RPI (Rest, Proximal Plate, 1 Bar) Clasp Retainer and Its Modifications

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In the last few years various clasp designs for removable partial dentures have evolved from a continuing effort to preserve the teeth and their supporting structures. Emphasis on preventive dentistry has added further impetus to this effort. This article will present one of these newer clasp designs and the rationale for its use.

It might be well at the outset to indicate two important considerations derived from concepts of preventive dentistry that will be emphasized in this article: minimal tooth coverage and minimal gingival coverage. These factors are equal to stress control in importance.

The role of plaque in dental caries and periodontal disease is now better understood. The concepts of minimal tooth coverage and minimal gingival coverage are based on an attempt to minimize plaque accumulations under clasps and other components that may endanger the health of the tooth and its supporting structures.

The reaction of the bone to stress still needs further study. Stress in the absence of inflammation, however, does not appear to cause vertical bone loss around abutment teeth. Yet in the presence of inflammation stress does appear to increase vertical bone loss significantly. The role of inflammation thus seems paramount. On the other hand, the bone of the residual ridge continues to resorb even in the absence of inflammation and the rate of resorption appears to accelerate under increased stresses. The difference in the response of the bone supporting the teeth and bone of the edentulous ridge is apparently due to the presence of the periodontal ligament that converts pressure on a tooth into tension on bone, which enables it to maintain its integrity.

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TOOTHBORNE AND EXTENSION BASE
PARTIAL DENTURES

The essential dissimilarity of the toothborne and the extension base removable partial denture must be recognized. In the toothborne removable partial denture, the occlusal stresses are transmitted to the bone by way of the periodontal ligament. Because all the edentulous spaces are bounded by natural teeth, this class of prosthesis functions like a fixed partial denture. Since the abutment teeth provide relatively unyielding support, the choice of structural elements is based on convenience and their ability to provide rigidity, thereby using each remaining tooth to contribute to the stability of the others.

The extension base removable partial denture, the true partial denture, must depend for its support upon two completely different tissues. The teeth represent a relatively immovable support, while the soft tissues covering the edentulous ridge have varying degrees of displacability. The problem of designing a removable partial denture that will protect both from eventual destruction constantly plagues the dentist. Any slight yield of the soft tissue structures, together with the residual ridge resorption, will permit vertical displacement of the base and subsequent tilting of the abutment tooth. This potential hazard to the abutment tooth in the extension base partial denture is quite universally recognized. Many ways to protect an abutment tooth from destruction, permitting it to function satisfactorily for an extended period of time, have been proposed. These approaches are all intended to insure against the tipping action described above.

Most authorities agree that in addition to the various types of stress directors, the dentist can control the amount of relative force delivered to the abutment by proper selection of clasps. This is due in part to the different degrees of flexibility possessed by the various types.

REQUIREMENTS OF A PROPERLY DESIGNED CLASP RETAINER

Support: the resistance to the vertical components of masticatory force which prevents the partial from being displaced toward the soft tissue. It is provided by the occlusal rest.

Bracing (stabilization): the resistance to horizontal components of force. It is provided by the rigid components of the clasp including the occlusal rest and the minor connector.

Retention: the resistance to dislodgement in an occlusal direction. It is provided by the clasp tip engaging the undercut when a dislodging force is applied.

Adequate Encirclement: The clasp assembly must engage more than
180° (more than half the circumference) to prevent the tooth from moving out of the clasp.

Reciprocation (reciprocal action): Each force exerted on a tooth by a clasp arm must be offset by an equal and opposite (compensating) force. This is provided by the reciprocal arm located on the opposite side of the tooth. Normally, the reciprocal arm does not engage an undercut.

Passivity: When the clasp is in place on the tooth, it should be at rest. Its retentive function is activated only when a dislodging force is applied. A force in an occlusal direction causes the retentive arm to engage the undercut from a gingival direction and so retain the partial denture in place. The clasp should never "grip" the tooth.

