Rotational Path Removable Partial Dentures: Part 2. Replacement of Anterior Teeth

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The first article in this series discussed the rotational path concept for replacing missing posterior teeth. In Part 2, the concept is applied to the replacement of missing anterior teeth using the anteroposterior (AP) rotational or dual path of placement. The anterior portion of the prosthesis is first placed along a straight path to gain access to tooth surfaces that provide the necessary undercuts after the partial denture is rotated into its final position. The most critical factors are the development of adequate cingulum rest seats to prevent migration of the abutment teeth and maintain intimate contact between the tooth and the rigid retentive components. *Int J Prosthodont 1988; 1:135–142.*

Part 1 of this series presented the history of the development of the rotational path concept as currently applied to the design of removable partial dentures. It also discussed the essential differences between the conventional straight path of placement and the rotational path, and described the two categories of rotational path designs.

The rotational path design replaces conventional clasps with rigid retentive units. Typically, each unit consists of a rest and its retentive component. The retentive component may be a minor connector, generally used on posterior teeth, or an extension from the minor connector, generally used on anterior teeth (Fig 1). The rigid retentive components are placed or rotated into undercuts and maintained in intimate contact with the tooth by modified rests and other conventional clasps. (The reader is encouraged to review Part 1, which discusses the rotational path concept in greater detail.[1])

Rotational Path Designs

There are two categories of rotational path designs based on the location of the framework rotational centers and their most appropriate clinical applications. Category I designs are primarily used to replace missing posterior teeth. The rotational centers of the framework are located at the ends of the long rests of the rigid retainers. The rotational centers on each side of the arch determine the axis of rotation for final placement. The rotational centers are seated first, then the entire prosthesis is rotated into place (Figs 2a and 2b). Category II designs are used primarily to replace missing anterior teeth. Their rotational centers are located gingivally as rigid extensions of the minor connectors. The portion of the removable partial denture with the rigid retainers is first placed along a straight path to gain access to the rotational centers, then the entire prosthesis is rotated into place.

When replacing missing anterior teeth, an anteroposterior (AP) path that incorporates a dual path of placement is used. The anterior part of the removable partial denture is placed first along a straight path, which gives the rigid retainers access to the

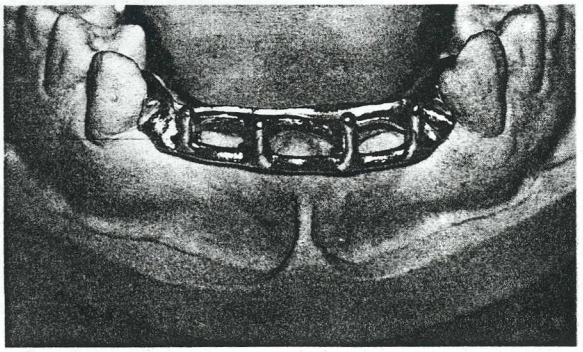


Fig 1 Extensions from minor connectors on canines engage mesiogingival undercut areas.

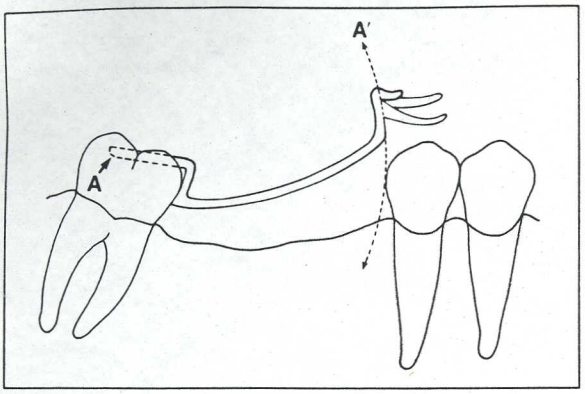


Fig 2a Category I rotational path design. (A, terminus of the occlusal rest on the axis of rotation around which the partial denture rotates into position along the arc, A'.)

