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Clasp design

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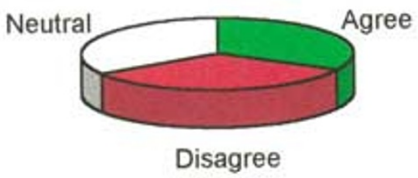
In this article statements related to the design of clasps are listed and discussed. The opinion of prosthodontic experts regarding these statements is indicated in the accompanying pie charts.

Many RPD design principles are based more on clinical experience than scientific evidence. Under these circumstances it is advisable for a dentist, when making RPD design decisions, to draw on the widest possible range of specialist opinion rather than to rely on the views of just one, or a few, prosthodontists.

To this end, this article and Chapters 11-15 of our BDJ publication *'A clinical guide to removable partial denture design'* present statements that have been proposed as principles governing metal RPD design. Numerous experts have expressed their opinion on these principles as part of a survey of the departments of removable prosthodontics in all dental schools in the UK and the Republic of Ireland. This survey was undertaken to produce the knowledge base for a computerised design assistant for RPDs.[1] All 17 of the departments responded and the results of the survey are given as pie charts indicating the expert group's level of agreement or disagreement with each design principle:



The experts' comments on these principles have been incorporated into the discussions that follow.

Readers are invited to use this article in an interactive way by first forming their own opinion of each of the design principles listed at the beginning of the article. When doing this it should be assumed that, to be acceptable, a design statement is likely to apply to the majority, though not necessarily all, cases. Readers can then compare their opinions with those of the experts and consider the points raised in the discussions.

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REFEREED PAPER

Design Statements

1 A clasp should always be supported by a rest.

2 A molar ring clasp should have occlusal rests mesially and distally.

3 A molar ring clasp, which engages lingual undercut, should have a buccal strengthening arm.

4 Retentive clasps can be used to provide indirect support for a distal extension saddle by being placed on the opposite side of the support axis from the saddle.

5 A wrought wire clasp should be attached to a saddle, not to exposed parts of the metal framework.

6 An occlusally-approaching clasp should not approach closer than 1 mm to the gingival margin.

7 A retentive occlusally-approaching clasp should run from the side of the tooth with the least undercut to the side with the greatest undercut.

8 Occlusally-approaching retentive clasps should have the terminal third of the retentive arm entering the undercut.

9 A retentive clasp should engage 0.25 mm of undercut if it is constructed in cast cobalt-chromium alloy.

10 If an undercut on a tooth that needs to be clasped for retention is less than 0.25 mm, then composite resin should be added to the tooth to create at least this amount of undercut.

11 A retentive clasp should be at least 15 mm in length if it is constructed in cast cobalt-chromium alloy.

12 Occlusally-approaching retentive clasps should be restricted to molar teeth if constructed in cast cobalt chromium alloy.

13 A retentive clasp should engage 0.5 mm of undercut if it is constructed in wrought wire.

14 A retentive clasp should be at least 7 mm in length if it is constructed in wrought wire.

15 If an occlusally-approaching retentive clasp is used on a premolar or canine it should be constructed in wrought wire.

16 Retentive clasps should usually be placed buccally on upper teeth.

17 Retentive clasps should usually be placed lingually on lower molars.

18 Retentive clasps should usually be placed buccally on lower premolar or canine teeth.

19 Where there are clasps on opposite sides of the arch, the retentive arms are best placed on opposing tooth surfaces ie buccal/buccal or lingual/lingual.

20 Retentive and bracing/reciprocating elements of a clasp should encircle the tooth by more than 180 degrees.

21 Reciprocation should be provided on a clasped tooth diametrically opposite the retentive clasp tip.

22 If a reciprocating clasp, rather than a plate, is used it should be placed at the gingival end of a guide surface on the clasped tooth.

23 Where a plate connector is used, reciprocation can be obtained by a guide plate on the connector.

24 Gingivally-approaching clasps are contra-indicated if the buccal sulcus is less than 4 mm in depth.

25 Gingivally-approaching clasps are contra-indicated if there is a tissue undercut buccally on the alveolus more than 1mm in depth and within 3 mm of the gingival margin.

26 A gingivally-approaching clasp should be used if a retentive cast cobalt chromium clasp is required on a premolar or canine tooth, assuming that sulcus anatomy is favourable.

27 The RPI system (rest, plate, I-bar clasp) should be used on premolar abutment teeth for mandibular distal extension saddles if the tooth and buccal sulcus anatomy is favourable.

28 The RPI system (rest, plate, I-bar clasp) should be used on premolar abutment teeth for maxillary distal extension saddles if the tooth and buccal sulcus anatomy is favourable.

29 A distal extension saddle should have a retentive I-bar clasp whose tip contacts the most prominent part of the buccal surface of the abutment tooth mesio-distally.

30 If the retentive clasp for a distal extension saddle is on a premolar or canine abutment, it should be either a cast gingivally-approaching I-bar or a wrought wire occlusally-approaching clasp.

31 A distal extension saddle should have a retentive clasp on the abutment tooth.

32 A unilateral distal extension saddle denture (Kennedy II) should have one clasp as close to the saddle as possible and the other as far posteriorly as possible on the other side of the arch.

33 Rather than making a design statement this section poses a question: 'What is the preferred number of clasps for RPDs restoring each of the Kennedy classes of partially dentate arch?'

34 Bounded saddles should have a clasp at least at one end.

35 A Kennedy III modification 1 denture should have 2 retentive clasps forming a diagonal clasp axis which bisects the denture.

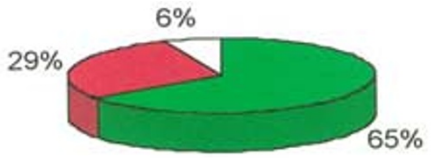
36 A Kennedy IV denture should have retentive clasps on the first molars if there is suitable undercut present.