PROPOSED CLASPS FOR EXTENSION BASE PARTIAL DENTURE

Agreement generally exists that the cast circumferential clasp, especially the Aker’s, being relatively rigid, is considered best suited for strong abutment teeth because it transmits the force directly to the tooth and provides the best bracing effect. It is, therefore, used more often in all toothborne removable partial dentures and in those extension base partial dentures where the abutment teeth are unusually strong.

Bar or Roach type clasps, usually being more flexible, are frequently used for somewhat weaker abutment teeth. Applegate, however, expressed fear that the bar type clasp transmitted too much tilting stress to the abutment. He based his statement upon the fact that it is half round and has therefore undergone a maximum reduction of flexibility. The use of this type of clasp in a distal extension partial denture, he felt, should be combined with some form of stress breaker. McCracken also warned against the use of a bar clasp in extension base partial dentures. Only where it was possible to utilize a distal rest and engage distal undercut did he employ this type of clasp, because of its rigidity (Figs. 1 and 2).

Swenson’s solution for the extension base partial denture was the provision of two abutments for each base with rest areas which were not adjacent to the edentulous ridge. For distal extension base partial dentures, clasp design is accomplished by a mesially originating back action clasp using distal retention (Fig. 3). However, such clasp design tends to exert a buccal force on the abutment tooth when the base and distal portion of the clasp moves tissueward under function (Fig. 4).

The cast combination clasp (half cast and half wrought wire), utilizing a distal rest for distal extension base partial denture is reported by many authors to have stress breaking action (Fig. 5). Applegate claimed that the combination clasp dissipated the stress of torque and leverage best because the retentive arm is round and therefore flexible in any direction. He claimed that since it is of wrought structure, it is tougher and

Text continued on page 636.
Figure 1. Modified T bar buccal clasp arm of a combination cast clasp utilizing a distal rest and distal undercut.

Figure 2. Circumferential C clasp with a distal rest engaging a distal undercut that may be used in an extension base partial denture to provide stress release. Its main disadvantage is its excessive tooth coverage.
Figure 3. Occlusal view of a back action clasp with a mesial rest.

Figure 4. Diagrammatic illustration of a distal view of a back action clasp on a bicuspid with arrow (A) representing a buccal force exerted on the tooth when an occlusal force on an extension base tends to move the clasp in a gingival direction (B). The lingual arm, which is above the height of contour, is rigid and will not flex. Consequently, any movement of the lingual arm in a gingival direction must necessarily produce buccal movement of the tooth. The use of this clasp on an extension base partial denture should be avoided.
Akers clasp with a wrought wire buccal arm and a lingual cast arm. Advocates of this clasp for extension base partial dentures claim that the flexible wrought wire buccal arm minimizes torquing of the abutment tooth under function.

can be used in smaller gauges, which further increases flexibility. This increased flexibility of the retentive arm permitted the clasp to function as a stressbreaker. Because the reciprocal arm of the combination clasp is cast and therefore rigid, it is able to resist lateral forces effectively and also to reciprocate the force exerted by the retentive wrought wire arm as the partial denture is placed or removed. The supposed flexibility of the retentive wrought wire clasp arm has been questioned in a clinical study⁵ and more recently by Clayton and Jaslow.²

REST-PROXIMAL PLATE-I BAR CONCEPT*

This concept of clasping abutment teeth is a modification of the concept presented by Kratochvil.¹ The components of the clasp are a rest with its minor connector,² proximal plate, and an I bar clasp. (Fig. 6). The RPI clasp fulfills the requirements of proper clasp design, and minimizes stress on the abutment tooth. The rest, located on the mesial occlusal surface of the abutment tooth, acts as the point of rotation and exerts a mesial force on the tooth rather than a distal displacing force. Pressure exerted on the extension base moves the proximal plate tissueward without torquing the tooth. The I bar also moves mesiodingivally away from the tooth under masticatory load (Fig. 7).

*From the author’s outline syllabus for removable partial denture design at the University of the Pacific School of Dentistry, November, 1972.
Figure 6.  
A. Buccal (1) and lingual (2) views of an RPI clasp for the extension base partial denture.  
B. Occlusal view (3) of an RPI clasp for an extension base partial denture.