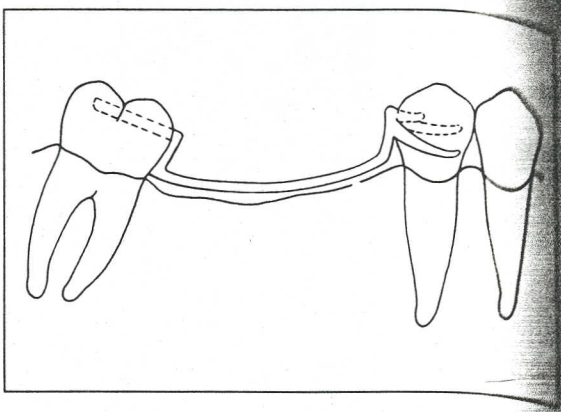
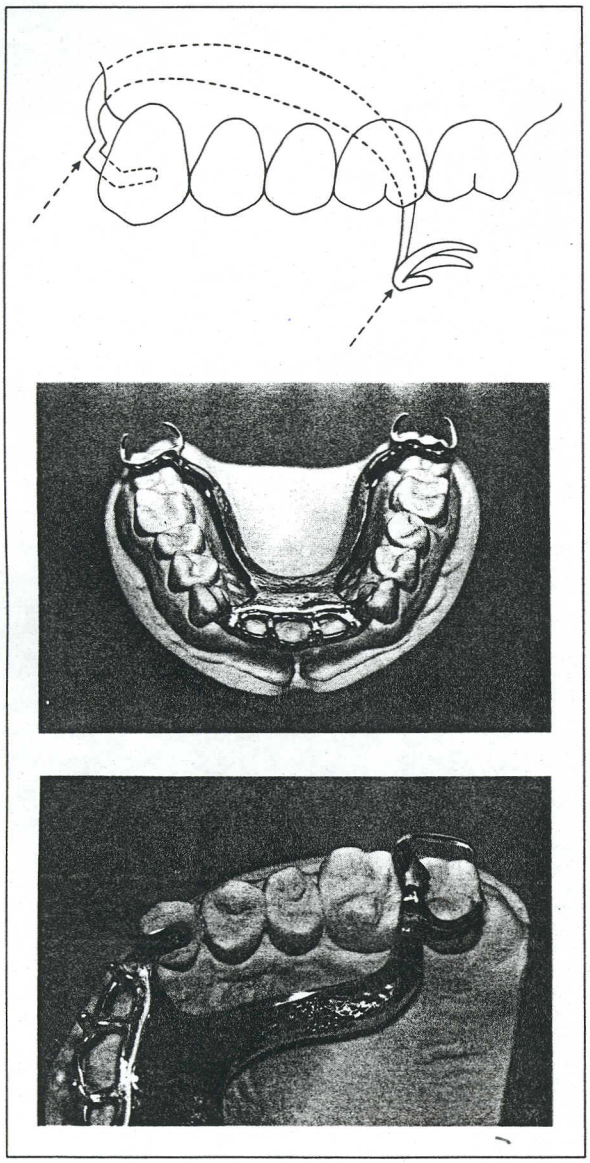


Fig 2b Framework shown in Fig 2a completely seated. Note the intimate contact of the minor connector with the mesial surface of the molar.



Figs 3a to 3c Category II rotational path design. Anterior segment placed first along a straight path.

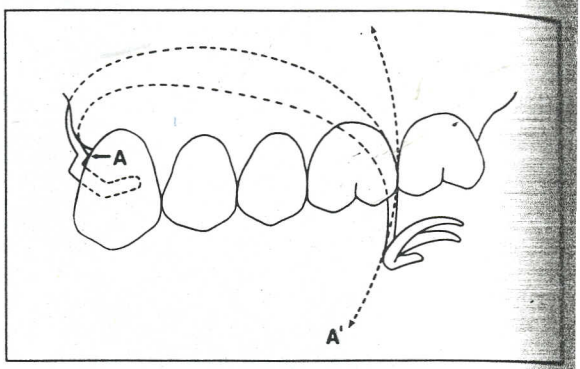
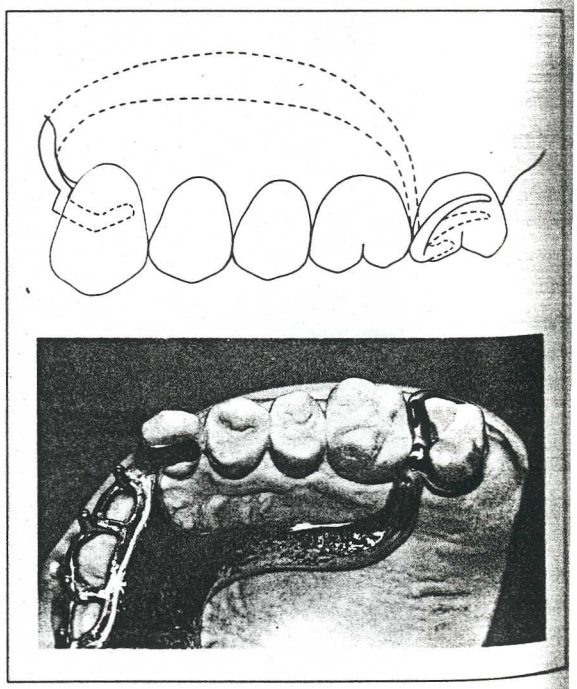


Fig 3d Partial denture framework placed anteriorly. (A, point on axis of rotation; A' arc on which framework will be seated.)



