Principles of Removable Partial Denture Design

Difference in Prosthesis Support and Influence on Design:
For a tooth-supported prosthesis, the movement potential is less because resistance to functional loading is provided by the teeth. Teeth do not vary widely in their ability to provide this support; thus, designs for prostheses are less variable. For a tooth-tissue–supported prosthesis, the residual ridge presents with variable potential for support. The underlying alveolar bone demonstrate a highly variable form following extraction and it continues to change with time. In addition, the overlying connective tissue and mucosa undergo change that places the soft tissue at risk for pressure-induced inflammatory changes. This variable tissue support potential adds complexity to design considerations.

Differentiation between Two Main Types of Removable Partial Dentures
Certain points of difference are present between 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.

The first consideration is 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 tissues underlying the base and secondary support from the abutment teeth. The Class III type derives all of its support from the abutment teeth.

Second, the method of impression registration and the jaw record required

Third, the need for some kind of indirect retention exists in the distal extension type of partial denture, whereas in the tooth-supported, Class III type, no extension base is present to lift away from the supporting tissues because of the action of sticky
foods and the movements of tissues of the mouth against the borders of the denture. This is so because each end of each denture base is secured by a direct retainer on an abutment tooth. Therefore, the tooth-supported partial denture does not rotate about a fulcrum, as does the distal extension partial denture.

*Fourth,* the manner in which the distal extension type of partial denture is supported often necessitates the use of a 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, which is entirely tooth supported, does not require relining except when it is advisable to eliminate an unhygienic, unesthetic, or uncomfortable condition resulting from loss of tissue contact. Metal bases therefore are more frequently used in tooth-supported restorations, because relining is not as likely to be necessary with them.

**Differences in Support**

The distal extension partial denture derives its major support from the residual ridge with its fibrous connective tissue covering. The length and contour of the residual ridge significantly influence the amount of available support and stability. Some areas of this residual ridge are firm, with limited displaceability, whereas other areas are displaceable, depending on the thickness and structural character of the tissues overlying the residual alveolar bone. The movement of the base under function determines the occlusal efficiency of the partial denture and also the degree to which the abutment teeth are subjected to torque and tipping stresses.

In evaluating the potential support that an abutment tooth can provide, consideration should be given to:

1. periodontal health; 2. crown and root morphologies; 3. crown-to-root ratio; 4. bone index area (how tooth has responded to previous stress); 5. location of the
tooth in the arch; (6) relationship of the tooth to other support units (length of edentulous span); and (7) the opposing dentition.

In a tooth and 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.

In evaluating the potential support available from edentulous ridge areas, consideration must be given to (1) the quality of the residual ridge, which includes contour and quality of the supporting bone (how the bone has responded to previous stress) and quality of the supporting mucosa; (2) the extent to which the residual ridge will be covered by the denture base; (3) the type and accuracy of the impression registration; (4) the accuracy of the denture base; (5) the design characteristics of the component parts of the partial denture framework; and (6) the anticipated occlusal load.

The amount of stress transferred to the supporting edentulous ridge(s) and the abutment teeth will depend on:

1. The direction and magnitude of the force
2. The length of the denture base
3. The quality of resistance (support from the edentulous ridges and remaining natural teeth)
4. The design characteristics of the partial denture.

**Differences in Impression Registration**

An impression registration for the fabrication of a partial denture must fulfill the following two requirements:
1. **The anatomic form** and the relationship of the remaining teeth in the dental arch, as well as the surrounding soft tissues, must be recorded accurately so the denture will not exert pressure on those structures beyond their physiologic limits. A type of impression material that can be removed from undercut areas without permanent distortion must be used to fulfill this requirement. Elastic impression materials such as irreversible hydrocolloid (alginate), rubber base, silicone impression material, and the polyethers are best suited for this purpose.

2. **The supporting form** of the soft tissues underlying the distal extension base of the partial denture should be recorded so firm areas are used as primary stress–bearing areas and readily displaceable tissues are not overloaded. Only in this way can maximum support of the partial denture base be obtained. An impression material capable of displacing tissue sufficiently to register the supporting form of the ridge will fulfill this second requirement. A fluid mouth-temperature wax, rubber base, the silicones, Zinc oxide–eugenol impression paste or the polyethers may be employed for registering the supporting form.

Three factors must be considered in the acceptance of an impression technique for distal extension removable partial dentures: (1) the material should record the tissues covering the primary stress–bearing areas in their supporting form; (2) tissues within the basal seat area other than primary stress–bearing areas must be recorded in their anatomic form; and (3) the total area covered by the impression should be sufficient to distribute the load over as large an area as can be tolerated by the border tissues.

**Differences in Clasp Design**

The tooth-supported partial denture, which is totally supported by abutment teeth, is retained and stabilized by a clasp at each end of each edentulous space. Because this type of prosthesis does not move under function (other than within the physiologic
limitations of tooth support units), the only requirement for such clasps is that they flex sufficiently during placement and removal of the denture to pass over the height of contour of the teeth in approaching or escaping from an undercut area. While in its terminal position on the tooth, a retentive clasp should be passive and should not flex except when one is engaging the undercut area of the tooth for resisting a vertical dislodging force. (Circumferential and like clasps)

In tooth-tissue supported RPD (class I and II), because of the expected functional movement of the distal extension base, the direct retainer adjacent to the distal extension base must perform still another function, in addition to resisting vertical displacement, It must be able to flex sufficiently to dissipate stresses that may be transmitted directly to the abutment tooth as leverage. (Combination clasp can be used instead of circumferential clasp)

The key to selecting a successful clasp design for any given situation is to choose one that will (1) avoid direct transmission of tipping or torquing forces to the abutment; (2) accommodate the basic principles of clasp design by definitive location of component parts correctly positioned on abutment tooth surfaces; (3) provide retention against reasonable dislodging forces (with consideration for indirect retention); and (4) be compatible with undercut location, tissue contour, and esthetic desires of the patient.

**Guiding Plane**

guiding plane can be define as two or more parallel, vertical surfaces of abutment teeth, so shaped to direct a prosthesis during placement and removal. After the most favorable path of placement has been determined, axial surfaces of abutment teeth are prepared parallel to the path of placement, and therefore become parallel to each other. Guiding planes may be contacted by various components of the
partial denture—the body of an extracoronal direct retainer, the stabilizing arm of a direct retainer, the minor connector portion of an indirect retainer—or by a minor connector specifically designed to contact the guiding plane surface.

*The functions of guiding plane surfaces are as follows:*

1. To provide for one path of placement and removal of the restoration (removal);
2. To ensure the planned actions of reciprocal, stabilizing, and retentive components
3. To eliminate gross food traps between abutment teeth and components of the denture.