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A simplified and evidence-informed approach to designing removable partial dentures. Part 3. The biomechanical basis of retention

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SUMMARY

For many decades the literature has regularly reported that there is a discrepancy between what is taught in dental school and what is practised, especially in the field of removable partial dentures. Not only that, but for more than 60 years reports from around the world have shown that, usually, most clinicians abdicate their responsibility to design a removable partial denture (RPD) and instead leave this to the dental technician, who has no knowledge of the clinical condition of the patient and works only from a cast. The majority of patients around the world who require RPDs to improve aesthetics and chewing can only afford a removable prosthesis simply because the majority are poor. But RPDs can improve these aspects and contribute to an improved quality of life.

The purpose of this series of articles is to derive the basic, evidence-informed principles of partial denture design and to suggest a simplified explanation and application of those principles in the hope that clinicians will increasingly take responsibility for the design of partial dentures. Part 1 summarised studies revealing what can only be described as the malpractice of abdication of responsibility for design by clinicians, and then explained the evidence-informed basic principles of design; Part 2 looked at the biomechanical basis of those principles in terms of support; this part will do the same for the biomechanical basis of retention; Part 4 will provide a simple seven-step approach to design, applied to an example of an acrylic resin-based and a metal framework-based denture for the same partially edentulous arch; and Part 5 will provide examples of designs for RPDs that have been successfully worn by patients, for each of the Kennedy Classifications of partially dentate arches. Much of this is referenced from an electronic book on the Fundamental of removable partial dentures.[1]

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None

Running title
A simplified approach to designing RPDs

The biomechanical basis of retention in RPDs

All dentures move in function, and that includes RPDs (apart from dentures retained on telescopic crowns, but that is in the realm of the specialist). All removable dentures therefore need to give the patient the best opportunity to control that movement and therefore to be able to use the denture. The previous part has provided the means to resist most movements from occlusal forces by providing support. This part will provide the means to resist all other movements as optimally as possible.

Most practitioners are familiar with the use of clasps to retain RPDs, but less familiar with two other forms of retention – the use of guide planes and guiding surfaces, and the concept of indirect retention. The latter has given many a headache to students and has created a large amount of literature mostly derived from laboratory studies with no clinical evidence. So, this part will try to deal simply with each of these different methods to achieve retention.

Direct, or active retention

This is about clasps. Called active, because this requires movement of the clasp as the denture moves, and that movement creates a force against a tooth, thus resisting the movement. Simple. Well, not so simple, because it is necessary to know what force is exerted, and what potential damage that force could cause.

A word of caution about the "class" of clasps: in Part 1 when discussing the principles, it was stated "Pre-formed and cast gingivally-approaching clasps were shown some time ago to be potentially more damaging to gingival health than circumferential clasps[2] so their use is not advocated here".[3] So what will be discussed from here on is the circumferential or "C-clasp", an occlusally approaching clasp for which there is much evidence for its efficacy.

To know what force is exerted by a clasp it is necessary to understand the behaviour of wires when they bend, from seating passively with the terminal third of the clasp in an undercut, to being bent while passing over the bulge of the tooth. Fortunately, there are now published guidelines – at least for the most popular cast material and the readily available wrought wires.[4] It is necessary to understand that a clasp needs to be able to bend while it moves over the bulge of the tooth, and then return to its original shape and to do this many times. This elasticity has a limit, the proportional limit, beyond which it will deform permanently, and so a clasp must remain well within its proportional limit, which is determined by the clasp material and its dimensions. The guidelines referred to above take into account the length of the clasp, its material and the force exerted when bending in and out of an undercut (Table 1).

www.sada.co.za / SADJ Vol. 78 No.10
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Table 1 Guidelines for the use of cast and wrought wire clasps. The wrought wire diameter is given in mms. The numbers in parenthesis show the mean force in grams. Co/Cr: Cobalt-chromium stellite alloy; S/S: Stainless steel (from [4]).

	Premolars	Molars		
Undercut:	0.25mm	0.25mm	0.5mm	0.75mm
Clasp material	Co/Cr cast (Vitallium) (1179) S/S round wire (Leowire) 1.0mm (676)	Co/Cr cast (Vitallium) (773) S/S round wire (Leowire) 1.0mm (657)	S/S round wire (Leowire) 1.0mm (657)	
For nickel sensitive patients	S/S round wire (Noninium) 0.9mm (360)			S/S round wire (Noninium) 0.9mm (363)

There is one caveat: the study calculated a realistic safety limit of 82% of the proportional limit, but the cast clasp of premolar length was within 1% of this safety limit so the conclusion is that, for short clasps, wrought wire would be a better choice.