Figs 3e and 3f Partial denture framework completely seated.

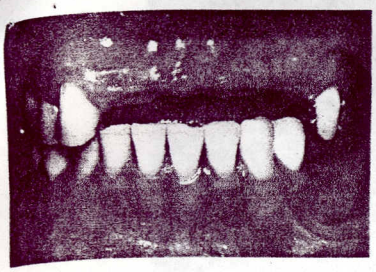


Fig 4a Maxillary anterior edentulous space.

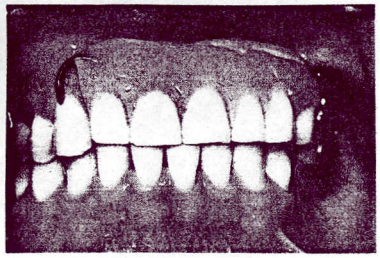


Fig 4b Patient's previous removable partial denture with facial clasp arms on anterior abutment teeth.

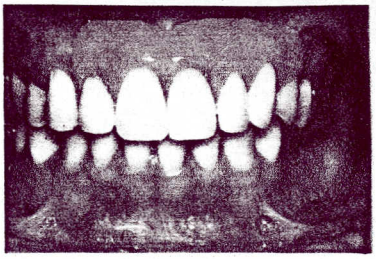
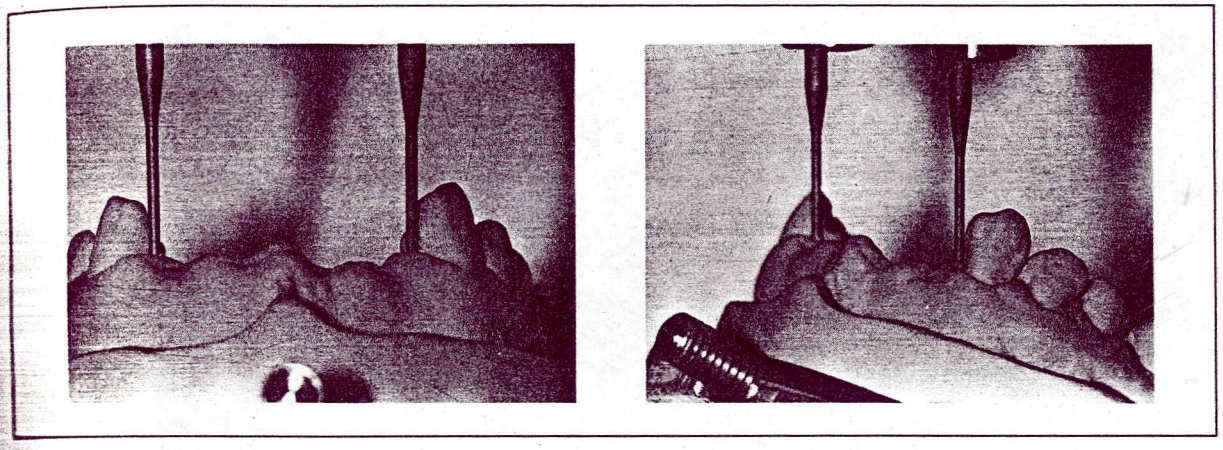


Fig 4c Category II rotational path partial denture. Note the elimination of facial clasp arms from anterior abutment teeth.



Figs 5a and 5b Mesial surfaces of anterior abutment teeth must be oriented to allow both rigid retainers access to the centers of rotation.

centers of rotation and undercut areas as well as the rest seats of the anterior abutment teeth (Figs 3a to 3f). The entire partial denture is then completely seated around the rotational axis as established by the rigid retainers.[2–4] The rotational path has a great esthetic advantage when replacing missing anterior teeth, since facial clasp arms on the anterior abutments are eliminated (Figs 4a to 4c).[5] Conventional clasping is used on the molar abutments, where esthetics is of less concern.

Rest Form of the Rigid Retainer on Anterior Teeth

When planning rest seats for a Category II partial denture with an AP path of placement, the proximal surfaces used for retention and the walls of the rest seats must be so related as to permit an initial path of placement (Figs 5a and 5b). The rest seat preparation on the incisors or canines may require a restoration to achieve an adequate rest seat. A composite-retained metal cingulum or composite restoration may be used (Fig 6). Regardless of the material selected, the floor of the rest seat preparation should be in the enamel to offer greater resistance to displacement of the restoration. The restoration serves primarily to prevent facial migration of the abutment.

