

Indirect retention

1.8

Indirect retention is a means of preventing the displacement of a saddle which is cantilevered out from the direct retainer(s), such as a free-end saddle or curved anterior saddle. A lever system must be created to keep the saddle in place.

DESIGN SEQUENCE

teeth to replace
support
connectors
retention
refine

Indirect retention is always a Class III lever system; it can never work at a mechanical advantage

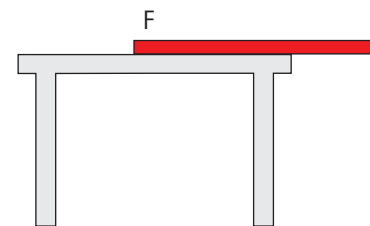
Here is an everyday situation where a book or a tray is overhanging the edge of a table. In this instance let us suppose that it is a block of wood.

Let us look at the forces involved in the retaining parts of partial dentures which cannot be held in place by direct means.

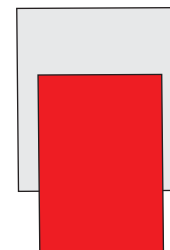
Indirect retention relates to saddles that cannot have a retainer at each end, or do not have the pontics in a straight line between the abutment teeth.

An example is a free-end saddle where there is only an abutment tooth at one end. Another example is an anterior saddle which is curved outside a straight line between the abutments.

It will be useful to be reminded of the Class III lever system, for it is the method by which indirect retention is effected. To help your memory of levers little diagrams have been added to many of the illustrations.

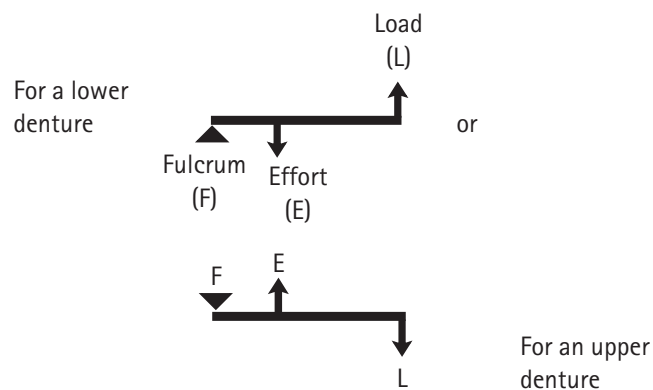


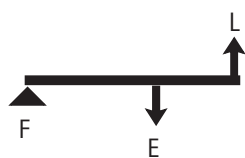
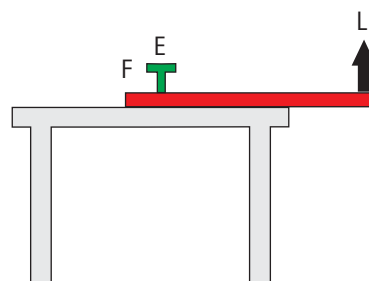
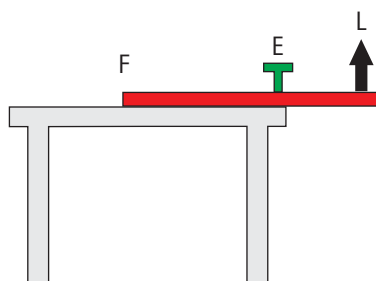
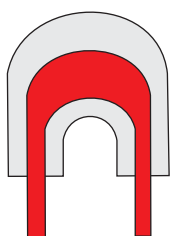
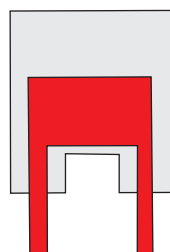
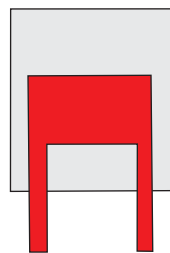
Look at the table and block from above



If you were to lift the block at the overhanging edge, then the opposite end would remain in contact with the table as the block hinged upwards, about its edge at F.

Apart from the weight of the block there is nothing to prevent this movement, is there?





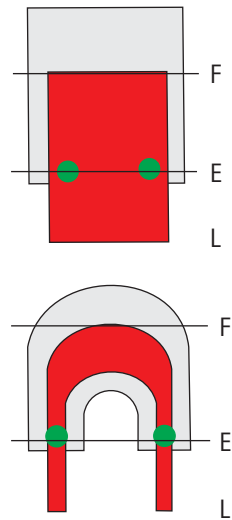
On the left you can see modifications have been made to the block and table. Whatever alterations are made, if the overhanging part is lifted, the other end will still lie on the table top and hinge about its edge.