Prosthodontic opinion on clasp design

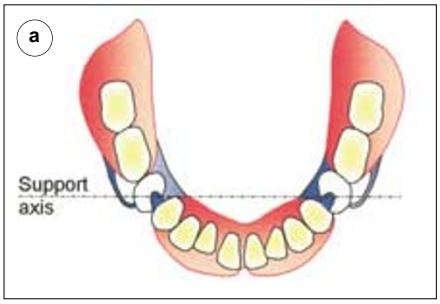
Statement 1 — A clasp should always be supported by a rest

A clasp should be supported to maintain its vertical relationship to the tooth. Without such support the clasp will tend to move gingivally with the following detrimental effects:

- The retentive tip of the clasp will lose contact with the tooth. It will not therefore provide retention for the denture until there has been sufficient movement of the denture in an occlusal direction to re-establish contact of the clasp with the tooth. The denture may therefore seem loose to the patient.
- The tip of the clasp may sink into and damage the gingivae.

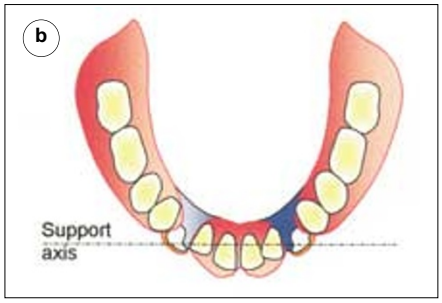


This statement is not universally applicable. For example, acrylic mucosally supported RPDs often employ wrought wire clasps without tooth support. However, even in this situation tooth support for clasps can sometimes usefully be obtained by wrought wire rests or clasp arms extending onto the occlusal surfaces.



It might be preferable to omit tooth support when, as shown in Fig. 1a, there are very few teeth remaining and rests on them would produce a support axis that approximately bisects the denture. In this situation tooth support can contribute to instability of an RPD because the denture tends to rock about the support axis.

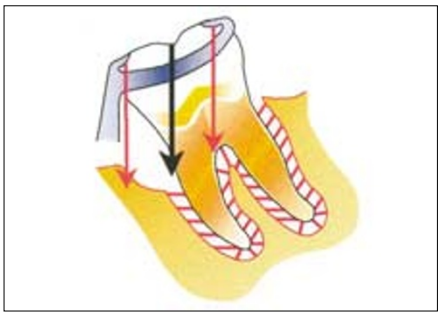
If however, there are very few teeth remaining, but rests on them would produce a support axis which forms a tangent to the residual ridge, tooth support can usually be employed to advantage and the denture remain acceptably stable (Fig. 1b).



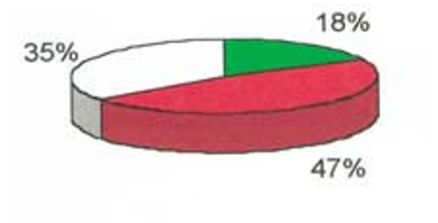
Statement 2 — A molar ring clasp should have occlusal rests mesially and distally

Such an arrangement may:

- Contribute to more axial loading of a tilted abutment tooth as indicated by the black arrow in the figure. This will reduce the leverage on the tooth compared with a mesial rest used alone.
- Support the clasp arm on the tooth distally so that if the clasp arm is inadvertently bent it is unlikely that the arm can move far enough gingivally to traumatise the periodontal tissues.

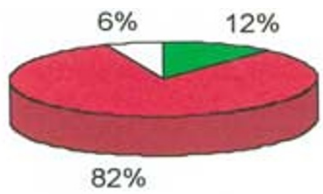


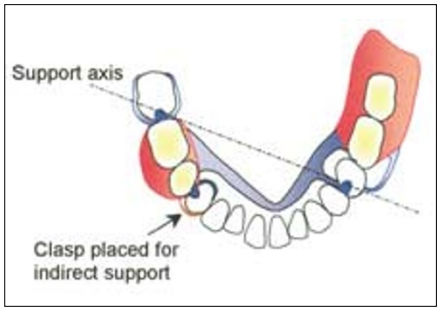
However, the prosthodontic specialists do not favour this arrangement. The commonest method of supporting a ring clasp is with an occlusal rest adjacent to the saddle. Occasionally clinical circumstances may dictate that a non-adjacent rest be used. This results in the entire load from the saddle to the rest being transmitted along the proximal section of the clasp. It is necessary therefore to strengthen this section, for example by thickening it.

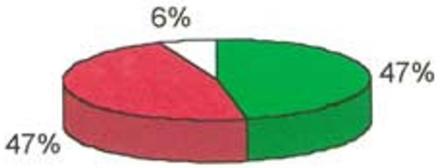


Statement 3 — A molar ring clasp, which engages lingual undercut, should have a buccal strengthening arm.

A molar ring clasp has a long arm, which is vulnerable to accidental deformation through mishandling. The addition of a buccal reinforcing arm is intended to prevent this happening. This variant is not popular with the prosthodontic specialists possibly because it complicates the design, thereby tending to retain plaque and reduce patient tolerance.







Statement 4 — Retentive clasps can be used to provide indirect support for a distal extension saddle by being placed on the opposite side of the support axis from the saddle

When an occlusal load is applied to a distal-extension saddle the displaceability of the supporting mucosa allows the saddle to sink. The denture rotates about the 'support axis' (an imaginary line passing through the occlusal rest adjacent to the saddle and the most distal rest on the other side of the arch) so that denture components anterior to the support axis move in an occlusal direction.