Incorrect choice of wire/undercut combination can lead to permanent deformation of the clasp (Figure 1), and this can also happen when patients use the clasps to pull on to first release the denture, and they should be warned that this can sometimes lead to distortion and sometimes injury to the mucosa.[5]

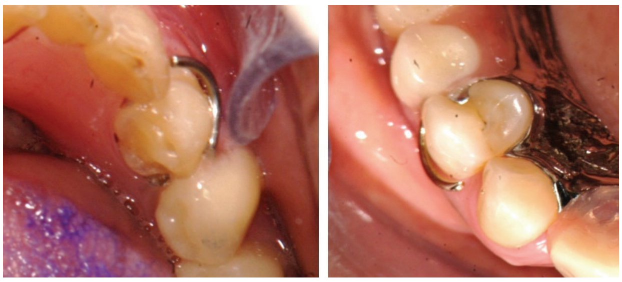

Figure 1. These clasps have exceeded their proportional limit and no longer contact the tooth and therefore provide no retention.

Reciprocation

During function, and of course during insertion and removal, the force exerted against the tooth is not dissimilar to the force used in orthodontics to move teeth. It for this reason that an active clasp arm's action needs to be resisted to prevent tooth movement and this simply requires another part of the denture – a cast arm, or the base itself – to be in contact while the clasp is exerting its force (Figure 2).

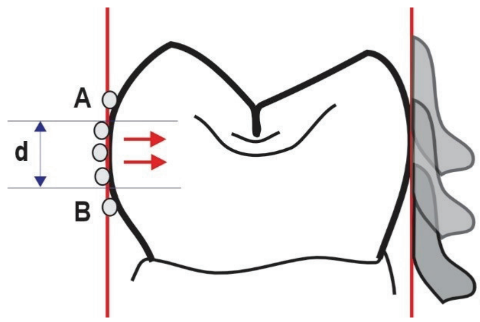

Figure 2. A clasp sits passively in the undercut at position B. As it moves over the bulge of the tooth over a distance d, it bends and therefore exerts a force (arrows) on the tooth until it returns to being passive at position A. During the distance d, a component of the denture, R, must contact the tooth to resist the force as the denture moves.

Ball clasps

Having said that pre-formed clasps should not be used, there is one type that does have its place, and that is the ball clasp (Figure 3). It provides support as it passes over the embrasure between two teeth, and retention by engaging the interproximal area, contacting both teeth. It is used mainly in orthodontics and maxillofacial prostheses but does also have an application in young teeth with short clinical crowns. Such a tooth does not have a large enough bulge area for a circumferential clasp to be effective (hence their use in orthodontics). Although the ball clasp is placed in the interproximal area where there are undercuts, they are generally so stiff that the retention they provide is more akin to frictional resistance which is the next type of retention.

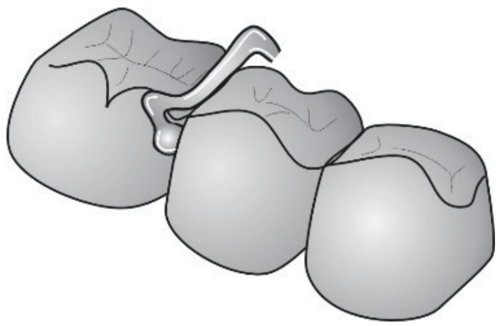

Figure 3. A preformed ball clasp passes between two posterior teeth and is bent back so that the ball portion sits in the interproximal area where there is a slight undercut.

When there is no undercut

Sometimes even a 0.25mm undercut is simply not there where you really want it, and there is no alternative. In this case an undercut can be created in two ways. The first, and easiest, is to recontour the tooth, always staying within enamel. Fine diamond burs are preferred, and you must use binocular vision to view the tooth along the path of insertion – place a pencil mark where you want the terminal third of the clasp to be, and be sure that you cannot see it when viewed along the path of insertion. The second method is to add a fine composite resin to create a suitable contour, but this is usually not necessary, and the evidence is that although this is quite feasible, retention will be lost over time.[6]

www.sada.co.za / SADJ Vol. 78 No.10
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Guidelines for indirect retention

1. Any movement that induces a rotation of the denture needs to be resisted.
2. The means of resistance is by the placement of an occlusal rest in such a situation that a favourable lever system is created.
3. The lever system in a mandibular distal extension base with a simple distal rest and circumferential clasp must be converted from a Class I lever to a Class II lever.
4. This is best achieved by placing a rest to act as a fulcrum anterior to the clasp; this increases the effective retentive force exerted by the clasp.
5. The rest is best placed one tooth anterior to the clasp assembly.
6. The lever system in a maxillary Class IV situation with a posterior clasp assembly with a mesial rest and circumferential clasp must also be converted from a Class I lever to a Class II lever.
7. This is best achieved by 'turning around' the clasp assembly so that the fulcrum is distal to the clasp; the clasp assembly now has a distal rest and the clasp arm engages the mesial undercut.
8. The lever system in a mandibular Class IV situation with a posterior clasp assembly with a mesial rest and circumferential clasp is favourable if the predominant movement is a tendence for the anterior segment to move down and posterior segment to move up.
9. However, if the predominant movement to be resisted is that of the anterior segment moving up, then the lever system must be converted to a Class II lever by 'turning around' the clasp assembly so that the fulcrum is distal to the clasp; the clasp assembly now has a distal rest and the clasp arm engages the mesial undercut.