The maxillary cingulum rest seat, when viewed from the proximal, should be the shape of an in-

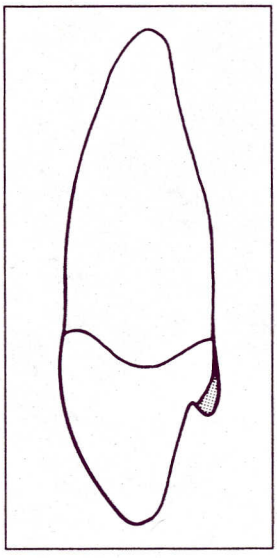


Fig 6 Maxillary canine with a restoration increasing the prominence of the cingulum to provide an acceptable rest seat. Note that the floor of the rest seat is in the enamel. The restoration is primarily used to prevent facial migration of the tooth.

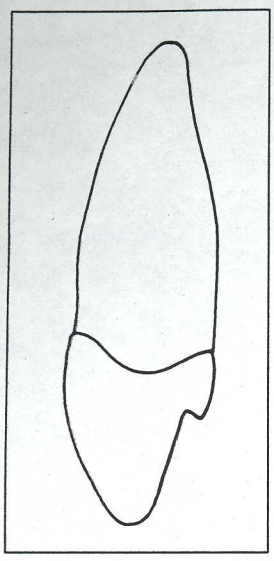


Fig 7 Proximal view of a maxillary canine with a prepared cingulum rest seat. Note the inverted V-shaped preparation.

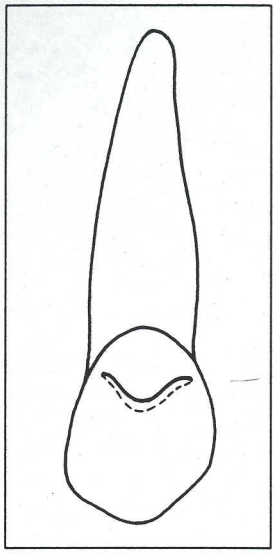


Fig 8 Lingual view of a maxillary canine with a cingulum rest seat. Note the U-shaped preparation.

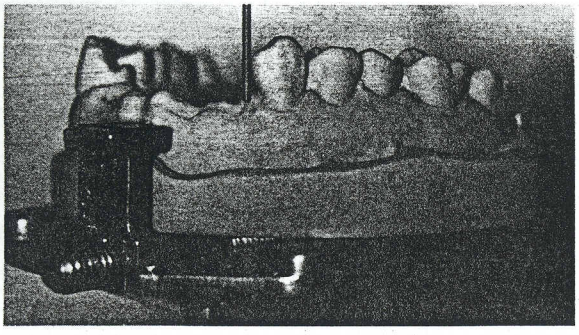


Fig 9a Cast surveyed at zero-degree tilt to analyze mesial surface of canine for adequate undercut.

Fig 9b Close-up view of Fig 9a.

verted V or U (Fig 7). When viewed from the lingual, it should have a V- or U-shaped configuration (Fig 8). The rest seat should be positive enough to prevent movement of the tooth. This same concept of rest preparation may be applied to any of the incisor teeth used as abutments.

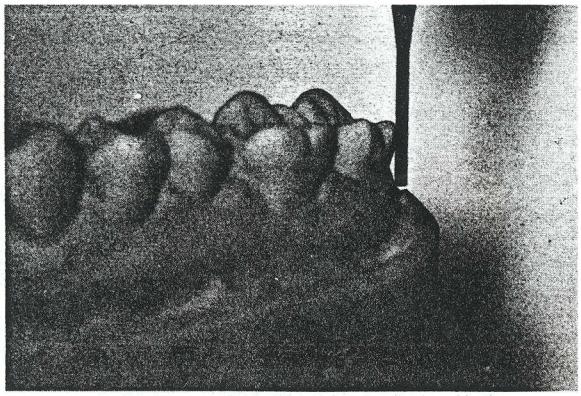


Fig 10 Cast surveyed at zero-degree tilt to analyze distobuccal surface of second molar for adequate undercut.

Surveying for Anterior Tooth Replacement

When replacing anterior teeth, the AP path is used exclusively. The cast is surveyed with a zero-degree tilt to determine the adequacy of undercuts on the mesial surfaces of anterior abutments (Figs 9a and 9b) and distobuccal surfaces of the posterior abutments (Fig 10). The amount of undercut on the mesial surfaces of the anterior teeth should be at least 0.020 inch. This often requires a facial extension from the minor connector in the form of a proximal plate or finger projection to engage this amount of undercut. The undercuts on the molars should be approximately 0.020 inch, but this depends largely on the clasp design.