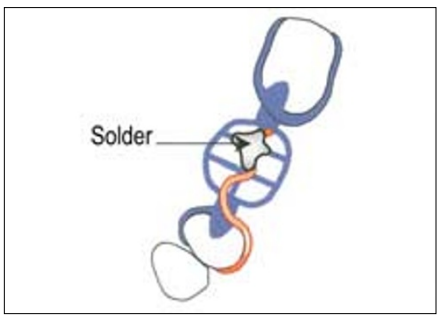
A clasp placed on the other side of the support axis from the distal extension saddle will tend to resist this movement to a limited extent. This resistance is known as indirect support. However, the occlusal loads tend to be high and the retentive force generated by the clasp relatively low; also the occlusal loads are usually working at a mechanical advantage to the clasp. This arrangement is therefore ineffective.

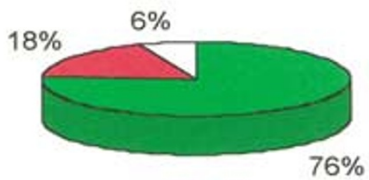
If the clinician does judge that indirect support is justified for a particular case the use of multiple clasps should be considered.

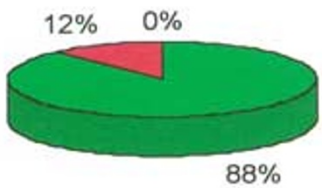
Rather than trying to obtain indirect support for a distal extension saddle it is normally advisable to focus on:

- Optimising direct support of the saddle through:
  - full extension of the base (A *Clinical Guide to Removable Partial Denture Design*, Fig. 4.2, statement 11.17);
  - the altered cast technique (*A Clinical Guide to Removable Partial Dentures*, Chapter 9);
  - the use of mesial occlusal rests (A *Clinical Guide to Removable Partial Denture Design*, Figs 5.9–5.11, statement 12.15);
  - regular maintenance, including relining when necessary (*A Clinical Guide to Removable Partial Dentures*, Figs 10.9–10.17).
- Minimizing occlusal loads generated during mastication by reducing the area of the occlusal table (A *Clinical Guide to Removable Partial Denture Design*, Fig. 4.1, statement 11.16). It is particularly important to shorten the occlusal table as this reduces the length of the cantilever arm created by the distal extension saddle. However, reducing the width of the occlusal table also helps, in this case by allowing the denture teeth to be pushed through the bolus more easily and therefore with less load being transmitted to the supporting tissues.

Indirect support can be of value for the Kennedy Class IV denture (statement 36).







Statement 5 — A wrought wire clasp should be attached to a saddle, not to exposed parts of the metal framework

An effective method of attaching a wrought clasp (stainless steel or gold) to a denture is to solder the origin of the clasp to the metal base of the saddle and then cover the solder joint with the acrylic resin of the saddle. The advantages of this are:

- The heat created by soldering is far enough away from the active part of the clasp arm not to change the properties of the wrought alloy.
- Subsequent corrosion of the solder joint by exposure to oral fluids is prevented by the investing acrylic resin.

These benefits are not obtained if an attempt is made to solder a wrought clasp directly to an exposed part of the cobalt chromium framework.

The soldering of the wrought wire clasp to the metal base of the saddle is best completed before the trial insertion of the metal framework into the mouth as this allows the adequacy of the clasp to be checked along with the other metal components.

Statement 6 — An occlusally-approaching clasp, which is supported by a rest, should not approach closer than 1 mm to the gingival margin

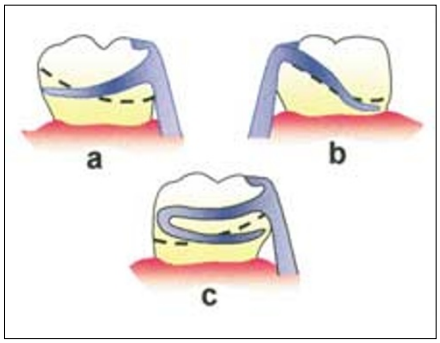
If a clasp is closer than 1 mm to the gingival margin there is the likelihood of gingival irritation.

If the clasp is not supported by a rest the separation of clasp tip and gingival margin should be greater than 1 mm so that when the saddle sinks the clasp does not traumatize the gingivae.

Statement 7 — A retentive occlusally-approaching clasp should run from the side of the tooth with the least undercut to the side with the greatest undercut (Fig. 7a)

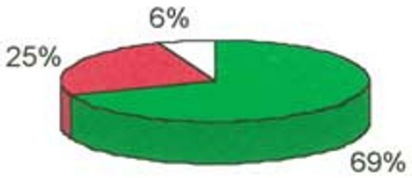
This usually results in:

- Most effective utilization of available undercut.
  If a clasp arm runs from maximum to least undercut, the undercut might be too little to provide effective retention in the region of the tip of the clasp.
- Optimum positioning of the clasp arm on the tooth.
  Only the terminal third of the clasp arm can cross the survey line and enter the undercut. The remaining, more rigid proximal part of the clasp arm has to be above the survey line. Therefore if the clasp is going the 'wrong' way the tip of the clasp may have to be placed unnecessarily close to the gingival margin, and the origin of the clasp located so high on the tooth that it might create an occlusal interference (Fig. 7b).



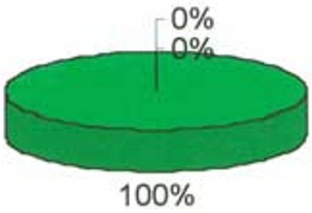
There are exceptions to this statement particularly if the tooth has a long clinical crown. In this situation the survey line may allow the clasp to run from the greater to the lesser undercut without compromising the positioning of the proximal or distal portions of the clasp arm or the depth of undercut engaged..

A clasp type, which does not strictly comply with the statement, is the recurved occlusally-approaching clasp (Fig. 7c).



