

Designs for removable prostheses

JEROME GOODMAN
OUTLINES 16 DESIGN
TENETS FOR PARTIAL
DENTURES USING THE
EQUIPOISE SYSTEM

The design of a removable prosthesis should be a most precise science. Three basic criteria must be met before the dentist can consider placing any clasp or retentive device upon the abutment tooth (Goodman, 1975b).

Firstly, all forces must be directed vertically along the long axis of the abutment tooth during the masticatory stroke, or function. A removable prosthesis must protect, preserve and strengthen the abutment tooth. This will only happen when a vertical force, and only a vertical force, is applied to the abutment tooth during function. As the prosthesis functions, the retentive device must relax away from the undercut area, thereby eliminating any lever action on the abutment tooth.

Secondly, maximum function for the patient must be assured. A removable prosthesis, while protecting, preserving and strengthening the abutment tooth, must also function as similar to the natural dentition as possible. No stress-breaking or hinge attachments can do this, since the movement of the denture

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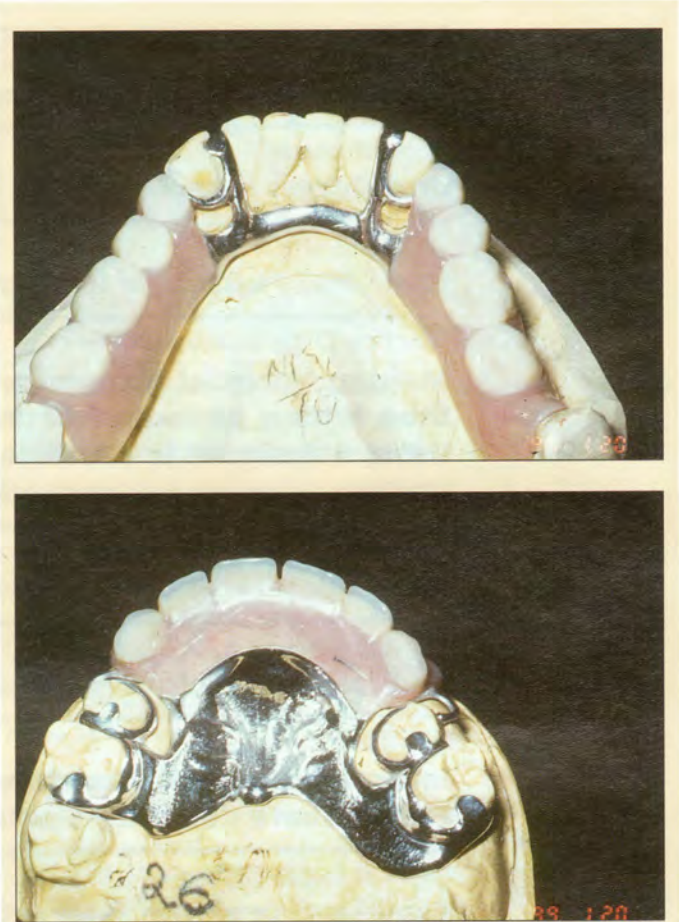


Figure 1a and 1b: The single or double free-end saddle removable prosthesis, whether anterior or posterior free-end saddles

base inhibits function and is destructive to the residual ridge. Porcelain teeth or high density resin teeth should be used

Finally, aesthetics must be considered. Many prostheses are rejected by the patient because of unsightly metal. A successful prosthesis must reflect our maximum aesthetic values, the 'natural look'.

FOUR BASIC DESIGNS

A successful removable partial denture requires abutment tooth preparation, a function

that only the dentist can provide. Two types of tooth preparation must be performed to adequately prepare the mouth to receive the prosthesis. Interproximal access areas must be created between the abutment tooth and the adjacent tooth for the minor connector and the reciprocation plate. Adequate rests must be prepared on the abutment teeth for stability and vertical force transmission.