If the undercuts appear adequate, the cast is tilted upward anteriorly until the undercuts on the mesial surfaces of the anterior abutments are eliminated (Figs 11a and 11b). The analyzing rod is then used to determine whether access still exists for the rests to be seated (Fig 12). If not, modifications in addition to the rest preparations are required. There must be

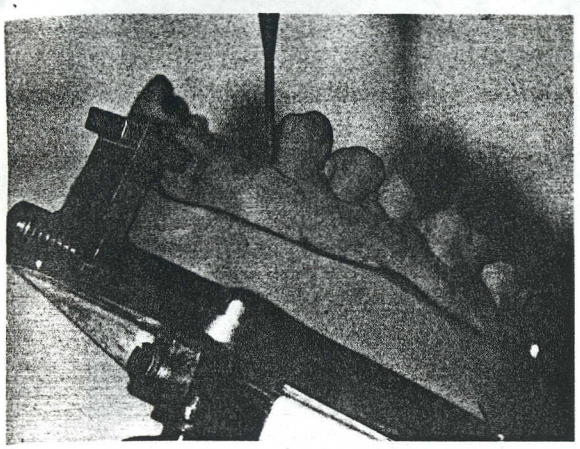


Fig 11a Cast tilted upward anteriorly to eliminate undercut on mesial surface of canine.

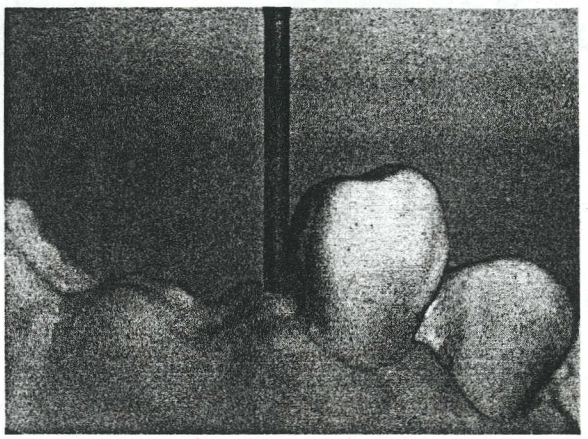


Fig 11b Close-up view of Fig 11a.

no interferences for the anterior portion of the partial denture to go to place along the designated path, since the rigid retainers provide no flexibility.

A variety of clasp designs may be used for the molars. From a mechanical standpoint, the second molars, if present and in normal alignment, generally make the best posterior abutments. Third molars usually have inadequate contour, and first molars are often too far forward to be optimally effective against displacement of the removable partial denture when the patient incises. The shape of the arch is also a factor. In a tapering arch, the distance from the fulcrum line to the incisal edges of the central incisors will be greater than in a square arch displacing the molar clasps with less force (Fig 13).

If the undercut on the mesial surfaces of the anterior teeth is less than 0.020 inch and displacement of the anterior segment of the partial denture could

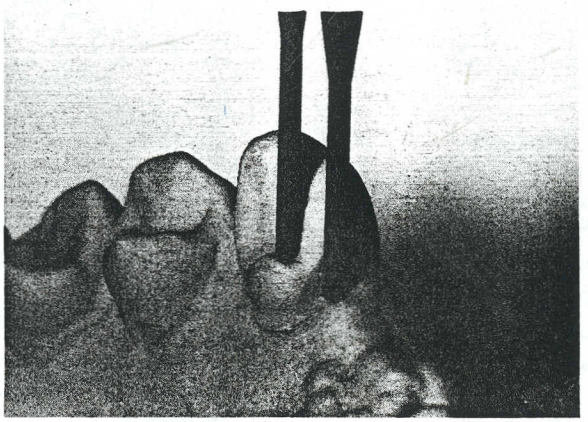


Fig 12 Double analyzing rod indicates access to rest seat preparation simultaneously with access to undercut on mesial surface of canine. (Double analyzing rods for demonstration purposes only.)