Passive retention

When two opposing surfaces, such as the tooth and the denture base, are in close contact, the denture will bind against the tooth when it is moved away along any direction other than the path of insertion/withdrawal. This is similar to a desk drawer – you only need very slight finger pressure to open or close a drawer, provided you do so along its path of withdrawal. However, if you try to open the drawer in any other direction, you will end up moving the whole desk, but not the drawer, especially as the path is a long and well-constrained one.

This is the principle of passive retention. The surfaces used will help to determine the path of insertion and withdrawal: on the tooth this is in the form of a guide plane, and on the denture, it is referred to as a guiding surface (Figure 4).

A recent study found that by preparing guide planes on the teeth only, the retentive force increased by 1.6 times, but when the denture guiding surfaces were modified to intimately contact the guide planes on the teeth, the retentive force increased by 10.2 times.[7] This has huge implications and should become a routine part of treatment with RPDs. If the edentulous spaces are favourably dispersed then the retention is sufficient to do away with clasps altogether. This is especially the case for acrylic-based dentures because the preparation of the denture guiding surfaces is relatively easier than for framework-based dentures.

Preparation

Teeth

The guide plane preparation is a simple one, but necessary to smooth out the natural contours of the teeth. It is not, though, just a question of flattening the surface adjacent to the saddle, as the bucco-palatal or bucco-lingual contour must be preserved (Figure 5).

As illustrated in Part 2,8 when teeth are to receive a rest seat and a guide plane, these two features should be continuous. It should be noted that the design of the denture precedes the tooth preparations: all preparations should be completed before the final impression is taken. And before the denture is waxed up, the technician should have blocked out all unwanted undercuts.

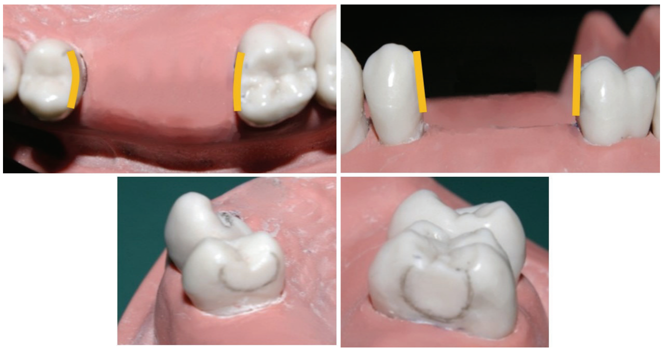

Figure 5. Guide planes demonstrated on typodont teeth. Top left: the guide planes follow the bucco-palatal contours. Top right: they must diverge slightly in an occluso-gingival direction. Bottom: the prepared guide plan shapes.

Denture

In *acrylic-based dentures*, it is a simplew procedure at the delivery stage to ensure intimate contact between the denture and the tooth. This is illustrated in Figs. 6-7.

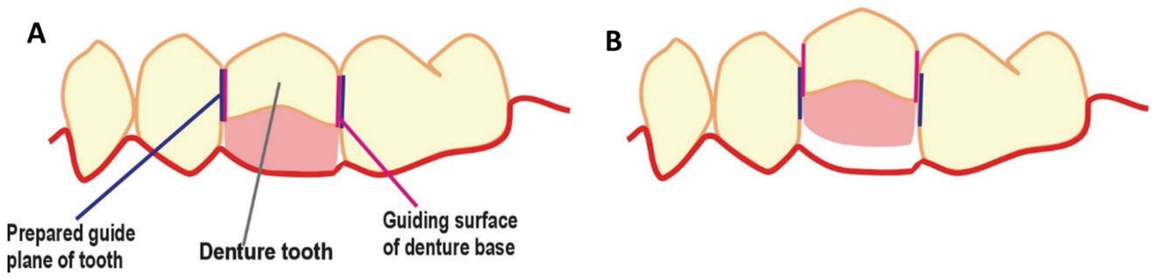

Figure 4 A: When a prepared guide plane on the tooth (blue line) and the surface of the denture (red line) are in close contact, they help define the path of insertion, and during withdrawal (B) will provide frictional resistance along that path, but much greater resistance to any deviation from that path.

www.sada.co.za / SADJ Vol. 78 No.10
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Figure 6. Left: with a round bur, drill retention holes where the guiding surface will be. Right: add autopolymerising acrylic, and then insert in the mouth, having lubricated the guide plane on the tooth. The procedure is similar to that of making a provisional crown in the mouth. Be sure to remove before the resin has set!

In *framework-based dentures*, it is generally considered that the minor connector to the clasp assembly or to the occlusal rest will be sufficiently accurate to provide adequate contact, but the fact is that the contact can never be as good as providing the guiding surface intra-orally as above. There is, however, a solution to this, and that is to provide sufficient space between the minor connector and the tooth to be able to apply acrylic resin in the same way as in the acrylic-based RPD. The disadvantage of this is that the framework, when tried in on its own, will have no retention; this is fine for the mandibular denture but the maxillary denture will just fall out so has to be held in place while assessing the fit.