There are only four basic designs for all teeth configurations (Goodman,



Figure 2: The free-end saddle on one side, all tooth borne on the other side



Figure 3: Free-end tips always face the edentulous area

1989). These are:

- The single or double free-end saddle removable prosthesis, whether anterior or posterior saddles (Figure 1a and 1b)
- The free-end saddle on one side, all tooth borne on the other side (Figure 2)
- One edentulous area or two edentulous areas, all tooth borne. Free-end tips of the clasp always face the edentulous area (Figure 3)
- Three or more edentulous areas, all tooth borne. The free-end tips of the clasps always face the same direction (Figure 4).

Before I begin to describe how to design the 16 basic restorations which I feel represent most of the removable prostheses constructed today, the following terminology should be explained (Goodman, 1977):

E-clasp

This is a lingual back-action clasp which is fully reciprocated, vertically and horizontally. The 'E' stands for



Figure 4: The free-end tips always face the same direction

Equipoise (Figure 5).

I-Bar, T-Bar and Roach arm

These clasps are used for auxiliary retention. When the dentist feels there is insufficient undercut on the abutment tooth, this type of retainer is placed just below the survey line on the buccal surface of the abutment tooth. It is attached to the denture base and will move in the same direction as the denture base. It is always used with an E-clasp assembly (Figure 6).

Interproximal access area

This is a space that must be created by the dentist between the abutment tooth and the tooth adjacent to the abutment tooth (Goodman, 1997). It must be at least 1mm wide. The dentist should remove equally, in a vertical plane, at least 0.5mm from each tooth. A small 1mm diamond stone or carbide bur is used to make the interproximal access area (Figure 7).

After the interproximal plate is prepared and the final impression taken, it is of the

utmost importance to maintain the integrity of the space. Do not acid etch and do not place bonding material on the abutment tooth and the adjacent tooth. Place composite in the interproximal plate space and light cure it. The patient must be told to come back to the surgery if the composite falls out.

Occlusal rest

These rests must be at least 1mm deep and be prepared on each abutment tooth. They are always placed on the side of the tooth away from the edentulous area when used with an E-clasp. Rests on the anterior teeth (D, E) should have a 15° bevel (Figure 8a and 8b).

Please note: all the drawings which follow are generic. They are neither upper nor lower, but configurations of teeth in either the maxillary or mandibular arches.

DESIGN TYPE I (1)

This is the most difficult partial denture for most dentists to construct and for most patients

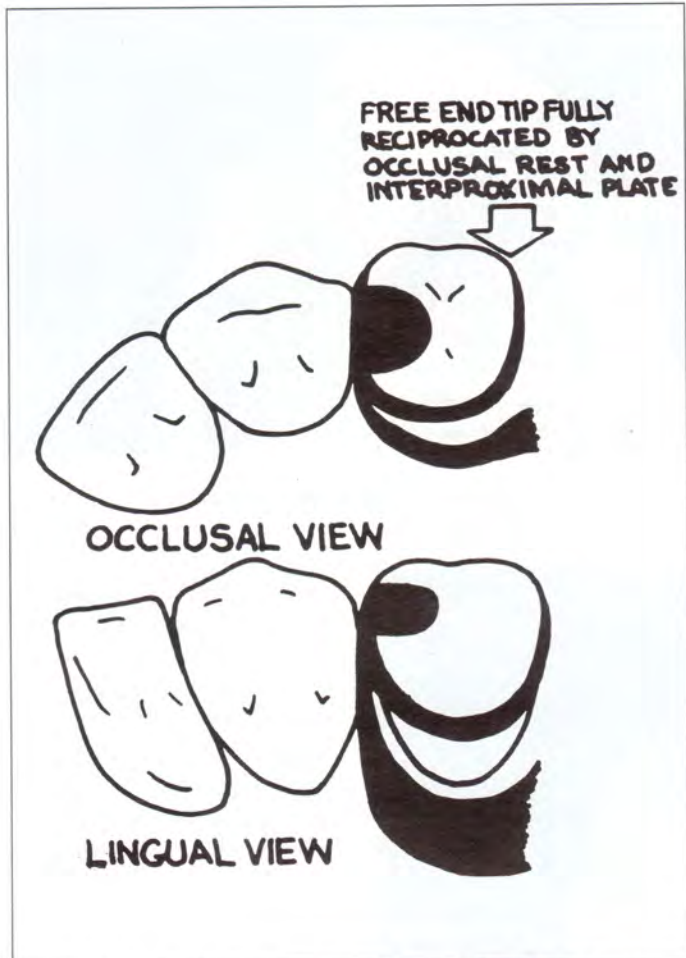


Figure 5: E-clasp – this is a lingual back-action clasp that is fully reciprocated, vertically and horizontally

