



Top tips for removable partial dentures: Part 1 – fundamentals of success

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The advent of dental implants to replace missing teeth, and an increase in adults retaining teeth into old age,¹ may mean that partial denture provision is not as regularly carried out as was the case 30 years ago. However, for many reasons this does not necessarily mean that an intact dentition will survive a lifetime, and provision of partial dentures remains a key skill in a dentist's armamentarium of treatment options.

For many patients a partial denture will meet entirely their functional, and aesthetic needs though it has been estimated that 30–50% of these prostheses are not worn.² Clearly, despite the intended benefit, these patients must perceive there to be no functional or aesthetic advantage in wearing the denture.³

An often-heard complaint is the denture was uncomfortable or inconvenient leading to rejection. This results in a disappointing outcome for both patient and clinician and reinforces negative perceptions about removable partial dentures (RPDs) on both sides. To mitigate this disappointment dentists should apply not just evidence but pragmatism and full consideration of the patient's wishes when considering dentures as a treatment option. In many cases replacing all missing teeth may be neither necessary nor desirable, and limiting treatment goals may be more sensible. A problem-solving approach should be used for tooth replacement decisions⁴ and patient made fully aware of risks and benefits of tooth replacement so that provision of a denture is patient-led,³ with the patient fully cognisant of how treatment or no treatment may impact on their oral health. For example the shortened dental arch (SDA) may be considered as the most sensible option if this can meet aesthetic and functional demands rather than considering more extensive tooth replacement.⁵

When discussing risk/benefits with the patient the detrimental effect of RPDs on plaque formation is well known, with the most significant increase in plaque accumulation due to lower dentures with a lingual plate design.⁶ The wearing of a partial denture can additionally result in an increased incidence of caries and periodontal breakdown,^{7,8} so picking the correct treatment modality for the correct patient is crucial.

Many patients understandably initially prefer and seek a fixed option for tooth replacement, but through the process of assessment of the patient and an understanding of the feasible options, may lead the patient to the choice of a removable solution.

It is the authors' experience that with patient education and understanding, considered design planning and control of clinical stages, it is possible to provide a denture that is comfortable, functional, aesthetic, and gives the patient confidence. The dentures

should integrate well with the remaining dentition so that the wearer can become unaware of the denture in the mouth.

In this series we discuss practical tips based on the authors' (cumulatively over a century!) experience of providing partial dentures which we hope will benefit all clinicians embarking on partial denture provision. The series starts with an analysis of fundamentals linked mainly to cobalt chrome dentures, in part 2 acrylic dentures, and part 3 managing challenging free end saddles.

Is the patient's mouth RPD ready?

There is good evidence that metal framework dentures with appropriate design and maintenance can function well⁹ and much of the potential harm can be mitigated by focusing on hygienic principles of RPD design.¹⁰

Fortunately for our patients there is a large body of evidence that further tooth loss is not inevitable, and meticulous oral hygiene can offset the potential harmful sequelae of wearing an RPD.⁹

'Dentists should apply pragmatism and full consideration of the patient's wishes'

The often-quoted adage 'that it is better to preserve what remains than replace that which is lost', is still very pertinent:

- Prior to making an RPD, educate the patient about the potential for further tooth loss if oral hygiene is not of a good standard, so that the patient understands the risks of wearing a denture
- Recommend the care of a hygienist; individualised oral hygiene guidance is of great benefit
- Provide diet advice to minimise sugar frequency and prescribe fluoride toothpaste where indicated
- Complete all other required treatment, such as caries control, periodontal therapy, endodontics and restorations, before constructing the denture. However, considering design of the denture at an early stage can facilitate provision of helpful features in the restorations such as suitable space for rests, undercuts for clasps, and guide planes.

Apart from a denture replacing teeth in a space visible to the patient, there is no evidence that a particular design increases patient acceptance of a denture.¹¹

« The design principles suggested are those that appear to work well with successful patient acceptance and long-term stability when reviewed in practice. They are based on a consensus opinion of prosthodontic specialists,¹² and the evidence that supports the importance of focusing on hygienic principles of design.¹⁰

Design the design!

In contemporary removable prosthodontics, the state-of-the-art denture combines hygienic design principles and good biomechanics. This cannot be achieved if the design is delegated to the laboratory.¹³ The clinician must be in control of deciding the design for the bespoke denture that is best for the individual patient.

Initially plan what you think is the best denture for the patient by looking at the cast, taking note of any obvious design challenges such as markedly tilted teeth etc. Plan a design incorporating the necessary components in the simplest hygienic form.