So when the master model is being blocked out by the technician, the blocking-out wax needs to be built up against the guide plane to provide a space, and it would be preferable to use a perforated mesh for the minor connector. This will provide retention for the autopolymerising acrylic (Figure 8).

Guidelines for guide plane retention

1. The guide plane is the re-shaped surface of the tooth adjacent to an edentulous area.
2. When a rest is also required on the tooth, the guide plane should be continuous with the rest.
3. Guide plane retention is most effective when there is intimate contact between the guiding surface of the denture and the guide plane of the tooth.
4. This is best achieved intra-orally by adding autopolymerising acrylic resin to either retentive preparations in the acrylic of an acrylic-based denture or to the acrylic and mesh in a framework-based RPD, when space has been created between the minor connector and the tooth.
5. With sufficient edentulous spaces, guide plane retention would be sufficient to obviate the need for clasps in both acrylic-based and framework-based dentures.

Indirect retention

There are three myths about indirect retention. The first is that it is not necessary; the second is that an axis of rotation must be determined and the furthest point from that is where a fulcrum must be placed, in the form of a rest; the third is that it only applies to mandibular distal extension bases. Each of these will be dealt with.

Indirect retention is not necessary

The goal with all removable prostheses is to limit the movement that inevitably occurs during function. Movement along or away from the path of insertion has been covered by providing support, guide plane retention and active retention. But rotatory movements also occur, and it is these movements that indirect retention helps to reduce, by changing any lever system that tends to create rotation. The next sections will show, therefore, that indirect retention is indeed necessary.

Figure 7. Left: the widely spaced edentulous areas make this an ideal case for the use of guide plane retention only; note that cingulum rests have been prepared on the 13 and 22, and occlusal rests have been prepared on the 16 and 27 for half-round wire. Right: appearance before and after.

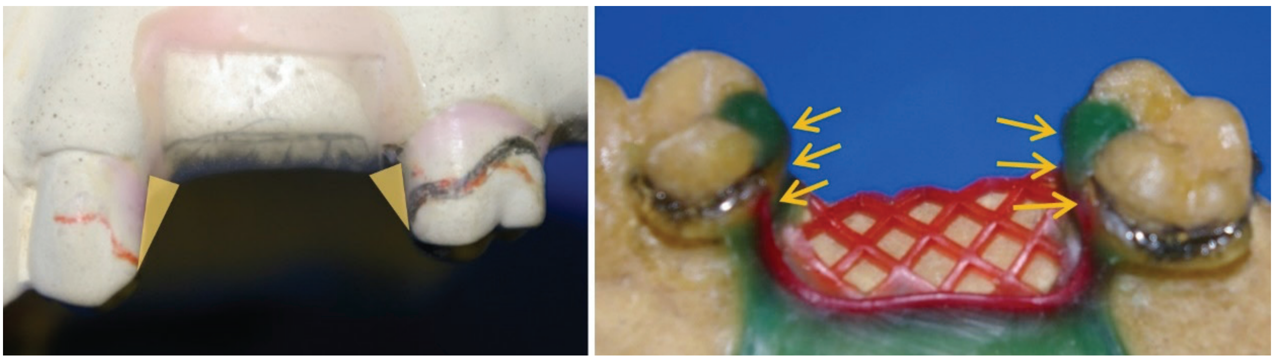

Figure 8. Left: it is suggested that a “wedge” of additional block-out wax be placed to provide a space between the minor connector and the tooth and that the minor connector (arrows, right) be perforated.

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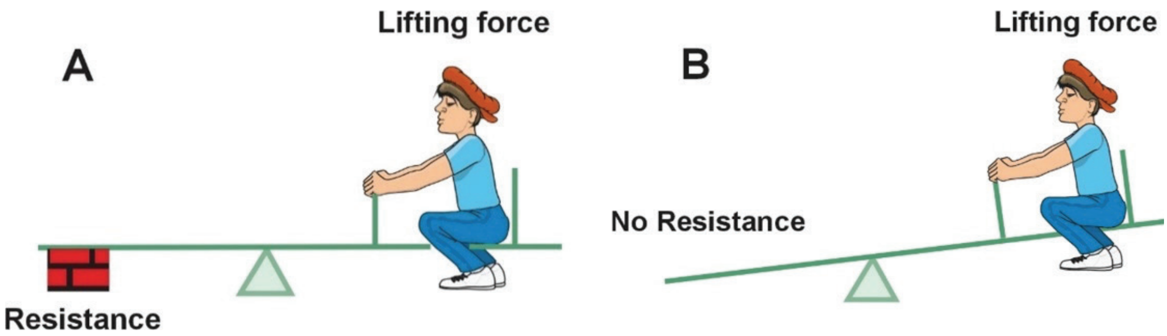

Figure 9 A: The person at the end cannot push up because the pile of bricks resists that. B: without the bricks, he can lift up easily.