to wear. When properly designed, this prosthesis will protect, preserve and strengthen the single abutment teeth and will be readily accepted by the patient. To ready the mouth for this prosthesis, the dentist must prepare two interproximal areas between the abutment tooth and the tooth adjacent to it (Figure 9). The access area must be at least 1mm wide, but no more than 1.5mm wide.

Two rest-seats are now prepared – one on each of the abutment teeth. These rests are always on the mesial occlusal surface of the abutment tooth

and are prepared with small barrel-shaped diamond stones. One option available is when cusps are used as abutments. A cingulum rest or incisal rest may be used on the mesial or mesial incisal sides of the cusps.

DESIGN TYPE I (2)

In my opinion, this is the most difficult of all removable partial dentures to design. Interproximal access areas are created between teeth four and five and two and three on the side opposite to the edentulous

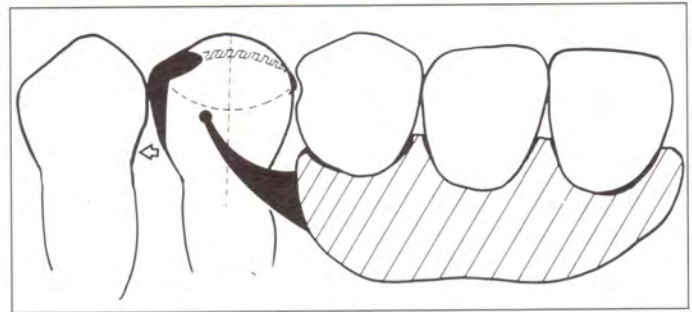


Figure 6: I-bar

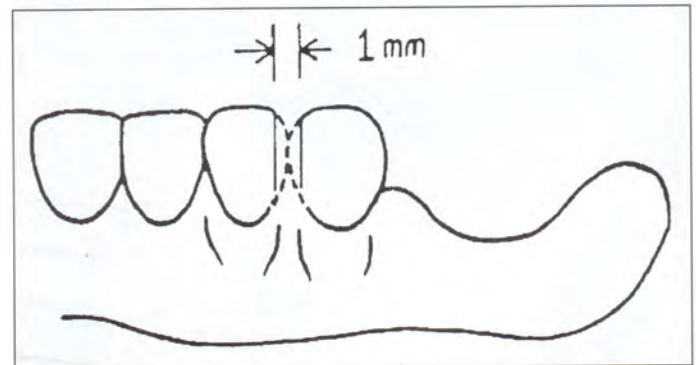


Figure 7: Interproximal access area. A one millimetre wide area created between the abutment tooth and the tooth adjacent to the abutment tooth

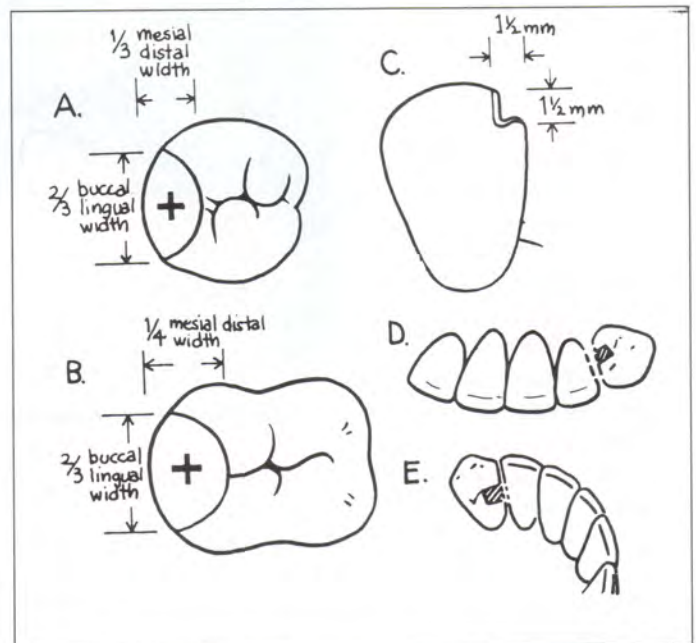


Figure 8a: Occlusal rest – molar, pre-molar and incisal rest

area. An occlusal rest is placed on the mesial of the abutment tooth on the edentulous side. Occlusal rests are also prepared on the mesial of five and the distal of four for stabilisation. Lingual reciprocation arms are placed on four and five. A clasp free-end tip is used for