Statement 8 — Occlusally-approaching retentive clasps should have the terminal third of the retentive arm entering the undercut

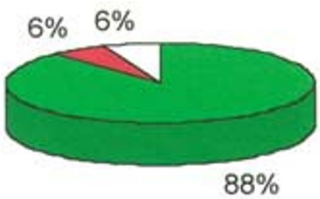
The flexibility of a clasp arm made of a particular alloy is related to length and thickness. The clasp arm is normally manufactured with a length and taper designed to provide sufficient flexibility for the terminal third to safely enter the undercut. If the clasp arm crosses the survey line prematurely, the arm is likely to permanently deform in function and to apply excessive force to the tooth. It is also likely to make insertion and removal of the denture difficult or impossible.



Statement 9 — A retentive occlusally-approaching clasp should engage 0.25 mm of undercut if it is constructed in cast cobalt chromium alloy

If a cast cobalt chromium occlusally-approaching clasp engages less than 0.25 mm, the inaccuracies in its production will represent a significant proportion of this value and thus the resulting retention is unpredictable.

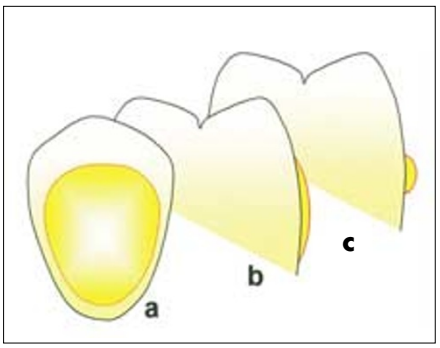
If the clasp engages more than 0.25 mm it is likely that its proportional limit will be exceeded when the denture is seated or removed. The clasp thus becomes permanently deformed and therefore non-retentive.The length of a clasp is a critical factor in determining how much undercut it can safely engage (statements 11–15)

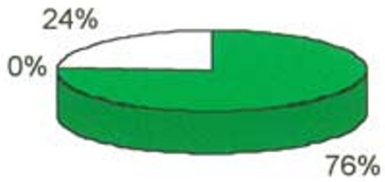


Statement 10 — If an undercut on a tooth, which needs to be clasped for retention, is less than 0.25 mm, then composite resin should be added to the tooth to create at least this amount of undercut

The modification of tooth contour with composite resin is a conservative, simple, durable and effective way of creating undercut for clasping where no, or inadequate, undercut exists (*A Clinical Guide to Removable Partial Dentures*, Fig. 15.25). The technique consists of creating a supragingival composite resin veneer that produces an undercut just detectable to the eye. A more precise check can be made by obtaining a study cast and measuring the amount of composite resin undercut with a surveyor, but in practice this is often not necessary. The composite resin should cover a broad area of the tooth surface so that it can be shaped to blend smoothly with the tooth contour (Fig. 10a, b). A small 'button' of composite resin is less satisfactory (Fig. 10c).

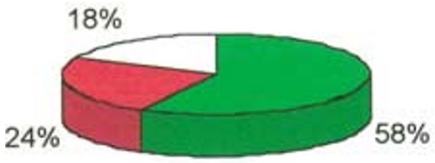
With early composite resins, the large, irregular filler particles caused significant abrasion of the clasps resulting in loss of retention and even fracture of the clasp. This does not occur with modern composite resins. Also, abrasion of the composite resin by the clasp is not generally a problem, particularly, if a round section wrought wire clasp is employed. Abrasion of composite resin sometimes occurs when a cast gingivally-approaching clasp is used since the tip of the clasp can act like a chisel.





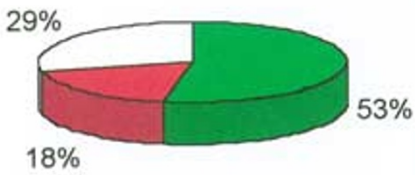
Other ways of creating undercuts for clasp retention are:

- Enameloplasty, by using a bur to create a small dimple in the enamel which can be engaged by the tip of a clasp (*A Clinical Guide to Removable Partial Dentures*, Figure 15.24).
- Metal or porcelain veneers bonded to the enamel surface.
- The fitting of suitably contoured crowns.



Statement 11 — A retentive clasp should be at least 15 mm in length if it is constructed in cast cobalt chromium alloy

For the retentive tip of a cobalt chromium clasp to flex 0.25 mm without deforming permanently, it needs to be about 15 mm in length (Fig. 10, p649, Part 6). This length can usually be achieved with an occlusally-approaching clasp on a molar tooth, and a gingivally-approaching clasp on any tooth.

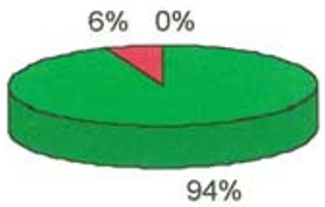


Statement 12 — Occlusally-approaching retentive clasps should be restricted to molar teeth if constructed in cast cobalt chromium alloy

An occlusally-approaching clasp on a molar tooth will be about 15 mm in length, but on a premolar or canine tooth will be considerably less than this. A ring clasp on a molar tooth may be longer than 15 mm, but the increased curvature results in a corresponding increase in stiffness so that an undercut of 0.25 mm remains the maximum that can be engaged safely.

A gingivally-approaching clasp can be made longer than 15 mm and in such cases the clasp can engage a depth of undercut greater than 0.25 mm.