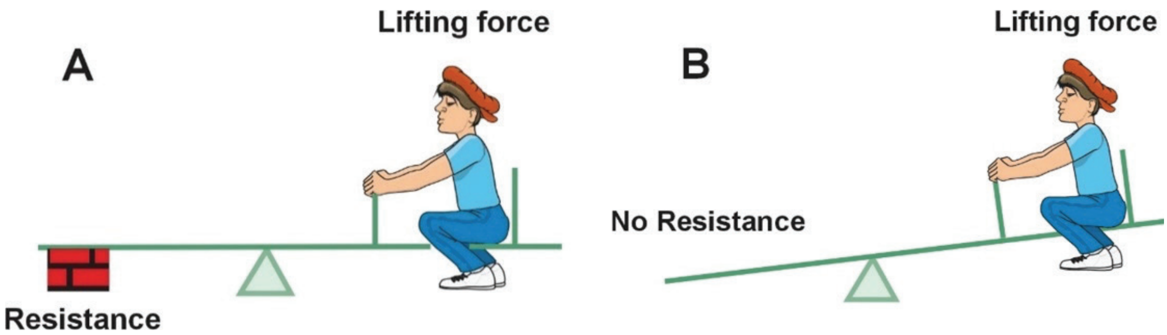

Figure 10 A: The clasp, in reality, is the fulcrum as well as the resistance. B: but it rotates downwards away from the bulge and provides no resistance.

Axes of rotation and the fulcrum: it's all about levers

Almost 60 years ago a seminal paper made this observation: "Indirectly then, partial denture units preventing … rotation retain the denture bases in contact with the underlying tissue, hence the name 'indirect retention'."[9] It is a concept, though, that many students have found difficult to grasp, perhaps because the analogies used of a see-saw representing a Class I lever, and wheelbarrow representing a Class II lever are difficult to apply to the mouth. So, the following is an attempt to provide an explanation thus far not found in the literature. The first analogy, of the see-saw, is shown in Figure 9. For the person at the end to push himself up there can be nothing to stop the end of the plank on which he sits from going down: the pile of bricks is the resistance to his going up. So, the explanation usually given is that if the person at the end represents a mandibular distal extension base then something furthest away from him must be placed to resist that movement.

But in terms of the reality of a partial denture and not a see-saw, it is necessary to realise that the fulcrum is in fact the clasp assembly, as that is the natural resistance to a lifting movement caused by something sticky at the distal extension, because that's how clasps work. We can take it that the fulcrum is the clasp (in engineering, considering solid body rotation, it is probably the tip of the reciprocal arm but it's close enough!). So, we will superimpose the active clasp arm as in Figure 10, and now this is, in reality, the resistance. But see what happens to it when the distal end lifts up – it goes down away from the bulge of the tooth and provides no resistance to the lift.

The conclusion is that the clasp assembly providing the fulcrum is no help, and everything is working at a mechanical disadvantage. To turn that into an advantage, the clasp assembly has to move up as the distal extension moves up so that it can encounter the bulge of the tooth and provide the resistance it is supposed to provide. This is done by moving the fulcrum *away* from the clasp assembly, which converts the lever from a Class I lever to a Class II lever.

Now the classic analogy for a Class II lever is the wheelbarrow (Figure 11). The fulcrum is the wheel and the resistance is whatever is in the barrow, the equivalent of the pile of bricks now on top of the original see-saw, making it not impossible for the person to push upwards, but just more difficult.

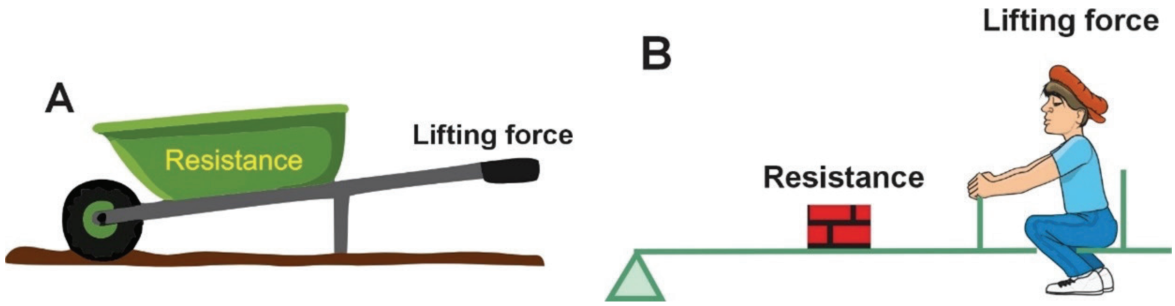

Figure 11 A: The classic example of a Class II lever. B: the equivalent in the see-saw.