- Follow a logical sequence of design, deciding on which teeth to replace, which may not be all that are missing. Determine optimal saddle extension. Then plan support, direct retention, reciprocation, major connector shape and need for any indirect retention
- Survey the primary cast or ask the technician to survey the cast if you are unable to do so yourself. The technician has great expertise in the technical aspects of your design and a teamwork approach can be very helpful at this stage
- The survey will help determine the best path of insertion and if the design will be possible. It will show if there is a need for tooth modification to achieve the ideal design at the chosen path of insertion, and the available undercuts for clasp positioning (this can be modified)
- Discuss the proposed denture design with the patient. This is both helpful if the patient has not had a denture before, and if the proposed new denture will be a different design to the existing denture. Patients tend to find this interesting and appreciate the thought that has gone into the making of their denture
- Tooth modification will improve denture stability and avoid occlusal problems. Modifications include:
 - Rest seat and gully preparation, to make space for the minor connectors, clasps and rest seats to fit over the occlusal surfaces without propping the occlusion
 - Guide planes give a specific path of insertion that can reduce the number of clasps required. Additionally, modifying the path of insertion can avoid compromising aesthetics with 'black triangles' on anterior saddles
- Additive tooth preparation using composite resin to exaggerate cingulum shape to improve support for rest seats or produce undercuts for clasps
- Tooth modifications can be planned and trialled on the primary cast. This allows you to see how much preparation you need, which can be difficult in the mouth. The cast can then be an *aide-mémoire* for mouth preparation
- Indirect restorations can have these modifications built in providing the denture is designed in advance and sufficient space is allowed when preparing the tooth
- An occlusal registration or tooth try-in will be needed prior to crown preparation, either to match the porcelain shade or

if the prepared tooth is the posterior occlusal contact (Fig. 1). The occlusal registration or try-in can then be transferred to the crown cast to ensure accurate articulation

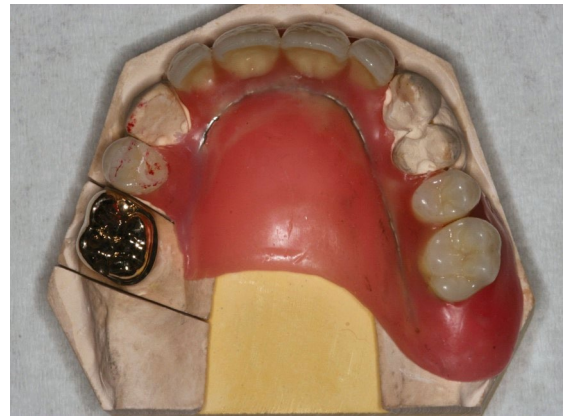


Fig. 1 Tooth try-in to establish anterior tooth position and convey required occlusion for fabrication of cast crown. Photograph courtesy of Linda Blakely

- Long span anterior saddles will require a tooth try-in to establish tooth position for retention tags/backings, and may affect decisions in the denture design
- Ensure the denture design is finalised and all tooth preparation completed before recording the master impression.

Design for hygiene

The weight of evidence is that the survival of the remaining teeth in the presence of RPDs is biological rather than mechanical (Fig. 2). This forms the basis of the Scandinavian approach to RPD design and provision.¹⁴



Fig. 2 RPD with good tooth and tissue support, hygienic major connector with horizontal minor connectors kept clear of the gingivae, two clasps for retention

Covering the gingival margins has a detrimental effect on periodontal health.⁸

The focus when designing a denture should be on hygienic principles, that interfere as little as possible with plaque control and do not damage the oral tissues, in accordance with modern concepts of preventative dentistry.¹⁰

- Avoid unnecessary gingival coverage
- 3 mm rule: this is essential to reduce the risks of periodontal inflammation, the denture should have 3 mm or more clearance of the denture base and connectors from the teeth.^{15,16} This minimises

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- ◀ plaque collection near the gingiva, allows saliva flow and gives access for interdental brushes with the denture *in situ*. This will be adjacent to premolars and molars and will not compromise aesthetics.
- To achieve the designed gingival clearance, the working cast will need careful blocking out, and good communication with the technician is essential
- Simple and hygienic design of major connector, that joins the saddles directly to keep clear¹⁶ of gingival margins, maintaining 3 mm rule
- In the upper a mid-palatal strap and modifications works well
- In the lower the best options for hygiene are lingual bar, dental bar or sub-lingual bar
- Lingual plate design is not hygienic and poses the highest risk to the remaining teeth and periodontal health
- Two clasps only (one each side) are preferable
- Connect cingulum rests laterally from the saddle and use horizontally approaching minor connectors and reciprocators to avoid covering the gingiva¹⁶
- Avoid using the baseplate/major connector for reciprocation. This covers the gingiva.

Design for stability and comfort

Good biomechanics are essential to give the denture stability in function. If the denture is comfortable and less like a foreign body in the mouth, it is easier for the patient to adapt and accept the denture.