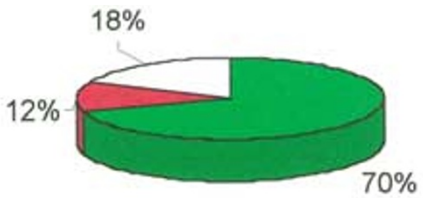
It should be remembered that a clasp may be used for stability rather than retention and in this case the above statement does not apply. A short cobalt chromium occlusally-approaching clasp placed on a non-undercut area of a tooth is ideal for this purpose. Even though such a clasp is for bracing and does not engage undercut, it may make a contribution to retention through frictional contact with the tooth.



Statement 13 — A retentive clasp should engage 0.5 mm of undercut if it is constructed in wrought wire

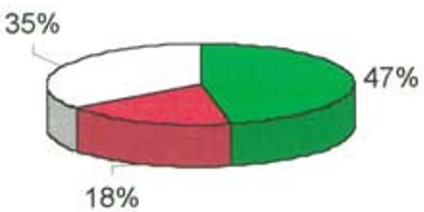
A wrought stainless steel or gold wire clasp is more flexible than a comparable design of cast clasp in cobalt chromium alloy and therefore needs to engage a greater depth of undercut to generate equivalent retention. As a wrought wire clasp has a higher proportional limit than a cast clasp (Fig. 9, p649, Part 6) it can engage this increased undercut without deforming permanently.

There can be technical difficulties in the production of accurately fitting wrought wire clasps as the required skill is not universally available.



Statement 14 — A retentive clasp should be at least 7 mm in length if it is constructed in wrought wire

A wrought clasp of about 7 mm in length can engage 0.5 mm of undercut without deforming permanently. However, if the wrought clasp is shorter that 7 mm, flexing into this undercut is likely to result in permanent deformation.

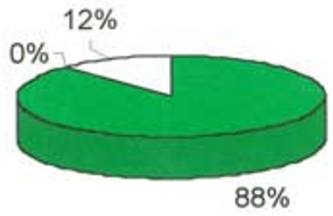


Statement 15 — If an occlusally-approaching retentive clasp is used on a premolar or canine it should be constructed in wrought wire

A premolar or canine tooth is usually wide enough mesiodistally to accept an occlusally-approaching clasp of about 7 mm in length but not much longer. A wrought clasp can therefore provide reliable retention in this situation whereas a cast clasp would be too rigid.

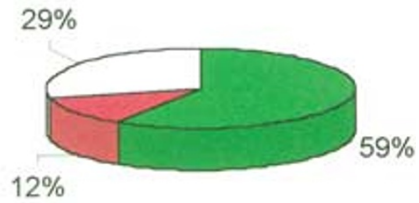
Statement 16 — Retentive clasps should usually be placed buccally on upper teeth

Retentive clasps should obviously only be placed where suitable undercuts exist or can be created. The statements 16–18 are commonly true because they reflect the usual distribution of tooth undercuts that are available for clasp retention. In the molar region this distribution of undercuts is associated with the tilt of the teeth creating the Curve of Monson.



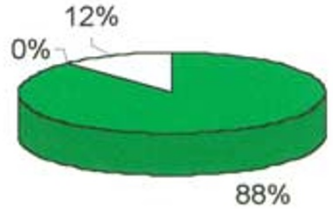
Statement 17 — Retentive clasps should usually be placed lingually on lower molar teeth.

Undercuts suitable for retentive clasping of lower molar teeth are most frequently located lingually.



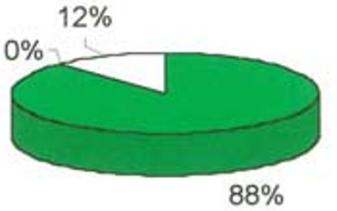
Statement 18 — Retentive clasps should usually be placed buccally on lower premolar or canine teeth

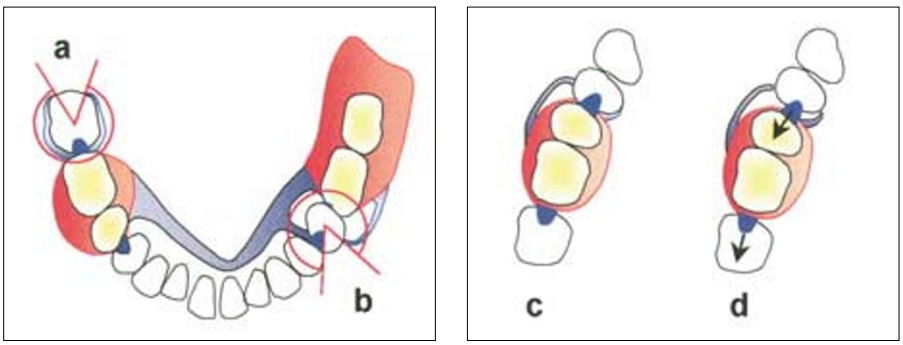
Undercuts suitable for retentive clasping of lower premolar or canine teeth are most frequently located buccally.

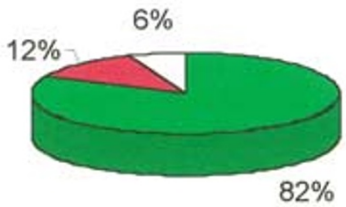


Statement 19 — Where there are clasps on opposite sides of the arch, the retentive arms are best placed on opposing tooth surfaces, ie buccal/buccal or lingual/lingual

This is because the retentive clasps then move along divergent paths of displacement. This is sometimes referred to as 'cross-arch reciprocation' (Fig. 15, Part 7). It is not as effective as reciprocation via guide surfaces on the clasped teeth as relative movement of the teeth within the periodontal ligaments is not prevented.