retention on the buccal of five. An E-clasp is placed on the distal of three for retention of the denture base.

As an option (Figure 10), if the dentist feels greater stability and reciprocation are necessary, and that the patient can adjust to more metal in his



Figure 8b: Cingulum rest with 15° inward bevel

mouth, the interproximal access area is made between five and six and the same design followed as for four and five above.

DESIGN TYPE I (3)

This is a simple restoration to construct a prosthesis that the patient can readily use with minimum adjustments. Interproximal access areas are made between left two and three and right three and four (Figure 11). Prepared rests are made on the mesial of left three and right four to stabilise and reciprocate the E-clasp placed on the distal side of both abutments. Rests are now prepared on the mesial of right three and the mesial of left one. These rests will stabilise the anterior denture

base during function.

DESIGN TYPE I (4)

Unilateral posterior free-end denture base, with missing anterior teeth (Figure 12).

This is another of the more difficult prostheses to construct. The single abutment must be strong. The design shown is used when the single abutment is of average or below average strength. Interproximal access areas are prepared between right three and four and right five and six. Stabilising and reciprocating rests are made on the mesial of left four, the distal of right three, the mesial of right six, and the distal of right five. E-clasps for retention are positioned on the distal of left

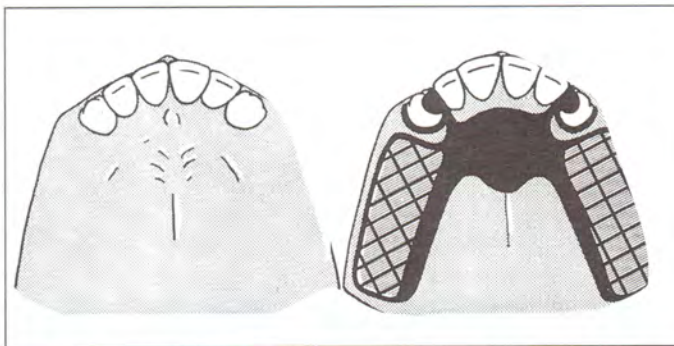


Figure 9: Double free-end denture base for upper or lower prosthesis

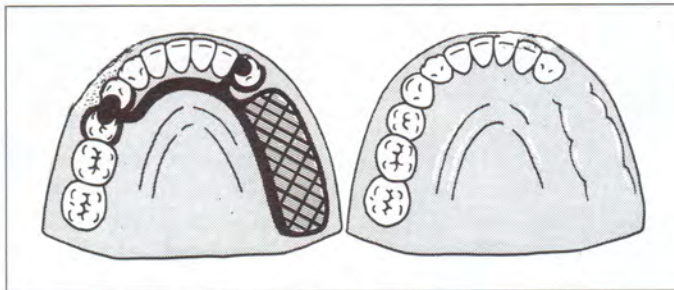


Figure 10: Unilateral free-end denture base option

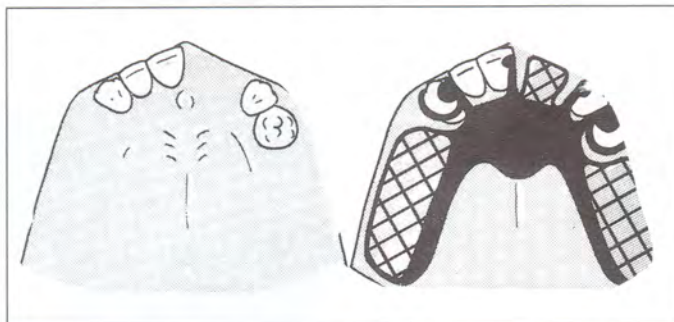


Figure 11: Double free-end denture base, with anterior missing teeth

four and the mesial of right three. Lingual arms for stability are made on right five and right six. Added retention and reciprocation is gained by the use of a buccal arm on right six.

