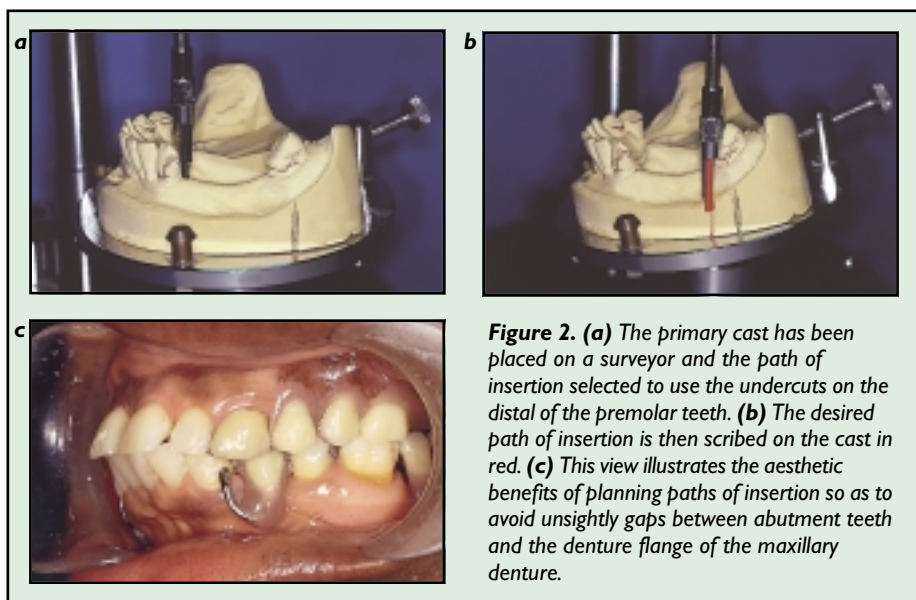


Figure 2. (a) The primary cast has been placed on a surveyor and the path of insertion selected to use the undercuts on the distal of the premolar teeth. (b) The desired path of insertion is then scribed on the cast in red. (c) This view illustrates the aesthetic benefits of planning paths of insertion so as to avoid unsightly gaps between abutment teeth and the denture flange of the maxillary denture.



Figure 3. There is no need to restore the edentulous spans with two premolars and two molars; the occlusal table should be reduced in width and length to reduce occlusal forces on the residual ridges.

flange to be extended further into an undercut labial sulcus to aid retention of the finished denture against occlusal displacement. However, unwanted undercuts elsewhere on the cast will also need to be blocked out in order for the denture to seat with this path of insertion.

Although wax rims are used for registration purposes when determining occlusal vertical dimension (if no natural tooth contact remains) and the level of the occlusal plane, softening of the wax and asking the patient to close, or using a wax 'squash bite', may be inaccurate. It is preferable to use either plaster keys or a proprietary occlusal registration material in the space between the rim and the opposing natural teeth or rim. The dentist

should then confirm that the registration in the mouth matches that on the casts.

It is not always necessary, or desirable, to replace all missing teeth on a denture saddle, particularly a distal extension one. An indication on the study cast can be made of how far distally the teeth should go. Likewise, premolar rather than molar teeth may be preferable in order to reduce forces needed to bite through food and this should be specified as appropriate (Figure 3).

The arrangement of the teeth anteriorly is probably the most important aspect of the denture from the patient's perspective. Details of how the teeth should be arranged, making use of a drawing if necessary, are helpful to the technician, as are impressions of existing dentures *in situ* (if they are desirable). As has been stressed throughout this series of articles, this is facilitated by having a wax trial insertion **before** recording the definitive impressions, as this enables the clinician, technician and patient to observe the overall appearance, detect space constraints and to evaluate the extent of the denture flange and the need for any mucosal staining.

When an upper cobalt-chromium RPD is being planned, the type of finish (stippled or highly polished) should be clarified. Some patients prefer the more 'natural' feel of the former; this is easy to

determine if the patient is an experienced (cobalt–chromium) denture wearer, but in a patient who is a denture-wearing novice, an incorrect prescription could prove costly to the clinician.

It is frequently advisable (some would think necessary) to provide metal protection for the posterior aspect/cingulum areas of the upper anterior denture teeth to prevent them being dislodged from a cobalt–chromium denture base. This is a further example of when it is advisable to incorporate a trial insertion visit **before** the recording of the definitive impression and thus before the metal framework is waxed up, in order that the ideal tooth position is determined.

CONCLUSIONS

The design and construction of partial dentures has progressed considerably from the days when a dentist took an impression and sent it to the laboratory with a request for 'a partial denture'. It is very much a team effort, in which clinician and technician work towards providing the patient with a satisfactory prosthesis. If good clinical and technical practices are performed, in an informed and integrated manner, this should go a long way to making an end product that is both aesthetically pleasing and functionally satisfactory, from all points of view.

BOOK REVIEW

A Clinical Guide to Crowns and other Extra-Coronal Restorations. By R.W. Wassell, A.W.G. Walls, J.G. Steele and F. Nohl. BDJ Books, London, 2002 (136pp., £34.95). ISBN 0 904588 73 4.

This is a compilation of a series of articles by the above authors and others, published recently in the *British Dental Journal*, and is the latest addition to the Clinical Guide series from BDJ books. Most of the authors work, or have worked, at the University of Newcastle School of Dentistry. However, its content has been widely sourced, and is based on current research and opinion. Where an in-house opinion is given, it is acknowledged as such. The

scope of this subject is huge, but the authors have wisely chosen not to deal with all possible restorations, in order to be more thorough in their coverage of those that are more frequently undertaken.

Generally, the book has a good balance between referenced research data and practical guidance, which should appeal to students, practicing dentists and academics. There are adequate numbers of diagrams and colour photographs to complement the text, and a relaxed style of writing is frequently adopted, which makes for easy reading. Of the 13 chapters, two are devoted entirely to treatment decision-making and assessment. This may deter some readers but, in the opinion of this reviewer, emphasis must be given to

these clinical stages as crowns are frequently over-prescribed and partial coverage restorations not considered. Indeed, it would have been good to have *more* on the design and execution of such less destructive options.

The section on occlusion is plainly written at an appropriate level for most readers, and should demystify this vital but poorly understood subject. Readers looking for an encyclopaedic reference work will be disappointed but, for the majority of practitioners, there can be few more useful and compact texts on indirect restorations available, and the authors have succeeded in their aims for this work.

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