Do you think that, with a little imagination, the third illustration on the left looks a bit like an outline partial denture (with free-end saddles) lying on an occlusal table?

You could stop the outer edge of the block being lifted by nailing the block to the table near to the table edge. Common sense tells you to put the nail near the edge, naturally you would not put the nail near the left hand edge of the block. Why?

Because you know that when you lifted the block the leverage would pull the nail out. This simple fact tells you how to make indirect retention work well.

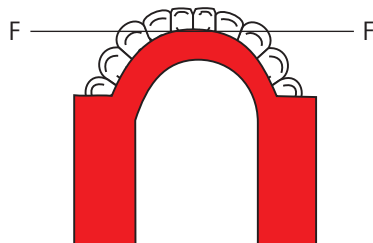
Check the lever diagrams, as a Class III system the nearer E is to the lifting load L the better.



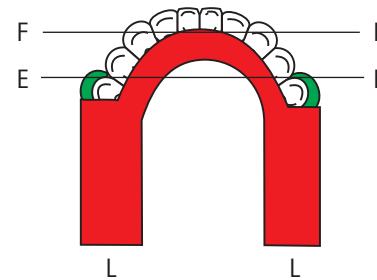
Looking at the next two illustrations (above), the same as the earlier examples but with added nails, you can see the addition of the nails and the lever system they have created will stop the overhanging part of the block from lifting. Therefore although the overhang cannot itself be directly fixed in position, it has been fixed in place indirectly by the table top acting as a fulcrum and the nails as the effort working together to prevent you lifting it.

Using a little imagination again, the lower illustration looks a bit like an outline partial denture lying on an occlusal table. With the teeth gripped at E the free-end saddles would be prevented from lifting (retained).

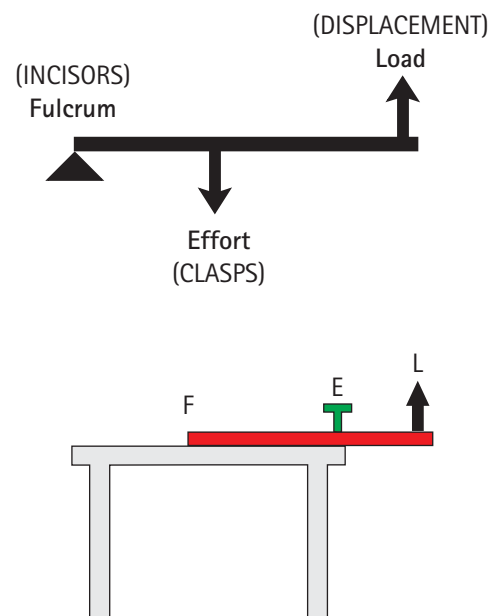
Applying our analogy of the red block representing a partial denture lying partly on the teeth and partly overhanging distally to replace the missing posterior teeth, it can be seen that if the posterior part were to be lifted, the denture would at first rotate about the axis F-F where it lies on the anterior teeth (as below). Then with further raising posteriorly the denture would just lift off the tissues altogether. This denture would not be retentive.



Look at the difference made by putting clasps on the premolars. If you try to lift the back of the denture, because of the grip of the clasps, it will *try* to rotate about the axis E-E.



This rotation is not possible as the anterior part of the denture is lying on the teeth (occlusal table) and cannot move (forming the fulcrum), so lifting of the saddles will be resisted.



Here is the lever system which has been created. It is a **Class III** system because the **fulcrum** axis **must** be at the part which cannot move—the teeth at F-F. The (retaining) **effort** is at E-E where the clasps resist upward movement of the force trying to displace the saddles (**load**).

The posterior part of the denture is now retained, not directly as there is no fixation at the back of the denture, but **indirectly** by the lever system.

Just to check, compare this to the table and block arrangement with which we started.

It is clear that a displacing force at L will be resisted by the nail at E, the fulcrum is at F.