As an option, when the single abutment left four is above average strength, the posterior units placed on right five and six may be eliminated.

DESIGN TYPE I (5)

Interproximal access areas are cut between right and left three and four (Figure 13). Occlusal rests are placed on the mesial of both first pre-molars. Cingulum rests are placed on the mesial of both cuspids to stabilise the anterior denture base. E-clasps for retention are placed on the distals of both first pre-molars.

As an option, for added

retention and stabilisation, an E-clasp may be placed on the mesial of one cuspid.

DESIGN TYPE I (6)

Usually only two or three teeth are present. This prosthesis is a must. It is easily fabricated and extremely successful, as the patient will adjust to this well-balanced and highly functional appliance. A removable prosthesis is not the means to an end, but should be the end itself. A dentist who extracts sound teeth sentences his patient to a full upper or lower denture and does his patient an extreme disservice.

Cingulum or mesial occlusal rests are prepared (Figure 14). Two E-clasps are then constructed just below the survey line on the distal of the

abutment teeth. Usually this is all the retention needed. During function, all forces will be directed vertically along the long axis of the abutment teeth by the distal denture bases.

If added retention is necessary, I-bars can be placed on the mesial buccal surface of the abutment tooth below the survey line.

The retentive device must

relax away from the undercut area during function, thereby eliminating any lever action on the abutment tooth.

Maximum function for the patient must be assured. A removable prosthesis, while protecting, preserving and strengthening the abutment tooth must also function as similar to the natural dentition as possible. Porcelain teeth or

high density resin teeth should be used.

A successful prosthesis must reflect our maximum aesthetic values, the 'natural look'.

DESIGN TYPE I (7)

This is a very common prosthesis. It is easy to construct and extremely aesthetic. This type of prosthesis is indicated when a fixed denture cannot be constructed. Interproximal access areas are cut between five and six and four and five on both sides of the arch for stabilisation and reciprocation. Rests are now prepared on the distal occlusal of four and five on both sides of the arch. Two E-clasps for retention are placed just below the undercut on the mesial of both fours (Figure 15).

As an option, in cases with strong large fours as abutment teeth, we may eliminate the interproximal access area and rests placed between five and six. Access areas need only be cut between four and five on both sides of the arch.

DESIGN TYPE I (8)

Interproximal access areas are cut between four and five (Figure 16). Occlusal rests are placed on the distal surfaces of right four and left four and the distal lingual of left two. Three E-clasps are used for retention and are placed on the mesial surface of each abutment tooth. Once again, all E-clasps face the same direction so that during function they are completely relaxed away from the abutment teeth and all forces are directed along the long axis of the

abutment teeth.

DESIGN TYPE I (9)

An interproximal access area is cut between left six and left seven. Occlusal rests are placed on the distal occlusal surfaces of the abutment teeth, left six, right three and right seven. Three E-clasps used for retention are placed just below the survey line on the abutment teeth. Notice that all E-clasps face the edentulous areas and, when possible, are placed in the same direction (Figure 17).

If the dentist feels that the right posterior denture base will get the greatest amount of stress during mastication or function tooth, right three will then have a mesial rest with a distal E-clasp. When designed in this manner the design is Type II as below.

DESIGN TYPE II (10)

Interproximal access areas are created between two and three on the left side of the arch and three and four on the right side of the arch (Figure 18). Three E-clasps are used for retention and are placed on the mesial of the left seven, the distal of left three and the distal of right four. Rests are prepared on the distal of left seven, mesial of right four and the mesial of left three, and are used for stability and reciprocation. Rests are placed on the mesial of left two and the mesial of right two, in order to stabilise the anterior denture base during function.

