Lingual Retention and the Elimination of the Visible Clasp Arm

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ABSTRACT

The modern removable partial denture (RPD), in response to the increased esthetic demands of our patients, is no longer acceptable if it requires visible buccal and facial clasp arms for retention. By eliminating the bracing arm and having its functions taken by paralleled guide planes and precise, positive rests, the retentive element, a lingual circumferential wire clasp arm, will provide the same amount of retentive force as if it were placed on the buccal surface and will not be visible. Designs for the major connector either plate the lingual surface of the abutment or, as in a lingual bar, leave that surface open. Both of these situations are adaptable to the lingual retentive clasp and are illustrated in this article.

CLINICAL SIGNIFICANCE

Design features such as metal clasps needed for the retention of RPDs can be very unsightly, creating an esthetic problem. This article reviews the concepts for creating lingual clasp arms that enhance the esthetic quality of prostheses.

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INTRODUCTION

The conventional removable partial denture (RPD) clasp assembly has historically consisted of both a retentive and a bracing or reciprocal arm, connected through a minor connector and, most often, with an occlusal rest. Before the era of cast framework, the arms were either wires or shaped from plated gold and soldered into a tang to attach the assembly to a vulcanite or swaged gold base.[1]

In a time when mouth preparation consisted of preparing a place for an occlusal rest, if anything at all, the retention of the partial denture was totally dependent on the clasp assembly because no frictional retention through the prepared guide planes and their corresponding minor connectors existed. The bracing arm was considered essential to eliminate potential destructive forces from the retentive clasp. It was not until the advent of the rest, guide plane, "I" bar (RPI) concept, presented by Kratchovil in the early 60s, that clasp assemblies considered the elimination of the bracing arm and the replacement of its function with the now well-known mesial rest and distal guide plane.[2] The elimination of the bracing arm has had no effect on retention or long-term tissue health. The combination of a distal rest and a distal guide plane provides the same reciprocating effect if the guide plane extends slightly beyond the line angles and the rest is truly spoon-shaped, giving an acute angle to the guide plane. Because the guide plates (minor connectors) contact the tooth long before the retentive clasp reaches the height of contour, the plate stabilizes the tooth on

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insertion and removal, and it provides lateral bracing when the partial denture is in function.

The RPI concept provided retention with a cast "I" bar infrabulge clasp, placed at the greatest convexity of the facial or buccal surface of the abutment tooth for all distal extension situations. The "I" bar was suggested to be more esthetic than the circumferential and suprabulge retentive clasp arm it replaced and, in many situations, it was. Nevertheless, when visible, and especially, in the maxillary arch, it was obviously a foreign body and, as patients became more and more esthetically conscious, more objectionable.

For those patients unwilling to show anything unnatural, a precision attachment usually offered the only alternative. Both intra- and extraoral attachments were and are available but, until very recently, crowning the abutment tooth was required to provide a base for the attachment with its potential risk factors and increased cost of treatment. The intraoral attachment required an additional reduction of dentin to create a space for the female component of the attachment to stay within the normal contours of the crown. The extraoral attachment often infringed on gingival tissues and interfered with hygiene efforts. To eliminate the required crown, bonded extracoronal attachments have been developed and used successfully in carefully selected cases.[3]

THE LINGUAL WIRE CIRCUMFERENTIAL RETENTIVE CLASP

Certain types of intracoronal attachments, having no inherent retentive element, have utilized a cast circumferential lingual clasp arm on the partial denture framework, resting on the milled lingual surface of the attachment crown, as the retentive element. Over the years, these have proven to be effective but carry the extra expense of the precision attachment treatment as well as the disadvantages of over-preparation for the intra-coronal attachment and the relative rigidity of the cast clasp arm when compared to one made of wire.

If the bracing arm can be eliminated and its function taken over by the minor connector/guide plane and rest, then the utilization of a lingual circumferential wire clasp of a suitable gauge will provide retention identical to that same clasp placed on the facial or buccal surface without the need for crowning the abutment tooth for prosthetic reasons alone.[4] The retention offered by a wire clasp arm is defined by its active length, its gauge, the alloy from which it was formed, and the depth of undercut into which it was placed. These factors are under the control of the clinician and must be a component of the instructions given to the dental laboratory.

