Designing options for mandibular unilateral distal extension removable partial dentures

Original Article

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ABSTRACT

Designing a unilateral distal extension removable partial denture (RPD) is often challenging for a clinician. Often, the use of conventional RPD design techniques results in a prosthesis that both the dentist and patient consider a failure. The two main difficulties encountered are (i) to obtain suitable retention on the dentulous side of arch (ii)stability of the denture to horizontal and vertical displacement. This article reviews the designing options for unilateral distal extension cases taking into consideration various forces acting on the denture and the means to control the same.

KEY WORDS: Clasps, designing options, unilateral distal extension removable partial denture

INTRODUCTION

Unilateral distal extension removable partial denture (RPD) derives its support from the supporting abutment teeth and resilient soft tissues; both the tissues exhibiting different degrees of displaceability.[1] These two factors have to be considered if one has to obtain suitable retention on the dentulous side of the arch, to stabilize the partial denture and maximize resistance to vertical and horizontal displacement. Proper designing is therefore essential to prevent any deleterious effect on the supporting structure. Forces that produce torque on abutment teeth and the alveolar ridge should be controlled and reduced in the design of direct retainers.[2]

Difficulties involved in the treatment of loss of posterior teeth have been known for decades. Dunn[3] used interproximal or embrasure clasp device to improve retention in a temporary removable partial denture. Interproximal wires were used by Hart that served as lingual clasps and supported the clasping side of unilateral distal extension partial denture, as reported by Mann.[4] Hart-Dunn attachment has also been used as a stress breaker for these dentures with free end denture base.[4]

Designing Options

A unilateral distal extension RPD essentially functions as a class I lever where the free end of the denture base acts as the effort arm and the cross arch stabilization arm acts as a resistance arm[5] [Figure 1]. Rotational movement about an imaginary vertical axis located near the center of such RPD can be controlled by:-

1. designing various extra coronal assemblies designed for abutment teeth adjacent to distal extension ridge
2. designing unilateral distal extension RPD:

a. without any modification spaces
b. with modification space/s

Designing Extra Coronal Clasp Assemblies for Abutment Teeth adjacent to Extension Ridge

I) Stress–releasing Clasp Design for distal extension RPD system

Literature describes four major stress- releasing clasp designs for distal extension RPD.[6]

RPI clasp with a mesial rest, proximal plate, and I bar[1,7]

RPA clasp with mesial rest, proximal plate, and circumferential clasp[8]

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RPL clasp with mesial rest, a proximal plate, and L-bar[9]
Equipoise back action clasp[10]

Henderson and Steffel[11] suggested a wrought wire clasp retentive arm that theoretically would be more flexible thereby reducing stress on abutment teeth. In the study on reaction of anterior abutment of a Kennedy Class II removable partial denture to various clasp arm designs, Firtell *et al.*[12] concluded that the anterior abutment tooth with a cast retentive circumferential arm placed at the survey line showed least movement as compared to:

- circumferential arm with cast retentive arm placed into the mesiofacial undercut of 0.01 inch
- circumferential arm with a wrought wire retentive arm placed into mesiofacial undercut of 0.01 inch
- buccal I-bar placed at the greatest facial curvature into 0.01inch undercut

All these retentive clasp system designs, for abutment teeth to a distal extension ridge, use class II lever effect allowing rotation of RPD base towards the tissues without torquing the clasped tooth. The axis of rotation is designed around the mesial rest, far from the distal extension, and the retentive arm is designed to be near the distal extension. Occlusal forces cause distal base and the retentive arm to move towards the tissue and around mesially designed axis, thus resulting in a stress-releasing effect.[6]

II) Abutments and Rests [13]

Special consideration must be given to the potential for rotation at the fulcrum line that will run from the distal most rigid contacts of the partial denture with the abutment teeth on each side of the arch. The decision to allow movement around fulcrum line must be made before mouth preparation. When the abutments are weak and few in number guiding planes will be reduced therefore functional relief must be provided. When the casting is relieved, the support of the edentulous area is obtained through altered cast impression.