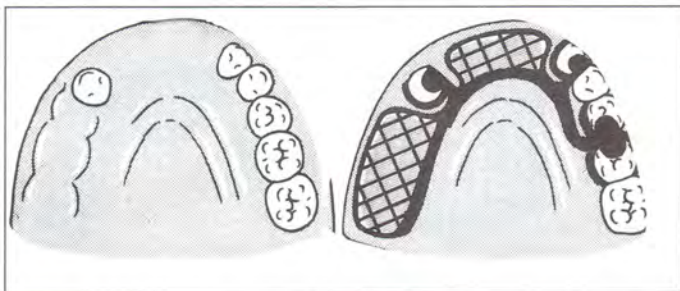


Figure 12: Unilateral posterior free-end denture base, with missing anterior teeth

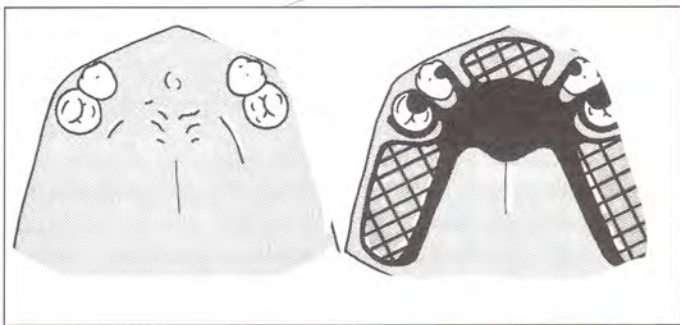


Figure 13: Double free-end posterior denture base with large anterior denture base

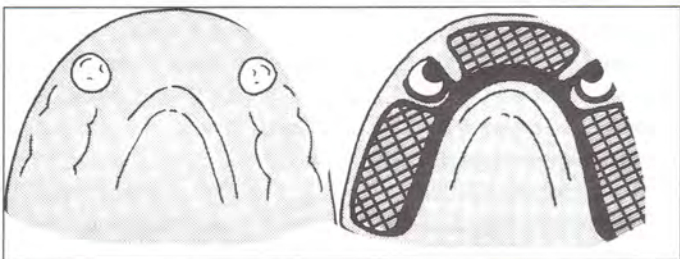


Figure 14: Double free-end denture base with anterior missing teeth

DESIGN TYPE II (11)

This is a simple prosthesis for the dentist to construct and a simple denture for the patient to wear. Interproximal access areas are prepared between the left three and four and the right three and four. Rest seats are made on the mesial occlusal of left and right first premolars. A rest seat is also prepared on the distal of right seven. E-clasps are used for retention and are placed just below the undercuts on the distal of left four and right four and the mesial of right seven (Figure 19).

DESIGN TYPE III (12)

The Nesbit (Figure 20) is a small prosthesis used to replace one, two or three missing teeth on one side of the arch. This type of prosthesis should be made only when patient economics warrants it, or if health problems prevent the dentist from making a fixed prosthesis. Interproximal access areas of at least one millimetre are created between left two and left three and the posterior abutment, and the adjacent tooth, if such a tooth is present. A distal rest is placed on the occlusal of left seven and on the mesial of left three. Two E-clasps for retention are placed just below the survey line on the abutment teeth next to the edentulous area. For additional retention and stability, an I-bar should be placed on the posterior abutment.

DESIGN TYPE III (13)

Interproximal access areas are prepared between two and three

on both sides of the arch (Figure 21). Cingulum or incisal rests are prepared on the mesial surface of both cuspids, while distal occlusal rests are prepared on both second molars. E-clasps for retention are placed on the distal of the cuspids and the mesial of the second molars. During function, these clasps will tend to move gingivally away from the undercut area of the abutment teeth, thereby directing all forces via the prepared rests along the long axis of the abutment teeth.

DESIGN TYPE IV (14)

An interproximal access area is cut between left four and left five. Occlusal rests are now prepared on the distal occlusal surfaces of the three abutment teeth, left four, right four and right seven. Stabilising rests are prepared on the distal lingual cingulum of right one and left one to stabilise the anterior denture bases. Most prostheses with random missing teeth need only three E-clasps for retention. These E-clasps are placed next to the edentulous areas just under the height of contour on the mesial surfaces of left four, right four and right seven (Figure 22).