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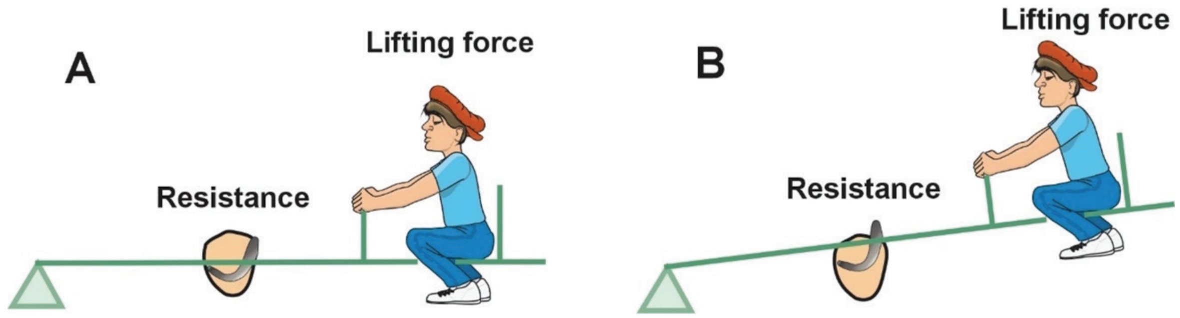

Figure 12 A: The fulcrum is now in front of the clasp assembly, so that when the distal end moves upwards as in B, the clasp arm also moves upwards, engages the bulge of the tooth and provides the resistance to the movement.

Now for the reality: the resistance is, in fact, the clasp assembly and with the fulcrum moved away, in front of – ie anteriorly to – the clasp, now the clasp tip moves up with the distal extension, engages the undercut, and provides the resistance (Figure 12).

Axes of rotation and the fulcrum: where to put it

As with many aspects of RPD design over the years, much of what would seem obvious from looking at diagrams of tooth arches has resulted in some strange designs with no clinical evidence for their efficacy. For many years it was accepted that a fulcrum line would exist between the distal abutment teeth in a Class I, II or IV denture and between the rests of saddles of a Class III denture. In fact, to this day, in the latest edition of a popular textbook which first appeared in 1960 little has changed: "An indirect retainer should be placed as far from the distal extension base as possible in a prepared rest seat on a tooth capable of supporting its function." A diagram similar to Figure 13 shows the favourable location for an indirect retainer to be "at 90 degrees to the fulcrum line between primary rests", to provide "efficient resistance to a denture base lift based on the longest distance to resistant rest support and because the occlusal rest is perpendicular to the load".[9]

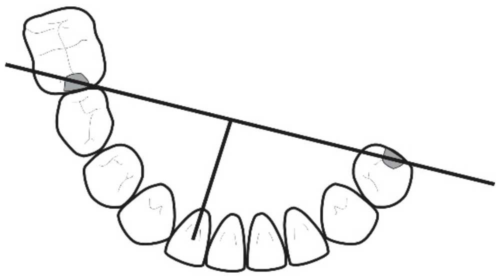

Figure 13. The fulcrum line is assumed to be between the distal rests and the indirect rest is recommended in a well-known textbook to be at right angle to the fulcrum.

However, this has been shown to be quite unnecessary, overcomplicates the design and actually reduces the effectiveness of the indirect retainer. The reason is that a simple analysis of beams and levers reveals a simple truth based on mechanics. The mechanical advantage of a lever is defined as the effort arm divided by the resistance arm and is quite easy to understand when dealing with a simple Class I lever, but not so easy (apparently) when trying to work out a Class II lever. So, consider a Class I lever first as a beam with equal weights each equidistant from the fulcrum (Figure 14). Everything balances but clearly a change in one of the weights or one of the distances will upset that balance, unless the weight and distance compensates for that, and restores balance again (Figure 15). There is no mechanical advantage in the latter: 5 x 20 divided by 100 x 1 is zero.

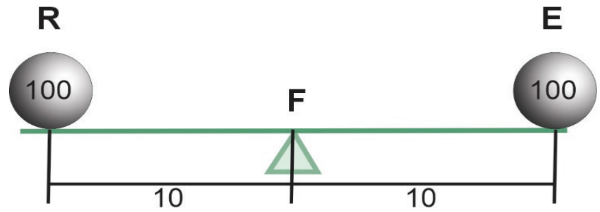

Figure 14. The beam is in balance because the weights (100 units) are equal and are of equal distance (10 units) from the fulcrum.

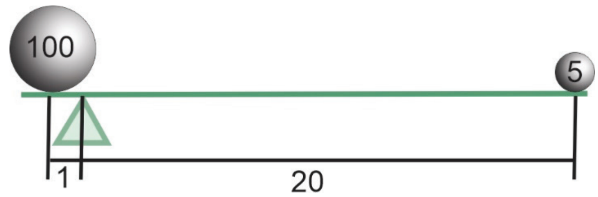

Figure 15. This beam is also in balance but because the right-hand weight is far from the fulcrum, the weight can be considerably reduced. Increasing the weight would create a mechanical advantage and the beam would tilt.