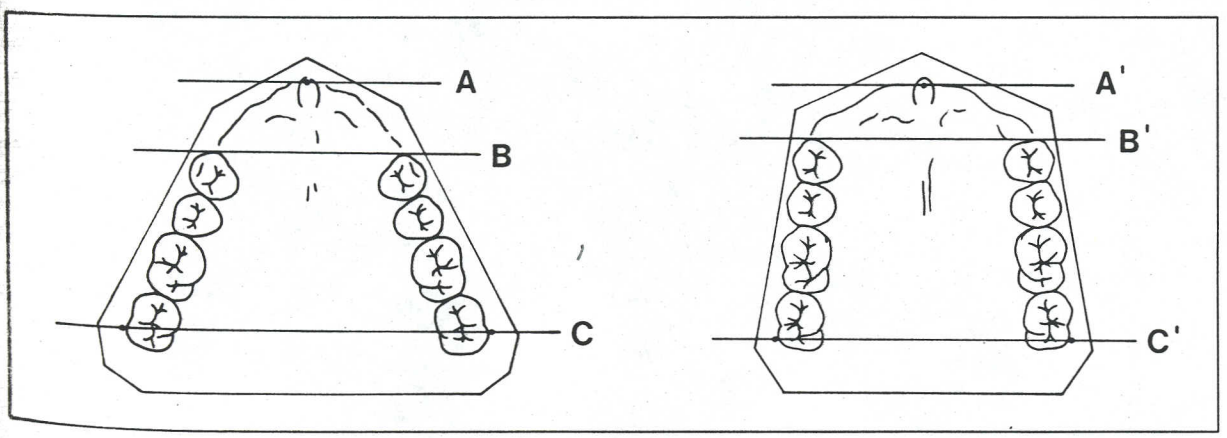


Fig 13 Tapering arch compared to a square arch. In the tapering arch, the distance between line A, passing through the most anterior portion of the incisive papilla, and line B, representing the fulcrum line, is greater than the distance between line A′ and line B′ in the square arch of similar dimension. Lines C and C′ pass through the retentive terminals of the molar clasps. Since the distance A–B is closer to the distance B–C than A′–B′ is to B′–C′, a greater displacing force will be applied to the molar clasps in the tapering arch when the patient incises.

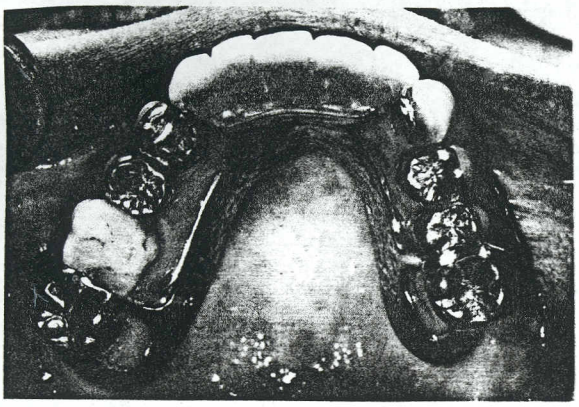


Fig 14 Rigid components on the distal surfaces of the clasped molars increase the resistance to vertical displacement of the anterior segment.

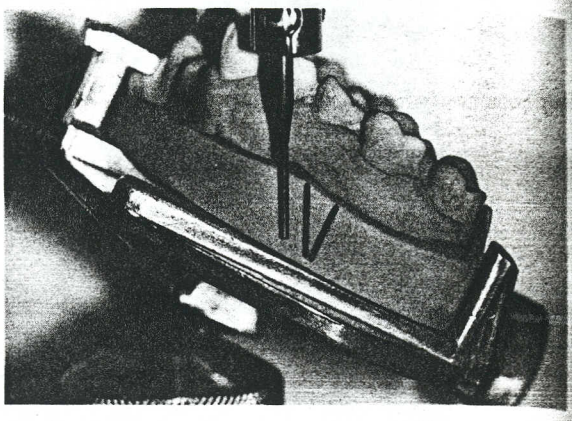


Fig 15 Master cast tripoded in tilted position and at zero-degree tilt.

likely occur in function, the use of a modified molar clasp as presented by Brien[6] may be helpful. A clasp design with a rigid component on the distal surface of the molar abutment (Fig 14) was shown to offer greater resistance to vertical displacement of the anterior segment. This may result from increased resistance against the forward movement of the prosthesis, which would be necessary to displace the anterior segment.

After surveying, the cast is tripodized for each position on the surveyor. Using the analyzing rod as a guide, three widely separated lines are drawn on the side of the cast at the zero-degree tilt. Three lines are also drawn with the cast tilted upward anteriorly to receive the anterior rigid retainer (Fig 15).

Multiple Edentulous Spaces

One or more edentulous spaces may exist posteriorly in addition to missing anterior teeth. As the number of minor connectors increases, so does the potential difficulty of rotating the partial denture framework into place. Undesirable undercuts of all minor connectors must be adequately blocked out.

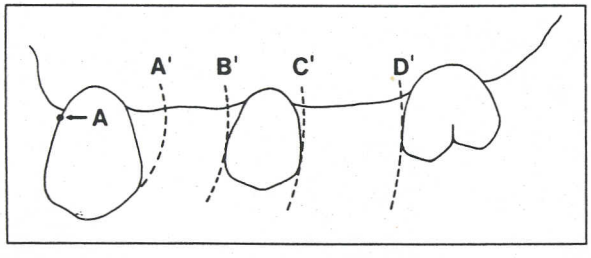


Fig 16 Multiple edentulous spaces. Adequate blockout of undercuts for all minor connectors is necessary. This may be determined by the use of a divider. (A, point on the axis of rotation around which the partial denture will rotate into position along arcs, A', B', C', and D'.)