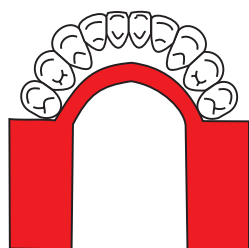
Be clear as to why the fulcrum is at F. If the displacing force is strong enough the nail will be pulled out; therefore the nail **must** be the Effort (retainer). The part against the table cannot move, so it has to be the Fulcrum.

The saddles are *indirectly retained* by the standing teeth through the Class III lever system

Note: Did you realize that the jaw works as a Class III lever—the Load is at the incisors, the Effort at the elevators and the Fulcrum at the joint? Just as well our molars are further back than the incisors where the muscles can be more effective.

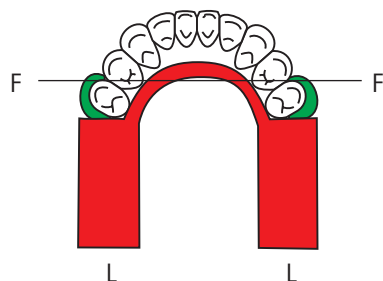
Now that the principle has been established, let us look more closely at partial denture design.

Partial dentures do not normally lie **on** the teeth; tooth support is usually derived through occlusal rests arising from the denture base or modifying part of the denture base to act as a rest. Therefore the denture is only supported by the teeth where the design dictates. This illustration outlines a denture utilizing no tooth support at all. It is also non-retentive.



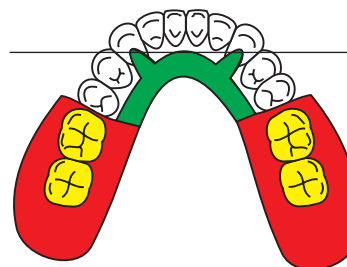
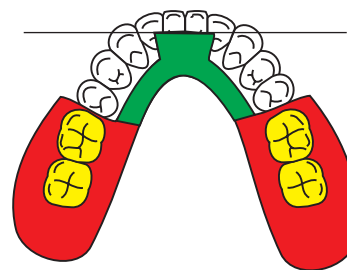
You can see from the next diagram that

Clasps alone will allow a rotation about the clasp tips where the tooth is gripped.



Because there is no part of the denture lying on the teeth anterior to the clasps, there is nothing to prevent the anterior part of the denture moving down towards the floor of the mouth. There is no proper lever system. There is a load and a fulcrum but no effort, so there is nothing to prevent the posterior part of the denture from lifting.

You have just seen that **clasps alone** only hold one part of the denture steady.

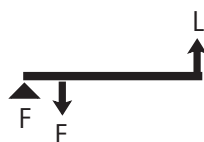
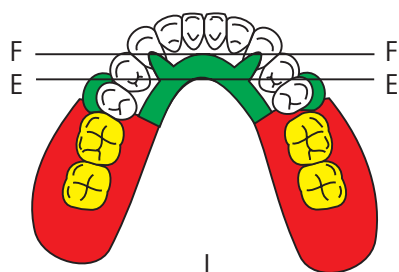
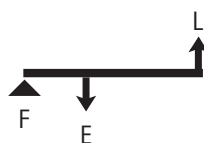
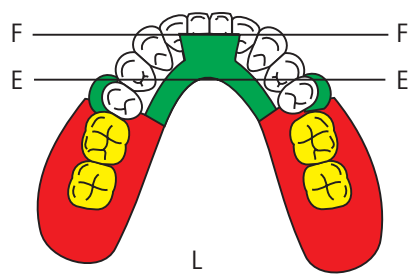


Looking at these two diagrams, it is clear that **rests alone** do nothing to retain the denture base, the whole thing can just be lifted off. If the posterior end only were lifted the denture would hinge up on the rests which are lying passively on the teeth, there is nothing to hold them, or the denture, in place.

So you can see that **indirect retention of a saddle cannot be achieved by clasps or rests acting on their own.**

Indirect retention can only be achieved through a combination of clasps and rests to form a lever system to retain the free part of the denture.

So let us now **combine the actions of the clasps and rests** we have been discussing into a working unit which will retain the free-end saddles.



Here, then, is a complete system which will retain the free-end saddles.

Observe, however, the relationship of clasps to fulcra.

You know that changing the lengths of the lever arms alters the efficiency of the system, and this will alter the degree of indirect retention possible.