Figure 7.  Diagrammatic illustration showing movement of RPI clasp with mesial rest.  
A. Approximate center of rotation.  
B. Guide plane that is not engaged by the proximal plate.  
C. Proximal plate.  
Curved arrows indicate the path of movement of the 1 bar and proximal plate under occlusal force.
MOUTH PREPARATION

Rest Seat Preparations

For distal extension base partial dentures where a bicuspid serves as the abutment tooth, a mesial rest preparation is made. For posterior teeth, where restorations are not placed, this rest seat can be prepared in the appropriate triangular fossa with a No. 6 carbide bur or diamond stone. The marginal ridge must be lowered about 1.5 mm. and the resulting preparation must have the deepest portion in the center of the triangular fossa.

Sufficient bulk of metal must be provided to permit the rest to function without fracturing or bending. Gold requires larger and deeper preparations than the non-precious metals (chrome cobalt, nickel cobalt, etc.). This preparation should be rounded and fully polished to permit some rotation when depression of the extension base occurs. If a cusp is to serve as the abutment, a mesiolingual rest preparation is made. The rest seat must be deep enough to prevent the metal rest from slipping gingivally (Fig. 8). As a general rule, mandibular cuspids have a thin enamel covering and when preparing an adequate rest seat, penetration into the dentin is often inevitable. If dentin is exposed, the preparation should be deepened and modified to accept a gold foil, amalgam, or other restoration which can be properly contoured (Fig. 9).

Guide Planes

A guide plane is prepared on the distal surface of the abutment tooth at the occlusal one third as proposed by Potter and associates, and should extend linguually just far enough so that the proximal plate together with the mesial minor connector will prevent lingual migration of the tooth (Fig. 6B). The guide planes should be approximately 2 to 3 mm. in height occlusogingivally (Fig. 7). This guide plane will often permit the proximal plate and the mesial minor connector to contact the
Figure 9. Amalgam restoration is placed in mandibular cusp to permit proper preparation of a rounded occlusal type rest without exposure of dentin.

tooth simultaneously and provide proper reciprocation against the force exerted by the retentive buccal clasp arm during the seating and removal of the denture. If the mesial minor connector and proximal plate cannot contact simultaneously, as may occur with cuspid abutments, then the retentive I bar should engage the mesiobuccal undercut and receive its reciprocation from the proximal plate alone (Fig. 10).

Figure 10. Incisal view of RPI clasp on maxillary cuspid. Placement of the I bar to the mesial of the greatest prominence permits reciprocation from the proximal plate during insertion and removal of the partial denture. On cuspids the minor connector cannot be used for reciprocation during seating of the partial denture since it usually does not contact the tooth until the partial denture is in place.
DESIGN OF THE RPI CLASP

Mesial Rest

The abutment tooth contains the mesioocclusal rest with the minor connector placed into the mesiolingual embrasure but not contacting the adjacent tooth.

Proximal Plate

When viewing a mandibular partial denture on the master cast, the superior edge of the proximal plate is located at the bottom of the prepared guide plane which should be at the junction of the occlusal one third and middle one third of the tooth (the remainder of the proximal plate lies below the guide plane) (Fig. 11A, C and D). The proximal plate extends lingually just far enough so that the distance between the minor connector and proximal plate is less than the mesiodistal width of the tooth (Figs. 11B and 12A, B and C). It should be 1 mm. thick and join the framework at a right angle. At the junction with the framework, the proximal plate is relieved so as not to contact the gingiva and is highly polished. A finishing line is placed at the base of the proximal plate to permit a butt joint with the resin base (Figs. 13 and 14).

I bar

The approach arm of the I bar extends from the framework so as to remain at least 3 mm. from the gingival margin and then crosses the gingival margin at right angles (Fig. 11A). Approximately 2 mm. of the I bar contacts the tooth surface, usually at the gingival one third of the tooth (Fig. 11A). The bottom portion of the I bar contacting the tooth surface should engage 0.01 in. undercut. The I bar should taper slightly from the base to the tip. It is usually placed at the greatest mesiodistal prominence on the buccal surface or towards the mesial, but not toward the distal. This is necessary to permit movement of the I bar away from the entire buccal surface in function. When the I bar is placed toward the mesial, it has the advantage that when properly adjusted it brings the proximal plate into tight contact with the distal surface (Fig. 10).