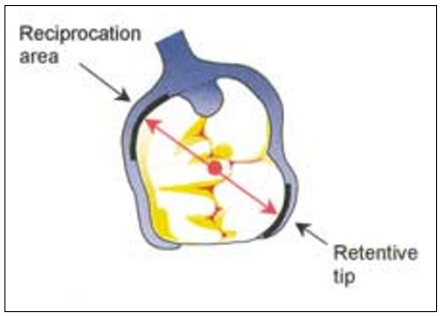


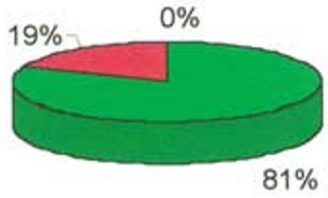
Statement 20 — Retentive and bracing/reciprocating elements of a clasp should encircle the tooth by more than 180 degrees

This is the principle of 'encirclement'. Unless encirclement is achieved the clasp can move away from the tooth (or vice versa) and thus lose its retentive and bracing functions.

Encirclement can be by a combination of retentive and bracing clasp arms (Fig. 20a), or by clasps and guide plates as in the RPI system (Fig. 20b).

Any attempt at using teeth other than the clasped tooth to provide bracing to prevent the clasp 'escaping' is not an effective substitute for encirclement. This is because loss of contact of the clasp with the tooth can still occur as a result of the movement of one tooth in relation to the other (Figs 20c and d).





Statement 21 — Reciprocation should be provided on a clasped tooth diametrically opposite the retentive clasp tip

Reciprocation (Figs 12–15, Part 7 of this series of articles) is resistance to:

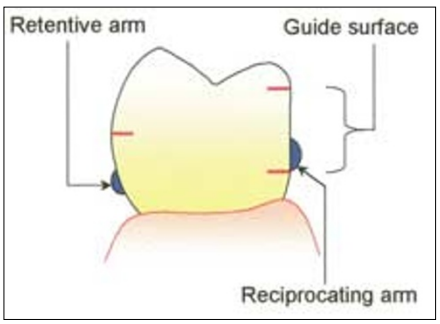
a) Displacement of a tooth by a direct retainer.
If a retentive clasp is not reciprocated, the clasp will apply a horizontal force to a tooth as it moves towards the height of contour of the tooth and this will displace the tooth within the periodontal ligament. This movement of the tooth will reduce the retentiveness of the clasp.

b) Escape of a direct retainer from an undercut.
If there is no reciprocation, the clasp will be able to escape from the undercut without flexing and creating a retentive force.

The most effective location for a reciprocating component is:

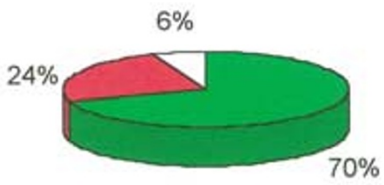
a) On the clasped tooth

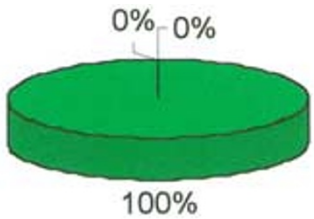
b) Diametrically opposite the retentive tip of the clasp. However, (a) is more important than (b) although the further that the reciprocation is from the ideal position the greater is the potential for tooth or denture movement resulting in reduced retention. It should be remembered that the RPI system does not conform to (b) as effective reciprocation is provided by the combination of mesial and distal guide plates that are not diametrically opposite the I-bar (Fig. 26, p653, Part 6 of this series of articles).



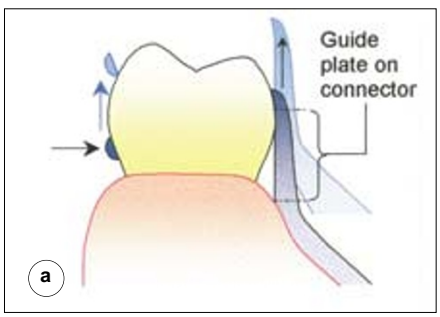
Statement 22 — If a reciprocating clasp, rather than a plate, is used it should be placed at the gingival end of a guide surface on the clasped tooth

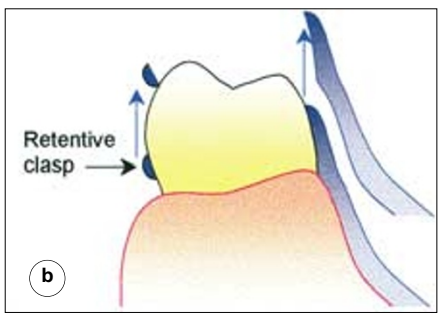
If the reciprocating clasp is placed at the gingival end of a guide surface (which is usually 2–3 mm in length), it will maintain contact with that surface as the retentive clasp moves through the retentive distance. Reciprocation will therefore be maintained for as long as the retentive clasp is active.





Statement 23 — Where a plate connector is used, reciprocation can be obtained by a guide plate on the connector



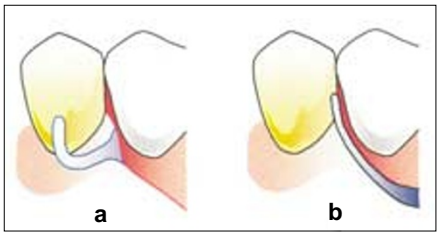


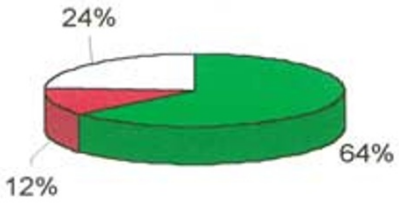
Where a plate major connector contacts a clasped tooth, a guide surface can be incorporated into it by using a surveyor to block out undercuts on the master cast prior to fabricating the refractory cast. The guide surface is therefore made parallel to the planned path of insertion and removal of the denture (Fig. 23a). However, reciprocation will not be provided by a plate if the tooth surface contacted has no undercut (Fig. 23b).