The lingual clasp option will take one of two forms: if an open lingual surface is present on the abutment tooth to be clasped, then the wire will originate from the edentulous area and extend as far as possible into the opposite embrasure to a retentive undercut of 0.010 inch (Figure 1). If, on the other hand, there is inadequate space to open

Figure 1. Open lingual surface on a natural tooth. The length of the clasp arm is slightly reduced because of the presence of the minor connector to the adjacent tooth.

Figure 2. Lingual plate with retentive wire clasp. The close adaptation of the wire on the superior surface of the plate makes food impaction unlikely and offers no irritation to the tongue.

Figure 3. Strut rest to open lingual surface. The onlay portion of the rest brings the lingual cusp area into better contact with the opposing complete denture. Cingulum rest on the cuspid is bonded Ni-Cr.

the casting for any reason, then the area in question is plated and, after casting and finishing the framework, the plate is reduced in vertical height to allow the same wire circumferential clasp to lie on the occlusal surface of the plate at the height of contour for the first two-thirds of its active length and then pass into the same lingual undercut in the terminal third of the lingual surface (Figure 2). In either case, the clasp will give the same retentive resistance.

The selection of gold wire used for the circumferential retentive lingual clasp can be made using the following criteria: <7-mm active length requires 20 ga; 7 to 10 mm a 19 ga; and >10 mm an 18 ga.[5] These wires, placed into an undercut of 0.010 inch in their terminal third, will all function beneath their proportional limit and therefore resist deformation in normal function. The retentive resistance they produce should be in the range of 400 to 700 g. Base-metal wires can be expected to perform in a similar fashion, provided that a wire one-gauge smaller is selected. Reciprocation or bracing will be provided by the guide planes established on the abutment tooth as well as by the rest, assuming that the tooth/frame relation has been carefully managed during the finishing process to allow actual contact between the framework's minor connectors and the prepared parallel guide planes.[6]

Healthy abutment teeth are modified with either subtractive or additive mouth preparation or some combination of the two. When restorative needs demand crowning the abutment, then ideal contours can and should be established through milling of the crown.[7]

It is essential in either of these two situations that the active length of the wire clasp be as long as possible in order to obtain maximum flexibility of the clasp and to keep its deflection beneath the proportional limit of the wire. When a mesial rest is used, the minor connector to the rest will reduce the clasp length because it will compete with that clasp for space on the lingual surface of the tooth. The minor connector for that rest can often be repositioned to an adjacent tooth and the rest form altered to what might be called a "strut rest" to completely open the lingual surface (Figure 3). The concept of lingual wire retention is limited to circumferential clasp forms, as this shape lies only on the tooth surface and offers no apparent irritation to the tongue. Infrabulge forms, "I" bar or "L" bar, do interfere with the tongue, offer no advantage at all, and should not be considered.

Figure 4. Abutment crown with milled surfaces, special positive rest preparation, and mesial-lingual retentive area. The edge-to-edge occlusal relationship of this patient's anterior teeth permits the enlargement of the cingulum area.

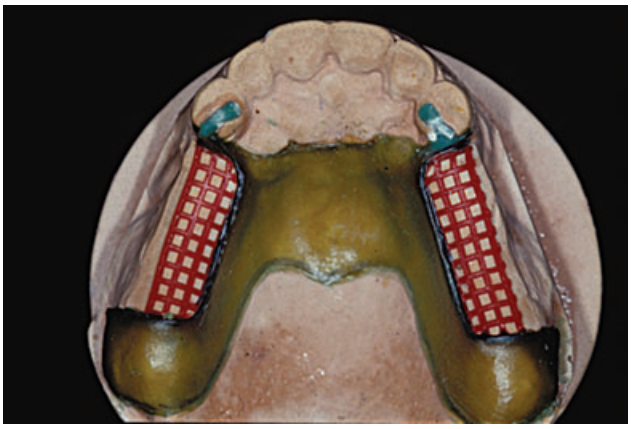

Figure 5. Wax-up of major connector illustrating the open anterior area of the palatal strap major connector. Metal coverage of the tuberosities is required because of the lack of interarch space in the posterior.