Good biomechanics also improve stress distribution and avoid trauma to the tissues.

- Support saddles optimally with rests, this includes anterior saddles
- Rest seat preparation will improve the stability of the denture, control the loading on the teeth, prevent the teeth moving away from the framework and indicate to the laboratory the position for the rests. Preparing space for rest seats avoids occlusal interferences and further occlusal adjustment
- Aim for four well distributed areas of support (tooth or mucosal support)
- Provide good retention to resist displacement. Ideally only two clasps are used, so their position needs careful planning to be effective. The use of guide surfaces facilitates use of fewer clasps. On premolars and canines cast occlusally approaching clasps do not work in the longer term as there is not enough length for flexibility. Use a cast I-bar or a wrought clasp (stainless steel/gold)
- Ensure the clasp is reciprocated (see mouth preparation)
- If using C-clasps on single standing molars, ensure there is sufficient encirclement from the active clasp and reciprocating arm to prevent the tooth escaping from the clasp assembly. An alternative, the ring clasp will give better encirclement
- The major and minor connectors, rests and bracing components should be rigid to control stress to abutments and tissues
- The denture should not interfere with the patient's intercuspal position (ICP). Maintain guidance on natural teeth where possible
- There should be simultaneous contact on closure with natural and denture teeth
- The framework should have a good fit and be passive when seated to avoid pressure on the teeth.

Finally, review the overall design for simplicity and that the design conforms to hygienic principles and discuss with the patient. ▶▶

« Clinical tips

Primary impressions

Impressions are required that show good detail of the teeth and the alveolar ridges with a record of full sulcus depth to survey and plan the denture as well as for fabrication of accurate custom trays.

- Standard stock trays often do not allow for seating over the teeth with suitable adaption over the edentulous areas and palate, and sufficient extension into the sulci. Trays frequently require modification
- This is easily achieved using inexpensive putty or compound over the edentulous span and palate in the upper. Trim away any material that has spread over the teeth for ease of reinsertion and to allow a thickness of alginate of at least 4 mm around the teeth to allow the material to deform elastically on removal. Warmed baseplate wax can also be added to the rim of stock trays to give extension to full sulcus depth adjacent to teeth or into lingual sulcus
- Apply adhesive for an alginate wash ensuring it has dried before loading the alginate, avoiding overfilling the tray, reseat the tray back down to the putty and border mould.

Planning the space

This is an important and often overlooked stage of the process. Deciding on the adjustments necessary at the outset as part of RPD provision, is preferable to what may appear to the patient as unplanned post insertion adjustments.

Using the primary casts, assess the occlusion and anything that may make the denture more challenging:

- Ensure there are no blips on the cast; this can add millimetres of inaccuracy when articulating the casts
- If there are not enough remaining teeth to locate the casts accurately, preliminary rims will be needed. This will be the case with most distal extension saddles
- Decide if there is an acceptable and stable ICP, and if it is best to conform
- If the habitual ICP is compromised due to loss of vertical dimension, mandibular deviation and over erupted teeth, this will often require a further aspect of treatment planning for restoration of occlusion in centric relation at an appropriate vertical dimension and suitable occlusal plane
- If the denture is simply treated as gap filling exercise within an unfavourable occlusion, there will be a significant compromise on space for denture components, achieving a good occlusion and a stable denture.

Mouth preparation

Small adjustments to the teeth can greatly improve the stability, function, and comfort of the denture.

- Prepare rest seats – to create space for the rest to avoid an occlusal interference, blend with tooth contour, and improve axial loading of the abutment
- Bonded composite cingulum rests are useful on teeth with thin enamel (lower incisors/canines), and greatly improve support for lingual and dental bars where good support is challenging in the lower arch. Bonded composite rest are reliable if placed under optimum bonding protocol¹⁷
- Bonded composite can be added on buccal surfaces to improve undercuts for clasp retention. This is best over a wide area, and

adjusted to provide appropriate depth of undercut (0.25 mm for cast chrome, 0.5 for wrought clasps)

- To achieve effective reciprocation the tooth may need modification to provide a wider surface, so contact is maintained on the tooth preventing movement of the tooth as the clasp leaves the undercut
- Guide surfaces limit path of insertion/displacement, this allows the use of fewer clasps. The fit and stability of the framework will be better. Take care not to encroach on 3 mm rule by preparing the guide surface within 3 mm of the gingiva
- Prepare guide surfaces before rest seats
- Prepare gullies to allow clasp arms to exit, to give space for occlusal approaching clasps (especially with worn dentitions). Opposing cusps may also need adjustment to create space.
- If crowns are required that will be in contact with the denture base, plan to incorporate rest seats, guide planes and undercuts in the crown, to work with denture design.