Now if we move the fulcrum to create a Class II lever (Figure 16), we have a mechanical advantage as the resistance arm is part of the effort arm: the weight on the left will have to increase to maintain balance.

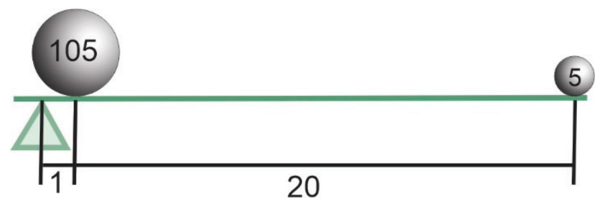

Figure 16. Moving the fulcrum to create a Class II lever means that the weight on the left must be increased to maintain equilibrium.

The principle is that the resistance arm, being part of the effort arm, is always going to be smaller, so the mechanical advantage will always greater than 1 in a Class II lever, which is why it is called a force multiplier. This is precisely the effect required in a distal extension base (Figure 17), we are trying to multiply the resistance created by the clasp when a lifting force is applied to the distal extension base. Let us assume that the lifting force at the end of the base is 6 units from the clasp, and the fulcrum is one unit away from (anterior to) the clasp (Figure 17).

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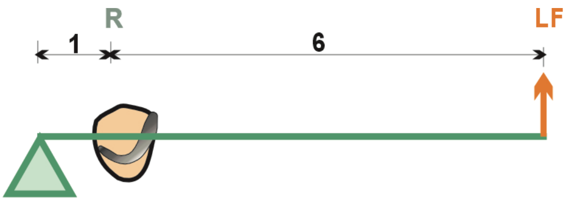

Figure 17. The beam of a mandibular distal extension base as a Class II lever. The effort arm is from the lifting force (LF) to the fulcrum, the resistance arm R is from the clasp to the fulcrum.

Ignoring the strength of the force, and just taking the distances into account, means that the multiplier effect on the resistance, ie the clasp, is 6 + 1 divided by 1, ie 7. A 7 times increase is surely going to make a difference to resist the lifting of the base. This is why the conversion from a Class I lever to a Class II lever is important because it effectively multiplies the resistance of the clasp. However, if the fulcrum is moved further away, as recommended in the literature and many textbooks, the multiplier effect is reduced, not enhanced. Taking the same units into account, if the lifting force is still 6 units away from the clasp, moving the fulcrum 2 units away reduces the multiplier effect to 4; to 3 units, it becomes 3; to 4 units it is 2.5, and so on.

So, it is only necessary to place a rest one or two teeth anterior to the clasp in a mandibular distal extension base to provide indirect retention.

Does it only apply to mandibular distal extension bases?

No, it applies to any force applied to the denture that has the potential to cause rotation. Or any tendency for the denture to rotate. Typical of this is the Kennedy Class IV maxillary denture. Retention anteriorly is reliant mainly on the guide planes and, to some extent, on the edentulous ridge. Guide planes on anterior teeth are small, and so the use of autopolymerising acrylic to create guiding surfaces on the denture is imperative. So, if the denture does tend to rotate downwards anteriorly, then a similar lever system prevails and, if a molar is clasped (as it should be), then the positioning of the clasp and the occlusal rest needs to convert a Class I lever into a Class II lever. This is shown in Figures 18-19.

For a mandibular Class IV denture, the situation is a little different. There is still a problem of limited retention anteriorly, but now you must decide which is the predominant movement to resist, because the denture could either move upwards anteriorly as a result of something sticky attaching itself, or the posterior part could move upwards as a result of an occlusal force angled against the anterior segment, which is what happens during incising. The fact is that both these rotating movements could occur, and the only evidence for one predominating over the other, is anecdotal and relies on the experience of clinicians and patients. In the author's experience, the movement most likely to occur is a rotation where the posterior part of the denture tends to rise. If you agree with this then the clasp arrangement has to be as per Figure 20, otherwise if you want to resist the anterior segment rising up, then the clasp assembly has to be as per Figure 21.

Guidelines for indirect retention

1. Any movement that induces a rotation of the denture needs to be resisted.
2. The means of resistance is by the placement of an occlusal rest in such a situation that a favourable lever system is creat ed.
3. The lever system in a mandibular distal extension base with a simple distal rest and circumferential clasp must be converted from a Class I lever to a Class II lever.
4. This is best achieved by placing a rest to act as a fulcrum anterior to the clasp; this increases the effective retentive force exerted by the clasp.
5. The rest is best placed one tooth anterior to the clasp assembly.
6. The lever system in a maxillary Class IV situation with a posterior clasp assembly with a mesial rest and

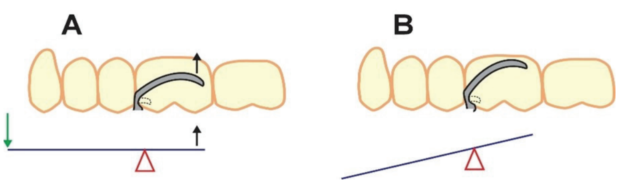

Figure 18 A: If the denture rotates downwards anteriorly and a clasp assembly has a mesial rest with the clasp engaging the distal undercut, a Class I lever is created with the mesial rest as fulcrum. B: this means that the clasp now moves in the wrong direction and does not engage the bulge of the tooth and so provides no retention.