CLINICAL CASES

Open Maxillary Lingual Surfaces with Crowned Abutments

A combination of a fixed partial denture and a maxillary RPD was constructed for a patient unwilling to show any clasping. Special rest seats were fabricated on the lingual of the abutment crowns for both cuspids, slightly flared to the occlusal, with the mesial well deeper than the other surfaces of the rest preparation (Figure 4). The rest seats were joined to the distal guide planes, which were milled parallel to each other. They extended buccal-lingually beyond the normal contour of the distal surface of a maxillary canine. Mesial-lingual undercuts (0.010 inch) were created to provide retentive areas for lingual circumferential wire clasps. The partial denture was waxed using a broad palatal strap major connector to open up both the anterior and posterior parts of the palate (Figure 5).

Figure 6. Completed partial denture demonstrating lingual retentive clasps.

Gold wires of 19 ga were adapted to the contours of the crowns and soldered to the mesh area of the framework to maintain flexibility of the wire. The teeth were then added and the acrylic components processed and finished (Figure 6).

Retention and stability of the partial denture are dependent upon the clasp, the mesial component of the rest seat, the fit of that rest into its seat, and the contact of the guide plates against the milled guide

Figure 7. Intraoral view of the anterior segment of the removable partial denture, indicating the precise fit of the casting and the retentive clasp arms.

Figure 8. Facial view contrasting the esthetics of the lingual retentive clasp with the conventional facial "I" bar on the mandible.

plane surface. The tooth/frame relation must be maintained to allow positive contact (Figure 7). Contrast the esthetics of the maxillary restoration with its lingual retentive clasp with that of the conventional "I" bar design in the mandibular arch. The challenge for this design is in reproducing the contour and color of the denture base (Figure 8).

Closed Maxillary Lingual Surfaces with Crowned Abutments

In this second case, the patient had several failing posterior teeth in both the upper and lower arches, and while implant support and retention was used in the mandible, the patient was unwilling to have implants in the upper arch because of the need for extensive grafting. The remaining teeth in the upper arch required crowning for restorative reasons, which allowed for ideal abutment contours. Milling of all the lingual surfaces of the abutment teeth was performed to create parallel guide planes on the proximal and lingual surfaces. Distal guide planes and occlusal rests on the distal abutments for the RPD were created, as well as mesial-lingual undercuts, to create adequate retention through the engagement of lingual clasps without any buccal display of metal (Figure 9). Although a mesial rest is considered to be preferable to a distal one, there is no clinical evidence that one is superior to the other, assuming that the rest seats are acute—that is, deeper as it extends to the center of the tooth (spoon-shaped)—and that the guide plate actually contacts the guide plane.

The wire circumferential clasp, shown in blue on the design cast, is co-incident with the lingual plate for the proximal two-thirds of its length. It enters the undercut at the terminal third where the lingual plate has been reduced vertically to allow the clasp to reach the 0.010-inch undercut (Figure 10). With the wire clasp lying on the occlusal surface of the lingual plate, any area where the plate has been reduced to the point in which a space opens between the plate and the lingual surface is occluded by the wire to reduce food impingement (Figure 11). The close approximation of the wire and the plate makes it difficult to distinguish the wire in the occlusal view (Figure 12).

A lateral view in a smile shows no evidence of a clasp arm. The border of the flange is difficult to disguise completely because of the natural bulge of the distal of the first bicuspid (Figure 13).

Figure 9. Maxillary fixed partial denture illustrating the preparation of milled lingual surfaces and distal rests for the lingual retentive clasp used with a lingual plate.

Figure 10. Design of lingual retentive arm combined with a lingual plate. The red line outlines the extent of the cast base, whereas the black line indicates the height of contour and area of undercut. The blue line represents the wire clasp as it enters the mesial-lingual retentive area while placed on the occlusal surface of the plate.

Figure 11. Completed partial denture showing the relationship of the clasp to the plate.

Figure 12. Palatal view of the completed partial denture illustrating a precise fit of the frame and clasp.