Statement 24 — A gingivally-approaching clasp is contraindicated if the buccal sulcus is less than 4 mm in depth

A sulcus of less than 4 mm does not have sufficient depth to accommodate a gingivally-approaching clasp without much of the length of the clasp arm being placed too close to the gingival margin (Fig. 24a).

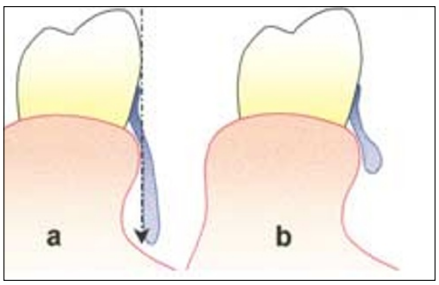
An exception to this statement is the 'De Van' clasp which is a gingivally-approaching clasp running along the border of the saddle to engage the disto buccal undercut of the abutment tooth. It does not enter the sulcus area buccal to the clasped tooth (Fig. 24b).

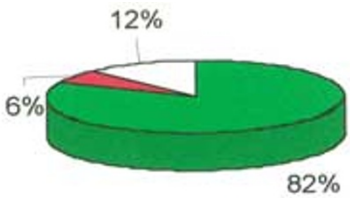




Statement 25 — Gingivally-approaching clasps are contra indicated if there is a tissue undercut buccally on the alveolus more than 1 mm in depth within 3 mm of the gingival margin

An undercut of these dimensions results in the gingivally-approaching clasp being relieved extensively from the attached mucosa so that the denture can be inserted without traumatizing the tissues. Such relief causes the arm of the clasp to be excessively prominent, resulting in possible irritation of the buccal mucosa, and the trapping of food debris (Fig. 25a). Alternatively, if the clasp arm is placed on the mucosa survey line it is likely to be too prominent and too close to the gingival margin (Fig. 25b).

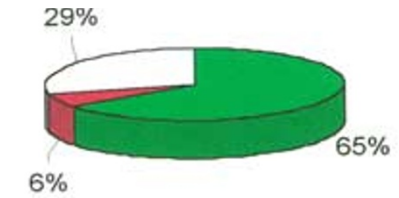




Statement 26 — A gingivally-approaching clasp should be used if a retentive cast cobalt chromium clasp is required on a premolar or canine tooth, assuming that sulcus anatomy is favourable

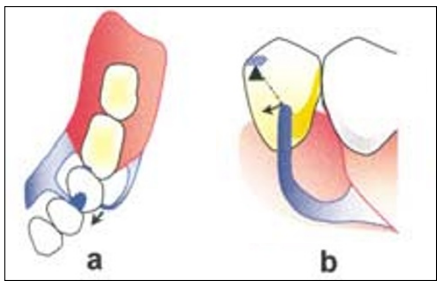
A gingivally-approaching clasp is an appropriate choice under such circumstances as it can be made long enough to achieve adequate flexibility.

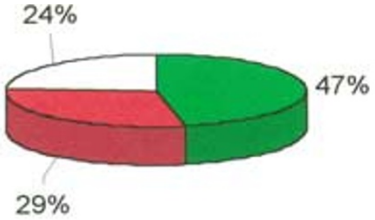
Canine and premolar teeth obviously vary in their mesiodistal dimension but are generally of the order of 7 mm. A cast cobalt chromium occlusally-approaching clasp may be a little longer than this (allowing for the curvature of the tooth surface and the fact that the clasp passes diagonally across the tooth). However, this may not be long enough to ensure that such a clasp has adequate flexibility and is working within its proportional limit. Therefore, on such teeth, more effective and reliable clasping can be obtained either by utilizing the longer gingivally-approaching clasp or by using a more flexible material (wrought wire).

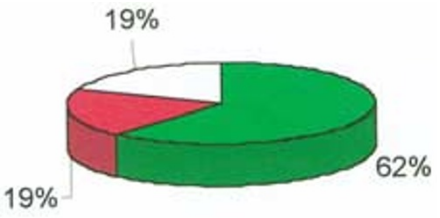


Statement 27 — A distal extension saddle should have a retentive I-bar clasp whose tip contacts the most prominent part of the buccal surface of the abutment tooth mesiodistally.

In the RPI system, the tip of the gingivally-approaching I-bar clasp contacts the most prominent part of the buccal surface of the abutment tooth mesiodistally (Fig. 27a). Thus when the distal extension saddle sinks under occlusal loads, the tip of the clasp moves mesially out of contact with the tooth and does not apply any potentially damaging torque to it (Fig. 27b).

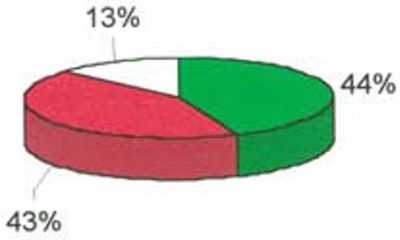






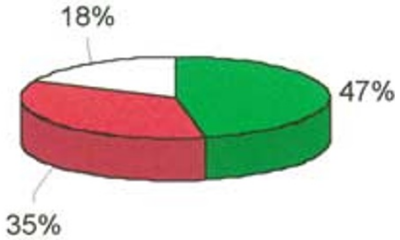
Statement 28 — The RPI system (Rest, Plate, I-bar clasp) should be used on premolar abutment teeth for mandibular distal extension saddles if the tooth and buccal sulcus anatomy is favourable

The RPI system is described in Figs 26–28, p653-654, Part 6 of this series of articles.