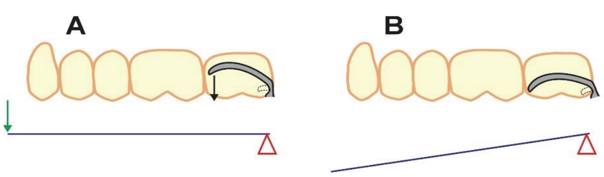

Figure 19 A: If the clasp assembly now comprises a distal rest, and the clasp arm engages the mesial undercut, a Class II lever is created. B: this means that the clasp now moves in the same direction as the denture, encounters the bulge of the tooth and therefore exerts a retentive force to reduce the movement of the denture.

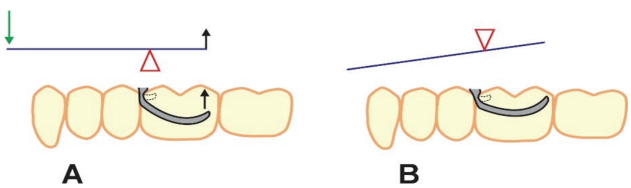

Figure 20 A: If the predominant action to resist is a rotation around the anterior segment from an occlusal force, then the fulcrum is the mesial rest and the clasp arm engages the distal undercut. B: the Class I lever created is in this case favourable as the clasp arm moves up to engage the bulge of the tooth and provide a retentive force.

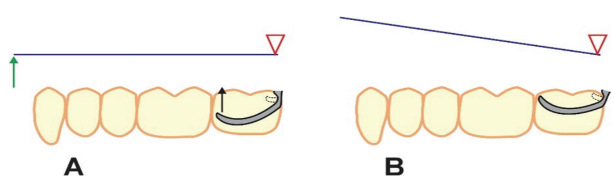

Figure 21 A: If, however, you believe that the movement to resist is an upward movement of the anterior segment, then it is necessary to create a Class II lever with a distal rest and the clasp arm engaging the mesial undercut. B: now the clasp arm will move in the same direction as the denture and provide retention.

www.sada.co.za / SADJ Vol. 78 No.10
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circumferential clasp must also be converted from a Class I lever to a Class II lever.

7. This is best achieved by 'turning around' the clasp assembly so that the fulcrum is distal to the clasp; the clasp assembly now has a distal rest and the clasp arm engages the mesial undercut.
8. The lever system in a mandibular Class IV situation with a posterior clasp assembly with a mesial rest and circumferential clasp is favourable if the predominant movement is a tendence for the anterior segment to move down and posterior segment to move up.
9. However, if the predominant movement to be resisted is that of the anterior segment moving up, then the lever system must be converted to a Class II lever by 'turning around' the clasp assembly so that the fulcrum is distal to the clasp; the clasp assembly now has a distal rest and the clasp arm engages the mesial undercut.

The mythology of the clasp system for mandibular distal extension bases

Distal extension base dentures derive their support from both the mucosa over the ridge, and the teeth. This creates a problem, because the mucosa displaces up to 20 times more than the periodontal ligament. This fact has historically caused considerable concern, because if the abutment tooth – the tooth next to the saddle – is clasped (as it has to be) and the base of the denture moves further than that tooth under an occlusal load, then there is the potential for some rotation around that tooth. And if that tooth is tightly gripped by a clasp assembly then, theoretically, tipping and torquing forces could be transmitted to that tooth. This is made worse by the fact that there is most likely to be a distally placed rest (as rests are usually placed next to the saddle), which could have the effect of tipping the tooth around its axis. These tipping and torquing forces have been thought to contribute to the periodontal problems often associated with the abutment teeth of partial dentures in general, and of distal extension bases in particular.

The entire explanation will only be summarised here and has been given elsewhere.[1] The first idea, proposed 60 years ago, was that a mesial rest and a gingivally approaching I-bar would reduce the tipping forces on the abutment tooth.[10] This was later refined into the RPI clasp system which was a mesial rest (R), a proximal plate (P) which was to disengage the tooth under occlusal load, and an I-bar (I) which was also supposed to disengage the tooth under load.[11] These ideas were presented without any clinical evidence, but were purported to be verified by photo-elastic stress analysis.[12] Then, in 1985, a seminal paper pointed out that there was no evidence either in vitro or in vivo for any of the claims that the RPI system was supposed to solve, and furthermore pointed out that the literature even at that time was showing that any periodontal problems associated with abutment teeth were not related to the RPD but to the oral hygiene of the patient.[13] This has, of course, been corroborated many times in the literature since then, yet, astonishingly, the RPI system is still in use today.

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CPD questionnaire on page 534

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The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.