

Principles of removable partial denture design

The supporting structures for removable partial dentures (abutment teeth and residual ridges) are living things and are subjected to forces. The ability of living things to tolerate force is dependent upon the magnitude or intensity of the forces.

The forces occurring through the removable partial denture can be widely *distributed*, *directed*, and *minimized* by the selection, the design and the location of components of removable partial denture and by developing a harmonious occlusion.

Types of partial dentures

1. Removable partial denture, which includes the cobalt chromium and acrylic removable partial denture.
2. Fixed partial denture.
3. Implant supported partial denture, this could be fixed (implant retained partial denture) or removable (implant support partial denture).

General principle

1. Utilize what is present.

Whenever possible, select a design that fits the teeth and soft tissues, rather than choosing one that requires tissue alteration. The goal is to avoid gross, unnecessary preparations.

2. Minimize the framework elements.

Whenever possible, the fewest number of minor connectors should be used. This decreases the potential for plaque adhesion.

3. Plan for future.

Planning for the future might involve designing castings with rest seats and guiding planes so they may subsequently be used as partial denture abutments, if required in the future.

4. Consider caries susceptibility.

Cast clasps cover more tooth surface than wrought clasps. The latter would be preferred if caries incidence is higher than usual.

5. Avoid placing rest seats or guiding planes on direct restorations such as amalgam.

It is better to redesigning the partial denture to avoid these restorations (*have high creep values and low yield strength*) or to replace the restorations with onlays or crowns.

6. Never design any removable partial denture without surveying.

Factors influencing the design of removable partial denture:

1. Which arch, is needed to be restored: because each arch may have certain criteria indicates specific design, and if both arches are needed to be restored, the relationship between maxillary and mandibular arches in removable partial denture designing and construction may consider:

- Inter-ridge space as well as space available for missing teeth restoration.
- Orientation of occlusal plane.
- Occlusal relationship of remaining teeth.
- Arch integrity.
- Tooth morphology.

2. Type of support: cases supported entirely by teeth are differ than cases with tooth-tissue support, if one or more distal extension bases are involved, the following must be considered:

- Type of secondary impression material and technique.
- Clasp design that will best minimize the forces applied to the abutment teeth during function.
- Need for indirect retention.
- Need for later relining or rebasing, which influence the type of base material used.

3. Abutment teeth: selection and modifications required (simple grinding to more complicated restorations or splinting). This may affect the clasp design and type.

Considerations in abutment teeth selection are:

- Tooth number and location in the arch relative to edentulous spaces.
- Periodontal health.
- Crown and root morphology.
- Crown to root ratio.
- Bone support (tooth response to stress (index area)).
- Opposing dentition relationship of the tooth to the other supporting unites (length of the edentulous span).

4. Type of major connector indicated.

5. Materials to be used for the framework and for the bases.

6. Type of artificial teeth to be used, this may have influenced by the opposing teeth. In general, removable partial dentures opposing natural teeth will require

greater support and stabilization over time because of the greater functional load demands. Therefore, occlusal relationships at maximum intercuspation should be broadly dissipated to the supporting units.

7. Patient past dental history and his experience with removable partial denture and the reasons for making a new one, e.g. if patient was objectionable for an anterior palatal bar because bulky, location or tissue irritation, another major connector could be used and located more posteriorly.

8. Using of other types of treatment modalities to restore missing tooth as replacing of single missed anterior teeth by fixed restoration or benefits from implant to simplify the removable partial denture design.

9. Response of oral structures to previous stress.

Different between the removable partial denture and fixed partial denture:

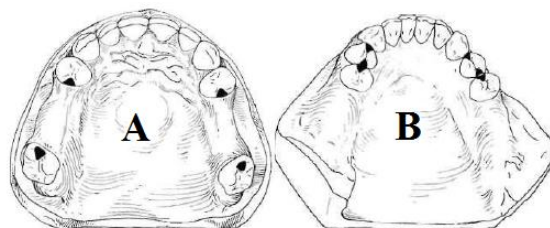
1. Fixed partial denture does not move in function, this mean that the fixed partial denture is cemented to the prepared abutment teeth not supported by clasp as in removable partial denture that the patient can easily insert and remove the removable partial denture in mouth.
2. Occlusal forces are usually directed down the long axes of the teeth in fixed partial denture since it also cemented to the abutment teeth so it considered to as a part of the natural tooth.

Differentiation between two main types of removable partial denture (Differentiation between tooth supported and tooth - tissue supported removable partial denture):

Certain points of difference are present between the Kennedy Class I and Class II types of partial dentures on the one hand and the Class III type of partial denture on the other.

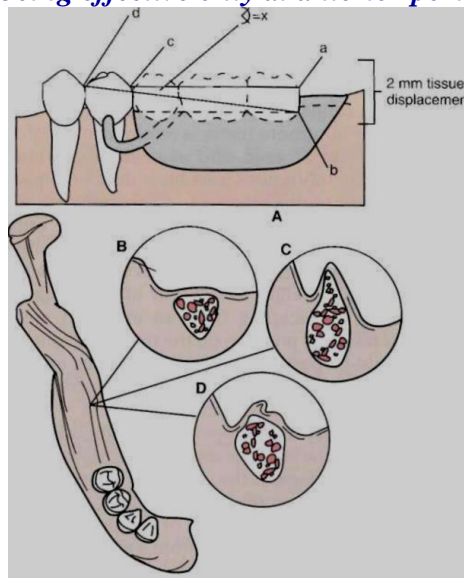
1. Differences in the manner in which each is supported.

The Class I type and the distal extension side of the Class II type derive their primary support from the tissue underlying the base and secondary support from the abutment teeth.