DESIGN TYPE IV (15)

Four abutments are used (Figure 23). Occlusal rests are placed on the distal occlusal surfaces of right and left seven and right and left three. Four E-clasps for retention are placed below the undercuts on the mesial of the four abutment teeth. Designed in this manner,

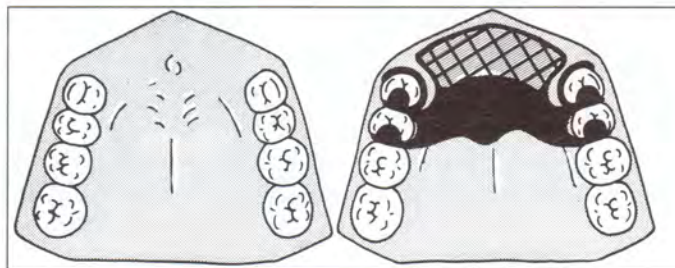


Figure 15: Anterior denture base with no missing posterior teeth

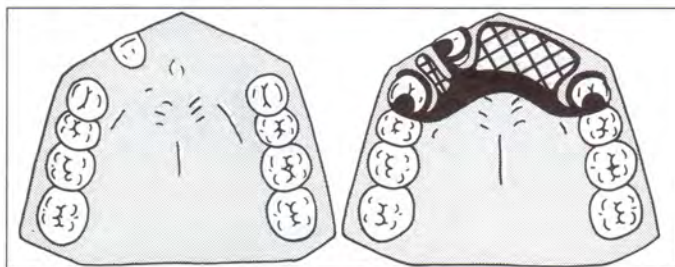


Figure 16: Anterior denture base with random missing teeth

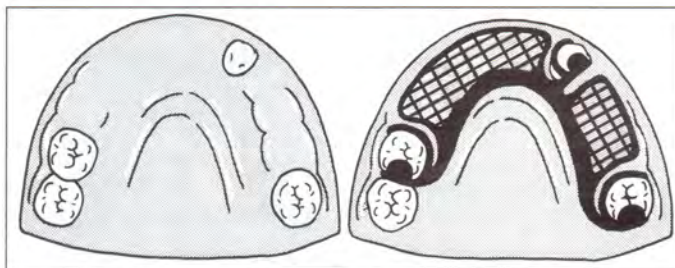


Figure 17: Large anterior denture base with one large posterior denture base

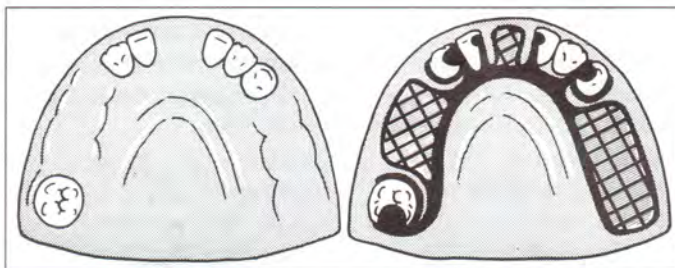


Figure 18: Unilateral posterior denture base with anterior and posterior missing teeth

all E-clasps face the same direction, so that during function they will relax away from the undercuts of the abutment teeth, and in this fashion all forces will be directed along the long axis of the teeth.

If one of the molars is doubtful the E-clasps on the anterior abutment teeth are reversed. They will now have mesial rest, mesial plate with distal E-clasps and the design will be changed from a Type IV to a Type III.

DESIGN TYPE IV (16)

This type of removable prosthesis should only be constructed when a fixed prosthesis cannot be constructed. An interproximal access area is cut between right six and right seven. Occlusal rests are prepared on the distal of the four abutment teeth; left seven, left four, right four and right six. Stabilising rests for small anterior denture bases are placed on the distal cingulum of right two and the mesial cingulum of left two (Figure 24).