DESIGNING OF KENNEDY'S CLASS II (WITHOUT ANY MODIFICATION SPACES)

Design I

When there are no modification spaces on the dentate side, an embrasure clasp on the first molar is the retention of choice. Although it is advantageous mechanically to have a long stabilization arm, the embrasure clasp is placed on the first molar rather than the second because the mandible curves into the retromolar space, starting at about the second molar [Figure 2]. Therefore, when a clasp is placed on the second molar, a lot of block out is required between the connectors and mucosa beneath, creating a food trap. A clasp arm should not to be placed on the second premolar as it will be placed anterior to the fulcrum line and also it will affect esthetics. The occlusal rest can be extended on the premolar as it will prevent food lodgement.[13]

Design II

The mandibular arch has a unilateral edentulous ridge that has been restored by a unilateral distal extension removable partial denture [Figure 3]. The fulcrum line connects the rest on the left mandibular first premolar with those on the right mandibular first and second molars. The direct retainer is situated anteriorly to the fulcrum line; thus, the clasp on right mandibular first molar will be put under strain each time the extension base denture is loaded, which may result in inactivation of the clasp. The denture has been designed with four minor connectors crossing the gingiva to reach the interproximal areas and one I-bar clasp with a gingival approach.

The modified[14] design [Figure 4] shows that the direct retainer has been placed posterior to the fulcrum as the right mandibular second molar has been used as the abutment instead of the right mandibular first molar. Thus, activation of the clasp should not take place when the extension denture base is loaded occlusally. Every attempt has to be made to cover as little gingival tissue as possible. In this design, the minor connector crosses the gingiva at an interproximal portion as the occlusal rest on left mandibular first premolar and the indirect retainer on the left mandibular canine to join the minor connector placed distally to left mandibular first premolar .The minor connectors crossing the gingiva can be further reduced in this design if the RPA[9] clasp system is used instead of the RPI[7] system.

Further, the indirect retainer mesially on the right mandibular first molar does not have an individual minor connector but joins the minor connector from the clasp on the right mandibular second molar. Indirect retention is largely sufficient with this design.[7] However, in this design, the cross arch stabilization arm cannot be extended between the first and second molars when there is a lot of soft tissue undercut, as described in the first design. In such a situation, the cross arch stabilization arm should terminate in between the second premolar and the first molar,[13] with similar above mentioned modified design.

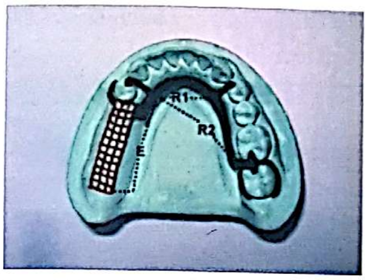

Figure 1: Effort Arm, R1 and R2 Resistance arm. (to counteract effort arm the resistance should be efficiently lengthened)

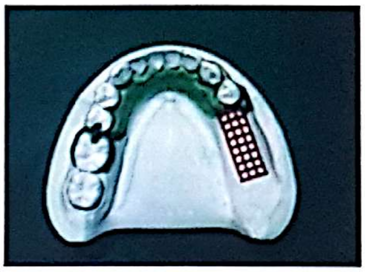

Figure 2: Design of cross arm stabilization arm should end in between second premolar and first molar