Open Mandibular Surfaces with Crowned Abutments

In this combination case, shown in Figures 14 through 19, a Class I situation was converted to a Class III, with implants used as stops in the second molar areas. There was a need to crown both remaining bicuspids as well as the left cuspid for restorative purposes. The surveyed crowns on the terminal abutments provided the ideal contours, creating rest preparations with retentive undercuts in the mesial-lingual surfaces of both teeth as well as large guiding planes on the distal surfaces. A cingulum rest was added to the left cuspid. Implants with healing abutments, contoured to a rounded occlusal surface, were placed as far to the distal as the bone allowed to provide posterior support (Figure 16).

The full-arch view illustrates how the retentive clasps blend into the lingual surfaces (Figure 17). In the lingual view of the mandibular right cuspid, the borders of the very precisely fitting cingulum rest

Figure 13. Lateral view of the completed partial denture illustrating a potential esthetic problem with the visible flange contour and tint that is extremely difficult to hide.

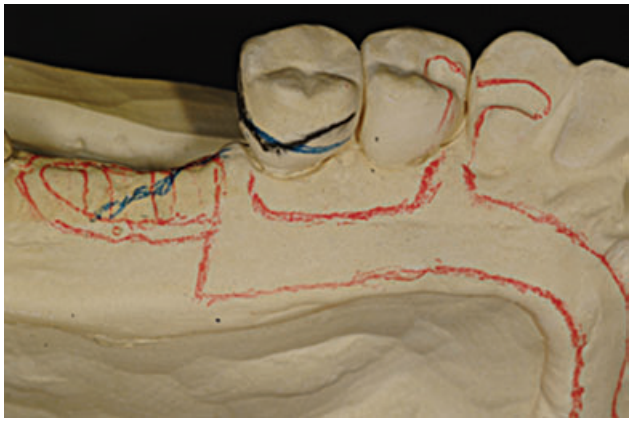

Figure 14. Design view of the splinted bicuspids, which allowed transferring the occlusal rest to the first bicuspid to open up the mesial-lingual retentive area with only one minor connector crossing the gingival margin.

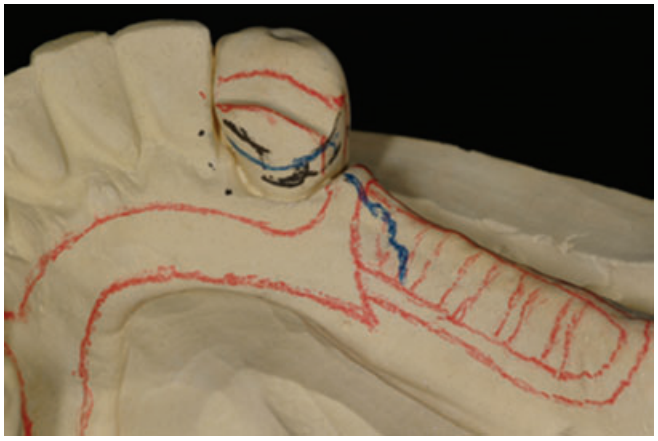

Figure 15. The cuspid crown shows a cingulum area that has been enlarged to accommodate the positive rest and the mesial-lingual retentive area.

Figure 16. The healing abutments that will provide posterior stops are visible distal to the mesh of the framework. Their support will be activated by a reline of their contact area after the partial denture is inserted using a dual-activated resin.

cannot be distinguished. The concept of the lingual wire clasp (20 ga) is clearly shown (Figure 18). A full smile gives no indication of the presence of the RPD (Figure 19).

CONCLUSION

Given positive rest preparations and precise parallel guiding planes with a framework that actually contacts those planes through minor connectors (guiding plates), there is no reason that visible clasping on the buccal surfaces cannot be eliminated. The amount of resistance provided by the lingual retentive elements is the same as if the clasps were placed on the buccal surfaces of the abutments. This system for retentive clasping, on any tooth that has or can be made to have a usable lingual contour with an appropriate undercut area, can only enhance the esthetics of the restoration. The lingual wire retentive arm has the added advantage over a buccal arm in that the patient is unable to use the clasp as a handle to remove the partial

Figure 17. Occlusal view of the completed partial denture, which now functions as a Class III.

Figure 18. Lingual view of the retentive clasp components, with the ideal frame/rest relationship.

Figure 19. Facial view of the completed partial denture, with no indication of a mandibular partial denture.

denture, a common cause of distortion of any wire clasp.

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