ADVANTAGES OF THE RPI CLASP

Vertical masticatory force on the distal extension base causes the I bar to move mesiogingivally away from the tooth and the proximal plate to move further into the undercut of the tooth. Thus, both the I bar and the proximal plate disengage the abutment and thereby reduce torquing of the tooth. The mesial minor connector together with the proximal plate provide the necessary reciprocation and eliminate the need
A. Distal view. The guide plane (gp) is approximately 2 to 3 mm. in height occlusogingivally. The buccolinguai width of the guide plane and proximal plate (p) is determined by the contour of the tooth. The I bar (I) makes a 2 mm. contact with the tooth in an occlusogingival direction. Note the slight relief over gingival margin.

B. Occlusal view. The proximal plate (p) extends far enough buccolingually so that the distance between its lingual margin and the mesial minor connector (c) is less than the width of the tooth. The mesial minor connector should not contact the adjacent tooth. The proximal plate should extend buccally far enough to permit development of a normal embrasure with the artificial tooth. The major connector comprising a part of the clasp assembly should be located at least 3 mm. away from the gingival (g) margin for mandibular partial dentures and at least 6 mm. away from the gingival margin for maxillary partial dentures.

C. Buccal view. The guide plane (gp) is approximately 2 to 3 mm. in height occlusogingivally. The proximal plate (p) contacts approximately 1 mm. of the gingival portion of the guide plane (gp). The proximal plate should be approximately 1 to 1.5 mm. thick. The approach arm of the I bar must be located at least 3 mm. from the gingival margin (g) and may be designed to follow its contour. The I bar itself approaches the tooth in a vertical direction.

D. Lingual view. The guide plane (gp) is approximately 2 to 3 mm. in height occlusogingivally. The occlusal rest preparation should be well rounded or spoon-shaped to permit rotation of the occlusal rest (r). The proximal plate extends linguually far enough so that together with the mesial minor connector (c) they prevent lingual migration of the tooth. The distance between the proximal plate and mesial minor connector should be no less than 5 mm. The major connector comprising a part of the clasp assembly should be located at least 3 mm. away from the gingival margin for mandibular partial dentures and at least 6 mm. away from the gingival margin for maxillary partial dentures.
Figure 12. A, Proximal plate (p) relatively narrow due to the tapering contour of the first bicuspid. The proximal plate should be designed to be as narrow as possible but still be able to prevent lingual migration of the tooth. A narrow proximal plate permits greater exposure of the gingival tissues (g). B, Proximal plate properly constructed makes minimal tooth contact and permits greater exposure of the gingival tissues. C, Proximal plate made too wide buccolingually for the contour of the tooth.

Figure 13. Diagrammatic illustration showing proper construction of the proximal plate. A, Junction of proximal plate with the framework. Too much bulk in this area would present a problem in positioning the artificial tooth. B, Finish line for butt joint with resin base. C, Underside of proximal plate should be highly polished and should not contact the gingival tissues. A relief of approximately 30 gauge may be used effectively. The mesiodistal width of this portion should be approximately 3 mm.
for a lingual arm. The mesial rest eliminates the potential "pump handle" effect that a force on the base often induces with a distal rest.

The RPI clasp contacts the tooth minimally and is advantageously used on caries prone patients, and since the I bar itself makes very little contact with the tooth, it is usually more esthetic than most other clasp arms.

**CONTRAINDICATIONS FOR RPI CLASP**

Any of the following conditions would preclude the use of the RPI clasp: (1) insufficient depth of vestibule to permit the approach arm of the I bar to be located at least 3 mm. from gingival margin (Fig. 15); (2) a tooth which has a severe lingual tilt and no labial or buccal undercut (Fig. 16A); (3) tissue undercut so severe that the approach arm of the I bar would be too far away from the tissue and act as a food trap or irritate the mucosa of the lip or cheek (Fig. 16B); (4) teeth which are severely flared labially or buccally (Fig. 16B); (5) a tooth which has only a distobuccal retention undercut and does not require a restoration; and (6) a mouth with a high floor in which a lingual plate is used on the lingual surface of the abutment tooth.