Statement 29 — The RPI system (Rest, Plate, I-bar clasp) should be used on premolar abutment teeth for maxillary distal extension saddles if the tooth and buccal sulcus anatomy is favourable

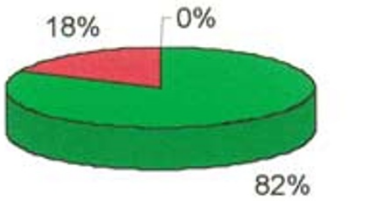
The RPI system is not such a popular choice for the maxilla as in the mandible, possibly because the potential for support from the denture-bearing area is greater in the maxilla than in the mandible, ie the 'support deficit' is less. The potential for harmful torque forces being applied to the abutment tooth is therefore reduced.



Statement 30 — If the retentive clasp for a distal extension saddle is on a premolar or canine abutment, it should be either a cast gingivally-approaching I-bar or a wrought wire occlusally-approaching clasp.

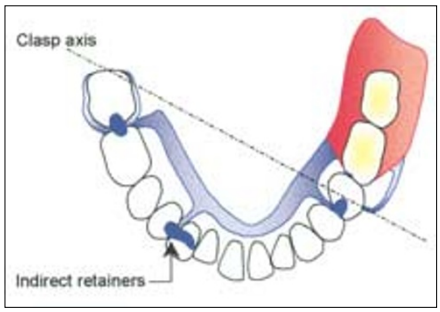
These are two types of clasp that minimize the chance of applying damaging torque to the abutment teeth of distal extension saddles.

In the case of a wrought wire occlusally-approaching clasp, the ability of the round section wire to flex in any direction also assists in avoiding potentially damaging torque.



Statement 31 — A distal extension saddle should have a retentive clasp on the abutment tooth

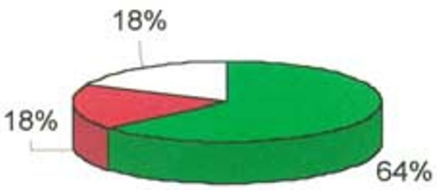
When practicable it is desirable to place a retentive clasp on the abutment tooth adjacent to a distal extention saddle so that one end of the clasp axis is located as close to the saddle as possible (see statement 32)



Statement 32 — A unilateral distal extension saddle denture (Kennedy II) should have one clasp as close to the saddle as possible and the other as far posteriorly as possible on the other side of the arch

These principles:

- Provide the most efficient direct retention for the mesial end of the saddle.
- Locate the clasp axis as far posteriorly as possible so that the most effective indirect retention can be provided for the distal extension saddle.



Statement 33 — Rather than making a design statement this section poses a question: 'What is the preferred number of clasps for RPDs restoring each of the Kennedy classes of partially dentate arch?'

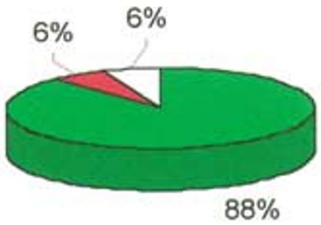
The pie charts indicate the percentage of prosthodontists preferring 2, 3 or 4 clasps for each of the Kennedy classes.

For all of the Kennedy classes the use of two clasps is the most popular choice for RPD retention. Two clasps are advantageous because:

- Simple denture designs are often better tolerated and minimize tissue coverage.
- Two clasps usually generate sufficient retention.
- A pair of clasps creates a clasp axis that can be positioned to bisect the denture and allow indirect retention to be obtained.

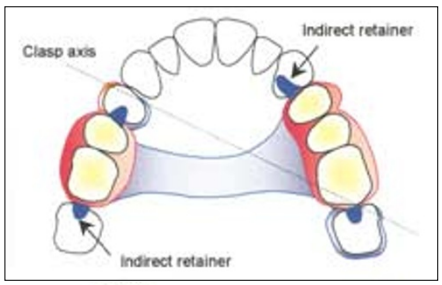
Statement 34 — Bounded saddles should have a clasp at least at one end

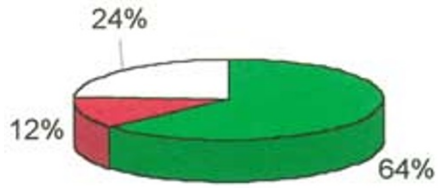
This allows for the utilization of indirect retention if required (see statement 35).



Statement 35 — A Kennedy III Modification 1 denture should have two retentive clasps forming a diagonal clasp axis which bisects the denture

If one end of a bounded saddle has a retentive clasp the other end will tend to be lifted by displacing forces. This tilting effect can be resisted by using an indirect retainer. If a bounded saddle has no direct retainer at either end indirect retention cannot be used to assist in the stabilization of the saddle.





Statement 36 — A Kennedy IV denture should have retentive clasps on the first molars if there is suitable undercut present

This is usually a good site for a pair of clasps retaining a Kennedy IV denture because:

- Normally the clasps are far enough posteriorly to be aesthetically acceptable. In those cases, usually maxillary RPDs, where clasps on the first molars would be too visible, it might be better to place the clasps even further back on the second molars if suitable sites exist.
- The molar is a sufficiently large tooth for cast occlusally-approaching clasps to be long enough to achieve adequate flexibility and resistance to permanent deformation.
- The clasps are sufficiently posterior to the support axis of the saddle to efficiently resist tipping of the denture as the result of incising forces, ie to provide indirect support for the saddle.
- If the retentive tips of the clasps can be placed mesially on the molars, the occlusal rests on the molar teeth will provide some indirect retention for the anterior saddle. In this instance the indirect retainers will be relatively close to the clasp axis and therefore their effectiveness will be limited. However, some direct retention is already likely to have been obtained for the anterior saddle by the saddle contacting guide surfaces on the abutment teeth and by the labial flange engaging undercut on the ridge. Therefore the modest indirect retention provided by the molar rests may be sufficient to stabilize the RPD.