The farther the minor connector is from the axis of rotation, the straighter the arc it must follow. The closer the minor connector is to the axis of rotation, the greater the curvature of the arch it must follow. This can be readily determined by using a divider to analyze all edentulous areas (Fig 16). The blockout required will assume a curvature coinciding with the arc of placement.

Adjustment of the Rigid Retainer

The rigid retentive units must be in intimate contact with their corresponding tooth surfaces to prevent migration of the tooth and loss of retention. There should be no movement between the rigid retainer and its corresponding tooth surfaces when the removable partial denture is completely seated. The dental laboratory technician must be advised to protect these critical surfaces of the rigid retainers during electropolishing and should neither finish nor polish these areas. All adjustments of the rigid retainers should be made by the dentist at chairside.

If a removable partial denture framework does not seat completely, a disclosing material such as rouge and chloroform should be painted on the tooth-contacting surfaces of the framework and the framework reseated in the mouth. Any interferences that show through the disclosing material should be reduced conservatively with suitable stones or burs. The procedure is repeated until the casting can be completely seated.

The effectiveness of the rigid retainers is evaluated by applying a vertical-displacing force anteriorly. If movement of the rigid retainers is apparent, corrective procedures may be necessary. Movement results from a lack of contact between the rigid retentive component and the corresponding tooth surface. To restore proper contact, a recently

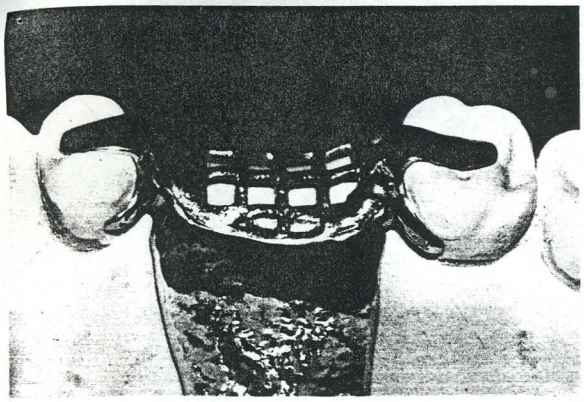


Fig 17a Lingual undercuts used for rigid retainers.

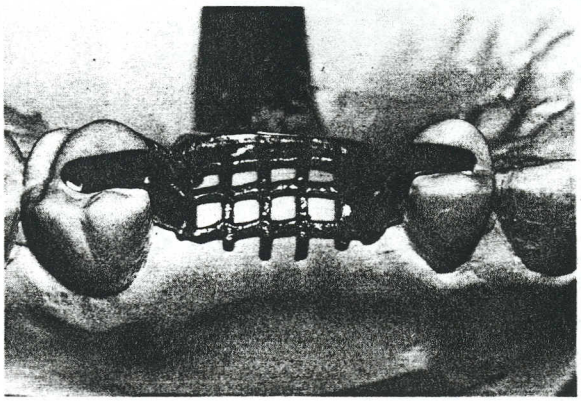


Fig 17b Facial view of partial denture in Fig 17a. Note absence of facial clasp arms.

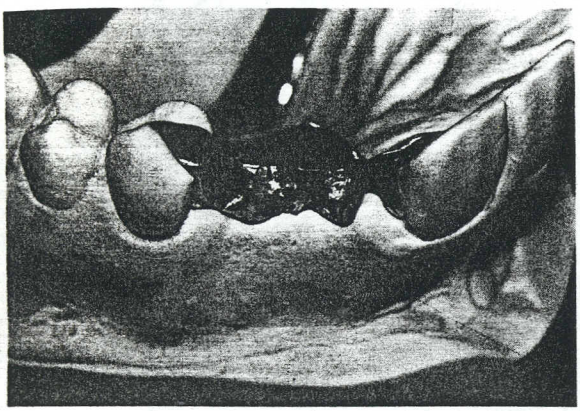


Fig 18a Proximofacial undercuts used for retention.