(A) Kennedy Class III, mod 1, partially edentulous arch, which provides total tooth support for prosthesis. Removable partial denture made for this arch is totally supported by rests on

properly prepared occlusal rest seats on four abutment teeth. (B) Kennedy Class I partially edentulous arch. Major support for denture bases must come from residual ridges, tooth support from occlusal rests being effective only at anterior portion of each base.



(A) The longer the edentulous area covered by the denture base, the greater the potential lever action on the abutment teeth. If extension base area is 30 mm (ac) and tissue displacement is 2 mm (ab), the amount of movement of the proximal plate on the guiding plane will be approximately 0.25 mm, (B) Flat ridge will provide good support, poor stability, (C) Sharp spiny ridge will provide poor support, poor to fair stability, (D) Displaceable tissue on ridge will provide poor support and poor stability.

2. Differences in the method of impression registration and jaw record require.

An impression registration for the fabrication of a partial denture must fulfill the following two requirements:

- **The anatomic form** and the relationship of the remaining teeth in the dental arch and the surrounding soft tissue must be recorded accurately so that the denture will not exert pressure on those structures beyond their physiological limits. The elastic impression materials, such as irreversible hydrocolloid (alginate), mercaptan rubber base (Thiokol), silicone impression materials (both condensation and addition reaction), and the polyethers are best suited for this purpose.
- **The supporting form** of the soft tissue underlying the distal extension base of the partial denture should be recorded so that firm areas are used as primary stress-bearing areas and readily displaceable tissues are not overloaded. An impression material capable of displacing tissue sufficiently to register the supporting form of the ridge will fulfill this second requirement.

No single impression material can satisfactorily fulfill both of the previously mentioned requirements.

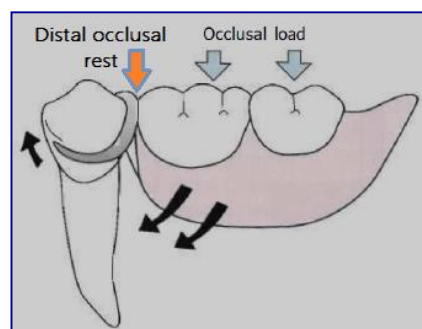
3. Differences in the need for indirect retention exist in the distal extension type of partial denture, whereas in the tooth-supported (Class III) there is no extension base to lift away from the supporting tissue, because a direct retainer on an abutment tooth secures each end of each denture base.

4. Differences in the type of the base material that can be relined to compensate for tissue changes. Acrylic resin is generally used as a base material for distal extension bases. The Class III partial denture, on the other hand, metal bases therefore are more frequently used in tooth supported restorations, since relining is not as likely to be necessary with them.

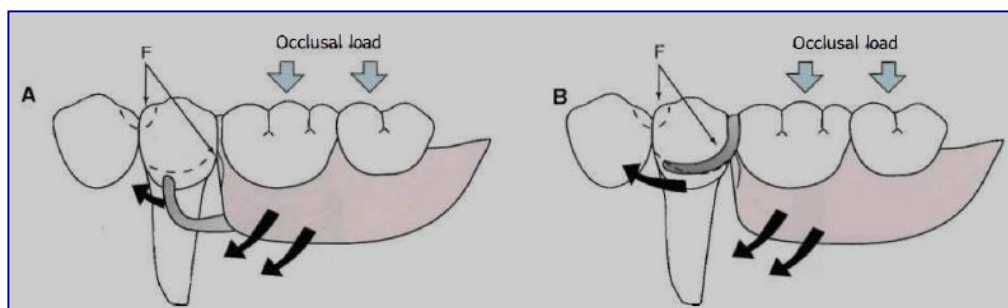
5. Differences in Clasp Design

- **The tooth-supported partial denture** is retained and stabilized by a clasp at each end of each edentulous space. Cast retentive arms are generally used for this purpose. These may be either circumferential or bar clasp.

- **In the tooth-tissue supported removable partial dentures**, because of the anticipated functional movement of the distal extension base, the direct retainer adjacent to the distal extension base must be able to flex sufficiently to dissipate stresses that otherwise would be transmitted directly to the abutment tooth as leverage, in addition to that of resisting vertical displacement. A retentive clasp arm made of wrought wire can flex more readily in all directions than can the cast half-round clasp arm. Thereby, it may more effectively dissipate those stresses (combination clasp), or R.P.I. system, or stress breaker may be used.



Design with a distal occlusal rest and wrought wire retentive clasp



Design with mesial occlusal rest and cast retentive arm

Essentials of partial denture design

Design of the partial denture framework should be systematically developed and outlined on an accurate diagnostic cast based on the following prosthesis concepts:

1. Where the prosthesis is supported.

In an entirely tooth-supported partial denture, the most ideal location for the support units (rests) is in prepared rest seats on abutment teeth. In a tooth-tissue supported partial denture, attention to these same considerations must be given to the abutment teeth. However, equitable support must come from the edentulous ridge areas.

2. How the support is connected?

Connect the tooth and tissue support units. Designing and locating major and minor connectors.

3. How the prosthesis is retained?

The retention must be sufficient to resist reasonable dislodging forces. Retention is accomplished by mechanical retaining elements (clasps) being placed on the abutment teeth.

The key to selecting a successful clasp design for any given situation is to choose one that will:

- Avoid direct transmission of tipping or torquing forces to the abutment.
- A clasp design with correctly positioned component parts on abutment tooth surfaces.
- Provide retention against dislodging forces.
- Compatible tissue contour and esthetic desires of the patient.
- Location of the undercut is the most important single factor in selection of a clasp.

4. How the retention and support are connected?

If direct and indirect retainers are to function as designed, each must be rigidly attached to the major connector.

5. How the edentulous base support is connected?

It is necessary to ensure rigidity of the base material without interfering with tooth placement.