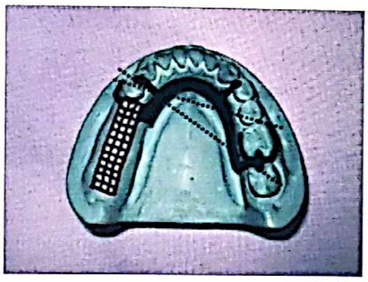

Figure 3: Traditional Design

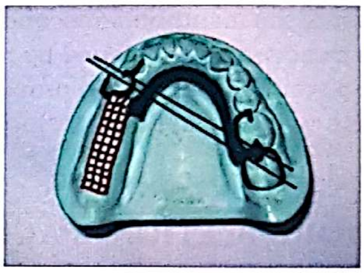

Figure 4: Modified Design

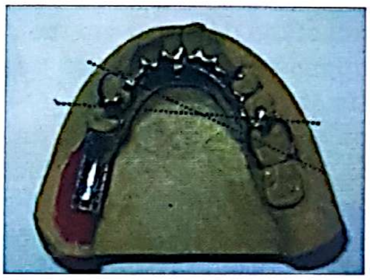

Figure 5: Alternate Design in Case of Weak Abutment Adjacent to Edentulous Area

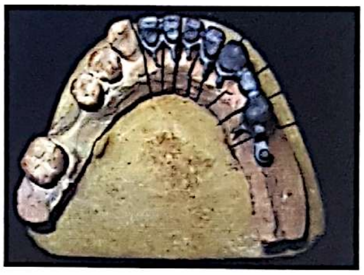

Figure 6: (A) Metal Tryin showing Rhein's Attachment

Figure 6: (B) Wax Up Showing Lingual Retainer on mandibular left second premolar

Figure 7: (A) Cast Partial Denture with Remodified Hart –Dunn Attachment

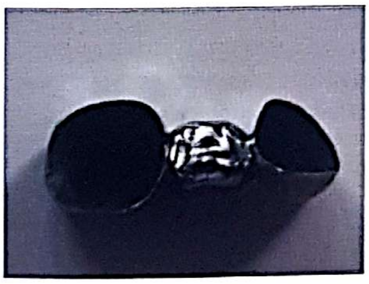

Figure 7: (B) Fixed Partial Denture with Modified Subpontic Area

Design III

This design [Figure 5] is advocated when a tooth adjacent to the edentulous area is of weak prognosis and there are chances that the tooth may be lost in future. The fulcrum line connects the rest on the left mandibular first premolar with those on the right mandibular second premolar and first molars and the direct retainer on the molar is placed posterior to the fulcrum line. Thus, when the moves away from the supporting tissues distal extension base, the linguoplate will provide indirect retention. The direct retainer on the left mandibular first premolar will disengage and the direct retainer on the right mandibular first molar will be activated which will prevent lifting of the RPD in the dentulous side of the arch.

In any event, if the mandibular second premolar is lost in future then the framework does not need to be remade, as the proximal plate and the distal occlusal rest of the mandibular second premolar will have to be removed and replaced by resin. The only compromise would be a lack of a proximal plate, the role of which will be played by resin.

DESIGNING OF KENNEDY'S CLASS II (WITH MODIFICATION SPACES)

Kennedy's Class II with Modification I

Design I

When modification space(s) is present, there is a lot of potential to develop additional frictional retention and reciprocation by increasing the number of guide planes adjacent to edentulous spaces.[13] This design utilizes a semi-precision attachment [Figure 6a] adjacent to edentulous side of the arch. The lingual retainer [15] without a visible buccal clasp arm is placed on mandibular left first premolar. The lingual guide plane on the anterior teeth serves for additional frictional retention [Figure 6b]

Design II

Remodified Hart-Dunn Attachment [Figure 7a]

The Remodified Hart- Dunn attachment described by Don Graver [16] can be used for Kennedy's class II with modification space. The modification space is replaced by a fixed partial denture [Figure 7b] with a modified subpontic area, which engages the wrought wire sub-pontic clasp of the stabilization arm. The undersurface of the pontic should be convex from buccal to lingual and concave from mesial to distal. The occlusal rest system directly over the attachment prevents vertical displacement on that side of arch; this clasping system reduces torque on the dentate side of the arch due to the subpontic attachment

CONCLUSION

There is good evidence that good oral hygiene and regular control of the dentures are the major factors of a good prognosis for prosthetic treatment with RPDs.[17] It is important to reduce vertical and horizontal forces transmitted to abutment of RPDs taking into consideration the various factors involved in designing a unilateral distal extension partial denture for favorable prognosis and prolonged service.

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