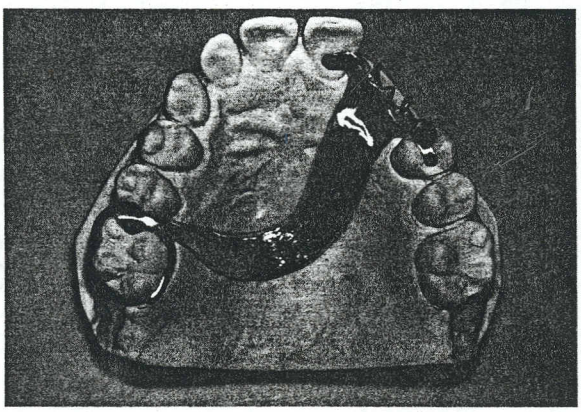


Fig 18b Occlusal view of partial denture in Fig 18a.

developed autopolymerizing acrylic denture base resin (Acrylic Solder, Parkell, Biomaterials Div, Farmingdale, NY) containing 4-methacryloxyethyl trimellitate anhydride (4-META), which bonds to framework alloys, may be used. Extreme caution must be exercised when this modification is performed. (Modification of the framework should be limited to those situations where the resin is not expected to flow into undesirable undercut areas. If the resin cannot be confined to the desired areas, this modification should not be attempted. If the resin were to engage excessive undercuts, the partial denture might have to be sectioned to remove it from the mouth. Alternatively, the partial denture may be removed several times while the resin is polymerizing. After the polymerization is complete, the partial denture may be returned to the mouth. If the partial denture cannot be reseated, this indicates that the resin has flowed into undesirable undercut areas and should be removed.)

The resin should be applied in a very thin layer to the appropriate metal surfaces after the denture base resin has been added. The partial denture is completely seated and excess resin should be removed before polymerization is complete. The modified partial denture should now exhibit adequate anterior retention. The longevity of the bond has not yet been determined, but initial results are promising.

Lateral Rotational Path

The lateral rotational path may be used when anterior or posterior teeth are unilaterally missing. Since most unilateral partial dentures can employ either the anteroposterior (AP) or the posteroanterior (PA) path of placement, the lateral path provides an additional option. For the lateral path of placement, the partial denture is usually designed to be placed first on the side where the teeth are missing, then seated by engaging one or two clasps on the contralateral side. If lingual undercuts are used, the design concept is similar to a Category I rotational path (Figs 17a and 17b). If proximofacial undercuts are used, the design concept is similar to a Category II rotational path (Figs 18a and 18b).

Distal Extension Partial Dentures

Distal extension removable partial dentures ordinarily do not lend themselves to a rotational path of placement because the rigid retainer will usually torque the anterior abutment teeth during rotational movements in function (Fig 19). If the residual ridges under the extension bases are firm and no perceptible movement of the partial denture toward the tissue is anticipated, the rotational path may be considered; however, even slight settling of the denture base will torque the abutments of the rigid retainer. Schwartz and Murchison[7] recommend the use of a spring clasp for anterior retention. This consists of a wrought wire clasp soldered into a channel that has been cast in the major connector. Since it is flexible instead of rigid, it does not generate as much torque when the distal extension base is depressed. Nevertheless, some torquing of the anterior abutment teeth still occurs. Generally speaking, the rotational path cannot be recommended for distal extension base removable partial dentures that replace missing anterior teeth.

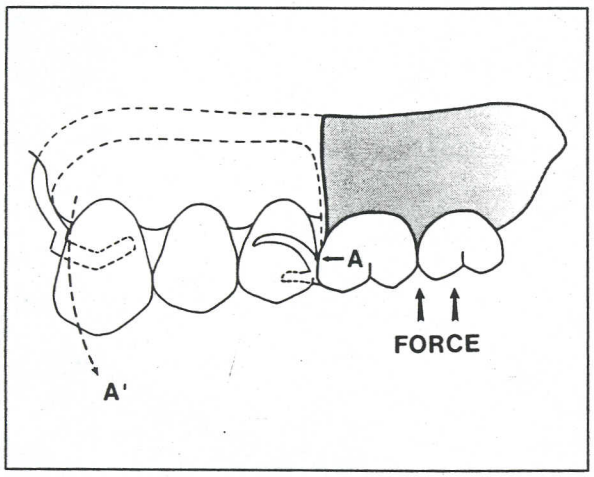


Fig 19 Extension base removable partial denture (A, center of rotation around which the partial denture will rotate under occlusal force. As the extension base is depressed toward the tissue, all components anterior to the fulcrum line, A, will tend to move away from the ridge along the arc, A'. This causes torquing of the canine abutment.)

Summary

Concepts and procedures for designing Category II rotational path removable partial dentures to replace missing anterior teeth have been presented. The primary advantage of the Category II rotational path is improved esthetics, since facial clasp arms are eliminated. A critical factor is the development of well-defined cingulum rest seats that prevent migration of the abutment teeth. The development of an acceptable rest seat may require a restoration.

A lateral rotational path may be used when teeth are missing unilaterally. It may be designed as either a Category I or II rotational path, depending on the location of the undercuts. The rotational path for extension base removable partial dentures is not recommended because of the potential for torque on anterior abutments.

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