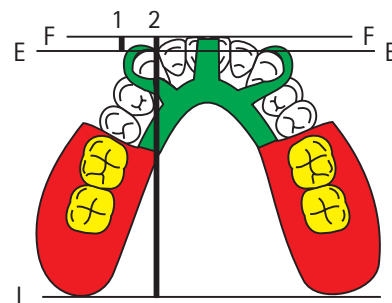
The fulcrum is at F-F, so when the lever arm FE is working against the arm FL, which is the part to be stopped from moving (retained), the greater the distance between the rests and the tips of the clasps the better, as it lengthens the retaining lever.

This means that the upper diagram is the more efficient design as the retaining lever (FE) is the longer.

As the retaining ability of the clasps is limited to the force required to drag them off the teeth, the upper diagram is still the design of choice.

How about this for a design?

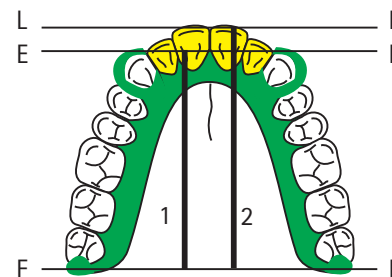
Look at the lengths of the levers.



The retaining lever (1) is so short that it would be useless against the leverage of the displacing force (2), unless the clasp was enormously strong—so strong that it would apply an extracting force on to the tooth with relatively little displacing force applied to the saddle.

The retaining lever must be as long as possible (Fulcrum to Effort).

Consider the next design:



This shows a design for missing upper incisors: this is mechanically very good. Look and see where the fulcrum is.

The fulcrum axis is through the posterior rests at F-F and any displacing force applied at the incisors to remove the denture (on the lever arm between L and F (2) is resisted by the lever arm between E and F (1) which is almost the same length.

Note: We are only concerned here with theory, not aesthetics or the amount of tissue coverage. These are factors which may cause modification of the design at a later stage.

For instance, in the last example, the tips of the clasps may have to be placed further back for aesthetic reasons, which would reduce the retaining efficiency.

By now you should be able to draw up different designs; indirect retention is quite simple if you look at it from the point of view of a simple lever system.

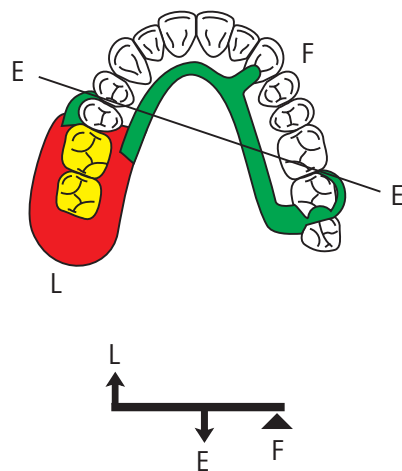
Let us suggest a definition: an *indirect retainer* is a supporting element on the other side of a line joining the tip(s) of the retaining element(s).

Do not forget this

An indirect retainer for a saddle is a supporting element the other side of a line joining the tip(s) of the direct retaining element(s).

Note: Beware of any definitions you might see which refer to a line joining the clasps as the *Fulcrum*. You have seen that this is *not* correct, as the clasps can be levered out of position, and is quite misleading as far as the effectiveness of the retention is concerned. This assumption makes the system appear to be a Class I lever which it certainly is not.

It has probably occurred to you that designs are not always symmetrical, as you can see from this example:

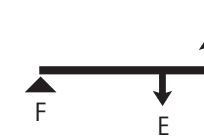
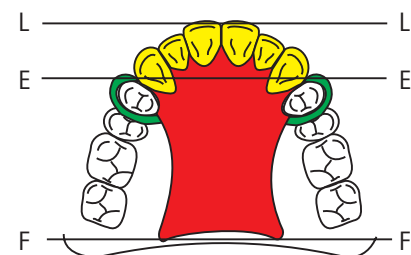
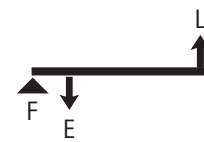
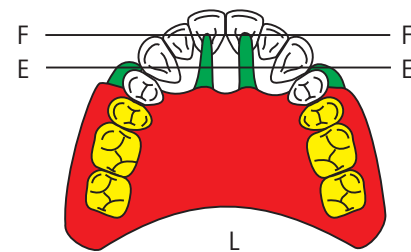


The lever principle still holds good, as the saddle at (L) cannot lift, can it?