**RPA CLASP**

The RPA clasp is similar to the RPI clasp except that in place of the I bar a circumferential Akers clasp arm arises from the proximal plate.
Figure 15.  A, Soft tissue irritation under base of I bar due to insufficient depth of vestibule. The depth of the vestibule should be carefully examined before deciding to utilize an I bar clasp arm since the approach arm of the I bar must be located at least 3 mm. from the gingival margin. B, Ulceration caused by the approach arm of the I bar is apparent. Also note inflammation of gingival margin.
The RPA clasp may be used in place of the RPI clasp when there is insufficient depth in the buccal vestibule or when the buccal tissue undercut is too great (Fig. 17). The shoulder of the clasp arm must be constructed so that only its occlusal border contacts the tooth at the height of contour. The undercut area in that portion of the clasp arm must be blocked out.

MODIFICATIONS IN THE CONSTRUCTION OF THE RPI CLASP

When two teeth are splinted the mesial rest is placed on the anterior tooth and the proximal plate on the posterior tooth with the I bar on the mesiobuccal surface of the posterior tooth (Fig. 18).

If a three unit fixed prosthesis is constructed, the mesial rest is placed in the anterior abutment and the proximal plate on the posterior abutment with the I bar placed on the mesiobuccal surface of the posterior abutment.

When designing an extension base partial denture, where an isolated tooth is involved, the RPI clasp may be placed on the tooth anterior to the isolated tooth and proximal plates on the mesial and distal surfaces of the isolated tooth with no rest. This design permits removal of stress on the isolated tooth (Fig. 18). It is important that the superior border of the mesial proximal plate on the isolated tooth be located at or gingival to the level of the occlusal rest of the RPI clasp.

The RPI clasp may be designed not to release in function by extending the proximal plate to contact the entire guide plane. This type of clasp may be used where it is desirable to load the tooth more than the edentulous ridge.

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Figure 17.  A, RPI clasp permitted on right second bicuspid even though a slight tissue undercut exists.  B, RPA clasp, Akers arm off proximal plate.  Due to severe tissue undercut the 1 bar buccal arm could not be used.
Figure 18. Partial denture showing modified RPI clasp used on splinted maxillary left bicuspids. Rest is located on mesial of first bicuspid with proximal plate on the distal of the second bicuspid. The I bar (not visible) is located on the mesiobuccal of the left second bicuspid. Note the use of two proximal plates on the maxillary right second bicuspid without the use of rests to reduce possible torquing of the tooth. An RPI clasp is located on the maxillary right cuspid.
Figure 19. Clasps on bicuspid and molar fulfilling the requirements of proper clasp design. Maxillary first bicuspid: Support is provided by occlusal rest; bracing is provided by minor connector, occlusal rest, and proximal plate; retention is provided by 1 bar on the buccal; reciprocation is provided by mesial minor connector and proximal plate; engagement of more than 180° of the circumference of the tooth is provided by proper placement of mesial rest with its minor connector, proximal plate, and 1 bar.

Maxillary second molar: Support is provided by mesial rest; bracing is provided by occlusal rest, mesial minor connector, and rigid lingual 1 bar; retention is provided by buccal 1 bar; reciprocation is provided by mesial minor connector and rigid lingual 1 bar; engagement of more than 180° of the circumference of the tooth is provided by proper placement of mesial rest with its minor connector and buccal and lingual 1 bars.

Although the RPI clasp has been presented for use in extension base removable partial dentures, a number of its characteristics make this clasp suitable for use in toothborne removable partial dentures as well. Such an RPI clasp and its modifications are shown in Figure 19.

SUMMARY

A clasp design that can be employed for abutment teeth on extension base removable partial dentures has been presented. The clasp referred to as an RPI clasp retainer minimizes tooth coverage and reduces stress on the abutment tooth. This same design may also be used to advantage on all toothborne removable partial dentures.

REFERENCES


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