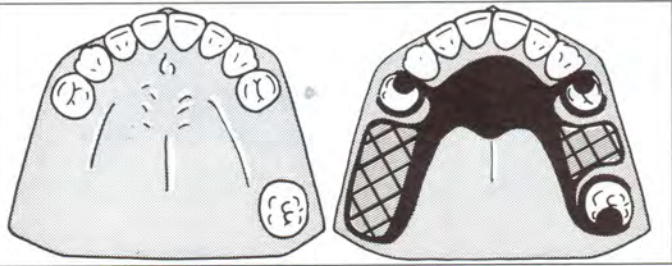


Figure 19: Posterior unilateral denture base with missing teeth on the opposite arch

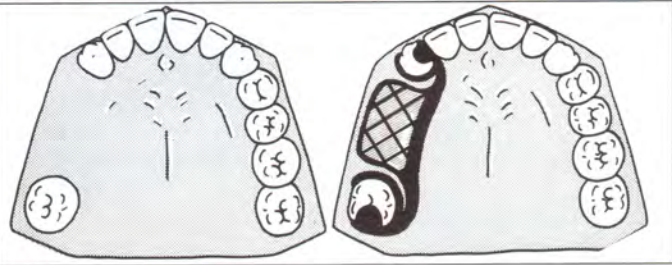


Figure 20: The Nesbit

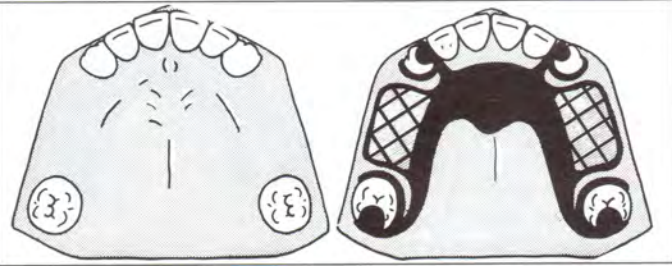


Figure 21: Large posterior denture bases with no missing random teeth

SUMMARY

This article shows the simplicity of the Equipoise balance of force system. No matter what the configuration of teeth, all removable partial dentures, when designed, will fall into one of the four design types. The most important rule to remember is that all free-end tips must be relaxed and away from the undercuts during function. When anterior and posterior edentulous areas are present, the free-end tips must be placed next to the edentulous area that receives the greatest amount of function.

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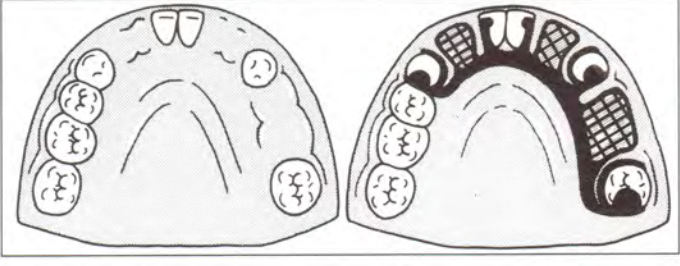


Figure 22: No free-end denture bases but anterior and posterior missing teeth

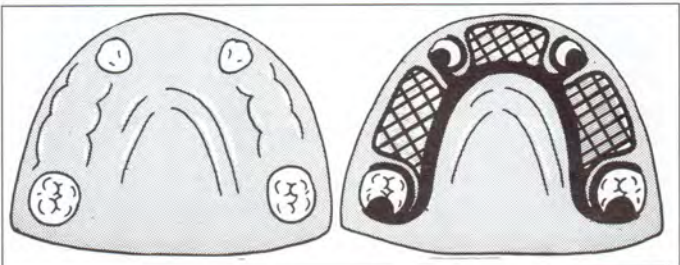


Figure 23: Large posterior denture bases with large anterior denture base

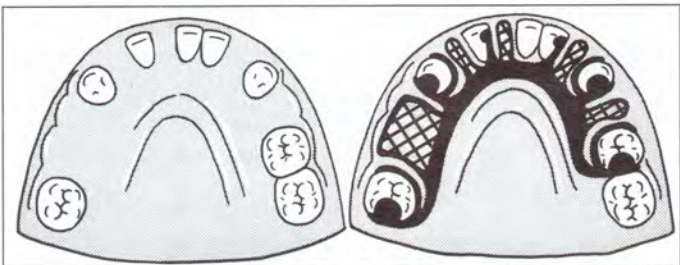


Figure 24: Random missing teeth throughout the arch

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