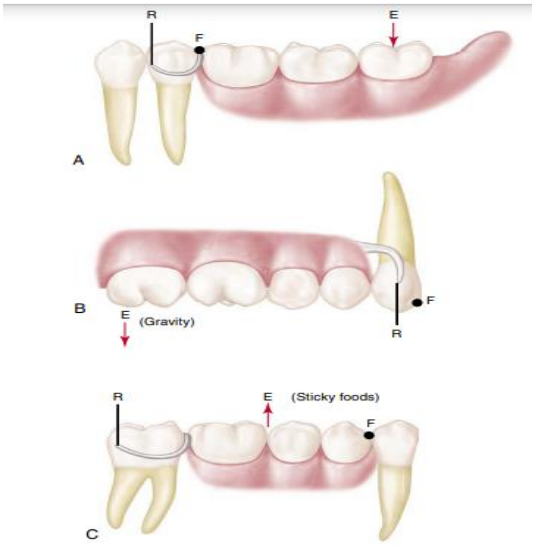
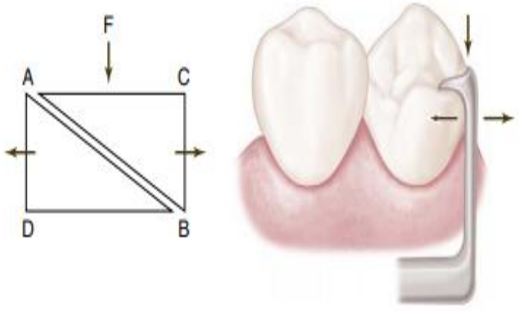
Lever (Fulcrum) Movement of Partial Denture

In its simplest form, a lever is a rigid bar supported somewhere along its length. It may rest on the support or may be supported from above. The support point of the lever is called the fulcrum, and the lever can move around the fulcrum.



A-C, The three classes of levers. Classification is based on location of the fulcrum *(F)*, resistance *(R)*, and direction of effort (force) *(E)*. In dental terms, *E* can represent the force of occlusion or gravity; *F* can be a tooth surface such as an occlusal rest; and *R* is the resistance provided by a direct retainer or a guide plane surface.

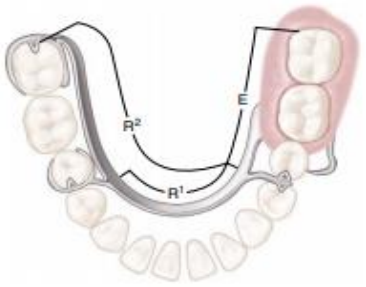


The result of force applied to an inclined plane when the floor of the occlusal rest preparation inclines apically toward the marginal ridge of the abutment tooth. *F*, Occlusal force applied to the abutment tooth. *AB*, Relationship of the occlusal rest to the abutment tooth when the angle is greater than 90 degrees. *ABC*, Removable partial denture framework. *ABD*, Abutment tooth.

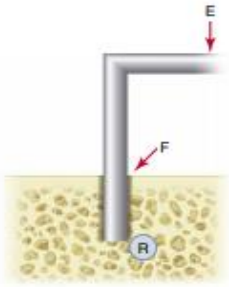
The rotational movement of an extension base type of removable partial denture, when a force is placed on the denture base, is illustrated in Figure 4-3. It will rotate in relation to the three cranial planes because of differences in the support characteristics of the abutment teeth and the soft tissue covering the residual ridge. Even though the actual movement of the denture may be small, a lever force may be imposed on abutment teeth. This is especially detrimental when prosthesis maintenance is neglected. Three types of levers are used: first, second, and third class.

A cantilever is a beam supported at one end that can act as a first-class lever. A cantilever design should be avoided. Examples of other lever designs and suggestions for alternative designs to avoid or minimize their destructive. The most efficient means of addressing the potential effects of a lever is to provide a rigid element at the unsupported end to disallow movement. This is the most

beneficial use of dental implants in conjunction with removable partial dentures (RPDs) and should be considered when support capacity for a distal extension is considered significantly poor.



The length of a lever from fulcrum *(F)* (see Figure) to resistance *(R)* is called the *resistance arm*. That portion of a lever from the fulcrum to the point of application of force *(E)* is called the *effort arm*. Whenever the effort arm is longer than the resistance arm, mechanical advantage favors the effort arm, proportionately to the difference in length of the two arms. In other words, when the effort arm is twice the length of the resistance arm, a 25-lb weight on the effort arm will balance a 50-lb weight at the end of the resistance arm. The opposite is also true and helps illustrate cross-arch stabilization. When the resistance arm is lengthened (cross-arch clasp assembly placed on a second molar (R2) versus a second premolar [R1]), the effort arm is more efficiently counteracted.



A cantilever can be described as a rigid beam supported only at one end. When force is directed against the unsupported end of the beam (as in this rest placed on a cantilevered pontic), the cantilever can act as a first-class lever. The mechanical advantage in this illustration favors the effort arm.

Possible Movements of Partial Dentures

If it is presumed that direct retainers are functioning to minimize vertical displacement, rotational movement will occur about some axis as the distal extension base or bases move toward, away, or horizontally across the underlying tissue. Unfortunately, these possible movements do not occur singularly or independently but tend to be dynamic, and all occur at the same time. The greatest movement possible is found in the tooth-tissue–supported prosthesis because of reliance on the distal extension supporting tissue to share the functional loads with the teeth. Movement of a distal extension base toward the ridge tissue will be proportionate to the quality of that tissue, the accuracy and extent of the denture base, and the applied total functional load. A review of prosthesis rotational movement that is possible around various

axes in the mouth provides some understanding of how component parts of removable partial dentures should be prescribed to control prosthesis movement.