No, the displacing force is applied to the lever LF and is resisted by the lever EF (E being the distance from F to the line E-E, of course).

All you have to do is work out the best lever system for each design when part of the denture is cantilevered out from areas which can be directly retained.

One other thing before we finish. The denture base itself can be used to gain indirect retention.



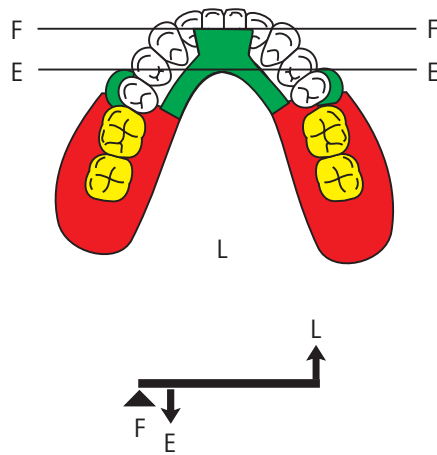
In both cases the denture base has been extended beyond a line joining the tips of the clasps.

In the upper diagram 'Cummer arms' have been incorporated to form cingulum rests on the central incisors; these will form the indirect retainers to stop the back of the denture falling. Not very efficient in this case, but nonetheless helpful. In the example illustrated, there is potential for food stagnation around the closely placed Cummer arms. Extension of the acrylic base around the anterior teeth would also provide indirect retention but

covering the gingival margins could be considered a disadvantage.

The last diagram shows a backward extension of the denture base, beyond a line connecting the tips of the clasps, which will act as an indirect retainer to stop the front of the denture falling. A very considerable help in this case.

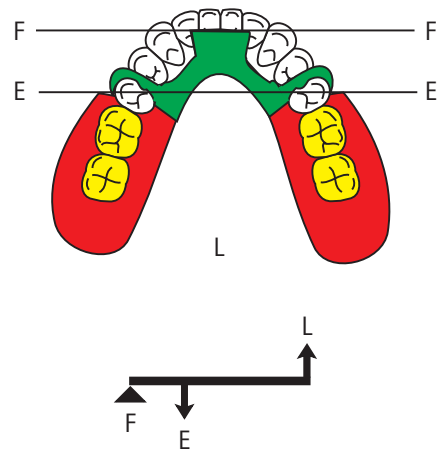
A further point to keep in mind.



You have seen this diagram before, but looking at it again can you see how the indirect retention of the saddles could be improved?

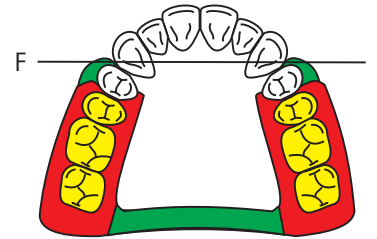
Just think *where* each force is applied.

Answer:



By changing the direction of the clasps, the rest/clasp lever is lengthened by moving the tips of the clasps (points of action) further away from the fulcrum (rest).

Here is a tissue supported denture.



There is minimum tissue coverage and the gingival margins of the standing teeth are free from cover. The posterior palatal bar is well back keeping the palate free and avoiding tongue action; reciprocal action is provided by the denture base.

All very laudable, apart from the fact that the denture will not stay up. It will rotate about the tips of the direct retainers (clasps) and will be absolutely useless. **Think your designs through!**

Do not be persuaded that indirect retention is a Class II, or even a Class I lever system. This presupposes that the clasp(s) is the fulcrum. This is not the case, as the fulcrum is on the teeth (which do not move) and the effort is the tip of the clasp(s) (which can move).

The principle and application is simple once understood.

Conclusions

Indirect retention is often considered to be a 'difficult' concept. In this chapter we have tried to explain it, because it is an essential feature of many dentures especially when free-end saddles are required, as in Kennedy class I and II designs.

Some points to remember

Be sure that you have grasped the following:

- the displacing **load** (sticky food) is applied to, for example, a free-end saddle as the mouth opens
- the prosthesis will try to displace by rotation about the **fulcrum** created by the most distant supporting component of the denture from the saddle, perhaps a cingulum rest in the case of the free-end saddle(s)
- resistance to movement, the **effort**, will be provided by the clasp(s) placed as far away from the fulcrum as possible