Secondary impressions

It is important that the impression is accurate and captures the detail of the teeth, any preparations and correct sulcus depths:

- Use a rigid spaced custom tray
- Use either lab fabricated or chair side added stops. This allows the required space to be maintained, the tray to be relocated to same position, and held without movement during border moulding and whilst the final impression sets to avoid deformation of the impression material. Avoid positioning the stops over teeth with rest seat preparations for a more accurate impression.
- Check extension in sulcus depth and around frenal attachments giving 3 mm space for impression material
- Interdental spaces should be blocked with soft wax or bite registration material to prevent the impression tearing. Check this material is not covering where the denture framework will contact.
- Do not overfill the tray with impression material and ensure tray is seated back down to the stops
- Remove the set impression carefully to avoid distortion, breaking the seal on the distal aspect can help with this
- Carefully inspect the impression for the absence of air blows and drags, and that the detail of the mouth preparations has been recorded.

Occlusal registration

In the authors' experience this is a frequent cause of inaccuracies both for planning the denture and fabrication:

- Use hard base rims if possible, this is particularly helpful for the lower rim
- Use full palatal coverage of rim for stability during registration, even if the final major connector will have less coverage
- When anterior teeth are missing, trim the rim for correct incisal level and lip support. Where lower incisors are present, the palatal aspect of the upper rim should be reduced to allow closure at the correct vertical dimension whilst maintaining the wax for the incisal position as the guide for tooth set up
- Using the warmed wax squash-bite approach is highly likely to introduce errors as the mucosally supported rim sinks into the tissues and possibly distorts. The articulated casts will not be in the same relationship as in the patient's mouth
- Trim the rims so the opposing teeth cusps very lightly touch ▶▶

- ◀ the rim without displacement or create a 1 mm gap. Use location notches if appropriate. A low viscosity material is used to finalise the registration. Tempbond or ZoE work well. Automix bite registration materials need to be used with care to avoid errors as there is a tendency for the material to extrude between opposing teeth. Ensure that the rims do not become displaced during registration and maintain gentle contact on the chin to avoid the patient opening as the registration material sets
- Place the casts into the rims and check the record is the same as seen in the mouth. Automix registration material often needs trimming to ensure the opposing cusps are fully seated.

Try-in

The framework should seat fully with a positive, passive location, not rock or interfere with the patient's occlusion:

- If the framework does not fit, use fit-check silicone or powder occlusal spray to identify where the framework is binding and adjust. Take care when adjusting to avoid opening up space between the framework and teeth which would allow food ingress in function
- A common area to cause binding is on the marginal ridge next to the rest seat
- After adjustment if the framework does not fit acceptably, check any mouth preparations for sharp angles, adjust and retake the master impression
- Once the framework is assessed as satisfactory, rims can be attached if a definitive jaw registration is required or proceed to a wax try-in of the teeth.

Fit and review

- Use light bodied silicone to check for over-extension for potential pressure areas on the fit surfaces of saddles. Carefully adjust the acrylic where it protrudes through the silicone
- Allow time to demonstrate and ensure the patient is able to insert and remove the denture, and not to use the clasps to remove the denture
- Explain to the patient what to expect in terms of being aware of the denture, transitory effect on speech, possible increase in salivation and the time it may take to adapt. A forewarned patient is more likely to take any issues in their stride and less likely to react negatively to the denture
- Give instruction on how to keep the denture clean
- The intricate shape of chrome frameworks can be tricky to clean, particularly around the internal aspect of clasp assemblies. Large size interdental brushes are perfect for this.

Ongoing care

Appointments with the hygienist are invaluable to reinforce oral hygiene measures to maintain gingival health which is essential for long-term prognosis of the remaining dentition.¹²

Disclosing a denture and abutments can be very instructive to show the patient how they are managing and where to clean more effectively.

The denture should be reviewed at regular intervals, to ensure the fit remains good and there are no problems.

In summary:

- Apply a problem-based approach to RPD provision
- Get the mouth RPD ready and gift your patient a state-of-the-art denture combining hygienic design and good biomechanics
- Successful RPD provision is a team effort between patient, clinician, hygienist and technician
- Maintain the mouth and denture – it should not be fit and forget, encourage the patient to return for reviews and appropriate maintenance.

This can be such a rewarding aspect of clinical practice, if you can do no harm, solve the patient's problem and exceed the patient's expectations.

It's extremely satisfying when my patient says, 'I love my denture!'

In part 2 we examine how some of the above principles can be applied to acrylic partial dentures to mitigate effects of such dentures on oral hygiene. ■

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BSG Spring Meeting

The British Society of Gerodontology (BSG) Annual Spring Meeting will be held in Belfast on Friday 28 April 2023, hosted by current President Professor Gerry McKenna.

The in-person meeting will be held in the Great Hall in Queen's University Belfast with presentations covering a number of important

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