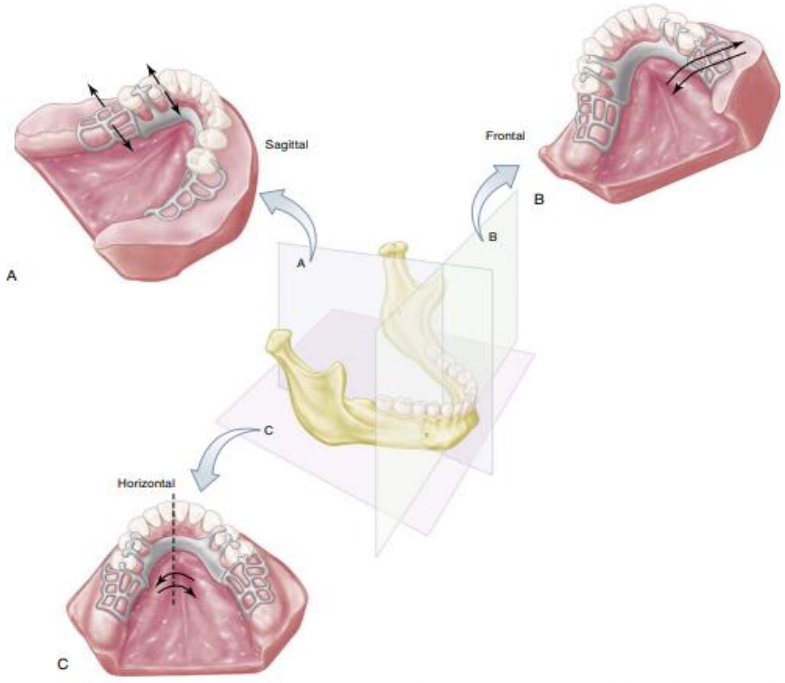
A. First movement is rotation about an axis through the most posterior abutments. This axis may pass through occlusal rests or any other rigid portion of a direct retainer assembly located occlusally or incisally to the height of contour of the primary abutments. This axis, known as the fulcrum line, is the center of rotation as the distal extension base moves toward the supporting tissue when an occlusal load is applied. The axis of rotation may shift toward more anteriorly placed components, occlusal or incisal to the height of contour of the abutment, as the base moves away from the supporting tissue when vertical dislodging forces act on the partial denture. These dislodging forces result from the vertical pull of food between opposing tooth surfaces, the effects of moving border tissue, and the forces of gravity against a maxillary partial denture. If it is presumed that, the direct retainers are functional and that the supportive anterior components remain seated, rotation—rather than total displacement—should occur. Vertical tissue-ward movement of the denture base is resisted by the tissue of the residual ridge in proportion to the supporting quality of that tissue, the accuracy of the fit of the denture base, and the total amount of occlusal load applied. Movement of the base in the opposite direction is resisted by the action of the retentive clasp arms on terminal abutments and the action of stabilizing minor connectors in conjunction with seated, vertical support elements of the framework anterior to the terminal abutments acting as indirect retainers. Indirect retainers should be placed as far as possible from the distal extension base, affording the best possible leverage against lifting of the distal extension base.

B. A second movement is rotation about a longitudinal axis as the distal extension base moves in a rotary direction about the residual ridge. This movement is resisted primarily by the rigidity of the major and minor connectors and their ability to resist torque. If the connectors are not rigid, or if a stress-breaker exists between the distal extension base and the major

connector, this rotation about a longitudinal axis applies undue stress to the sides of the supporting ridge or causes horizontal shifting of the denture base.

C. A third movement is rotation about an imaginary vertical axis located near the center of the dental arch. This movement occurs under function because diagonal and horizontal occlusal forces are brought to bear on the partial denture. It is resisted by stabilizing components, such as reciprocal clasp arms and minor connectors that are in contact with vertical tooth surfaces. Such stabilizing components are essential to any partial denture design, regardless of the manner of support and the type of direct retention employed. Stabilizing components on one side of the arch act to stabilize the partial denture against horizontal forces applied from the opposite side. It is obvious that rigid connectors must be used to make this effect possible.

In a tooth-supported partial denture, primarily the rests on the abutment teeth and to some degree prevent movement of the base toward the edentulous ridge by any rigid portion of the framework located occlusal to the height of contour. Movement away from the edentulous ridge is prevented by the action of direct retainers on the abutments that are situated at each end of each edentulous space and by the rigid, minor connector stabilizing components.



Distal extension removable partial dentures will rotate when force is directed on the denture base. Differences in displaceability of the periodontal ligament of the supporting abutment teeth and soft tissue covering the residual ridge permit this rotation. It would seem that rotation of the prosthesis occurs in a combination of directions rather than in a unidirectional way. The three possible movements of distal extension partial dentures are **(A)** rotation around a fulcrum line passing through the most posterior abutments when the denture base moves vertically toward or away from the supporting residual ridges; **(B)** rotation around a longitudinal axis formed by the crest of the residual ridge; and **(C)** rotation around a vertical axis located near the center of the arch.