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Review Article

Rotational path removable partial denture: A literature review

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Rotational path of placement has been introduced to dentistry since long but do not have adequate popularity because of different factors, which are discussed in this article. A comprehensive MEDLINE search from 1935-2006 with the key words of “rotational path” and “dual path” were supplemented with hand search to identify relevant peer- reviewed English articles published in dental journals. In order to fabricate a prosthesis with rotational path of insertion we should not only know the definition, advantages and disadvantages but also its problems and the approaches to overcome them.

Key words: Dual path, removable partial denture, rotational path

INTRODUCTION

Although implants have become a popular treatment in edentulous states, long-term follow-ups reveal some complications in the treatment and this emphasizes that conventional treatments have their own efficacy.[1] Removable partial denture is one of the most common treatments. Despite its simplicity and efficacy, removable partial dentures (RPDs) have some drawbacks, including poor esthetic and recontouring that is required to accommodate the dentition for the RPDs. Although modifications such as using attachments[2] and tooth color clasps[3] have resolved these problems, increased complications and problems (e.g., increasing cost and time and added laboratory phases).[4,5] The peer-reviewed English literature pertaining to the rotational path was identified through the Medline search engine and manual searching for the period between 1935 and 2006.

HISTORY

The procedure incorporating a curved path of placement is credited to Hallen Back; this was reported in 1935 by Humphereys.[6,7] In 1958, Mann described an attachment that required a modified path of placement.[8] A similar application of the curved path of placement was described by Garver.[9] The rotary path of insertion was introduced to dentistry in 1978 and became popular in 1980.[10-16] The system proposed by King *et al.*, although limited to tooth supported RPDs, has more versatility because it does not depend on a fixed prosthesis and it supplements the efforts to resolve the esthetic and functional problems.[13,14]

Krol and Jacobson offered physiologic and engineering principles for application of rotational path of insertion.[10,16] The most comprehensive description of this procedure was found in the study by Krol *et al.*[16] Helberstam and Renner stated that, although the rotational path RPD had been available for many years, it was often overlooked by the dental literatures.[17] Possibly, as Asher noted, there might be an inadequate understanding of the mechanics of the design of the rotational path RPD.[18] Other reasons may include the difficulty in obtaining scientific support, absence of the documented evidences for long-term clinical success or a general lack of confidence in the efficacy of the procedure.[5,19]

DEFINITION

The rotational path of insertion is an alternative to the conventional methods for attaining the retention of RPDs.[17] By exploring many clinical applications that is provided by this technique, emphasis is laid on its use in the esthetic replacement of missing teeth.[11]

The customary approach to partial denture design involves the use of a path of insertion relatively perpendicular to the existing occlusal plane. This normal straight path of insertion requires all the rests to be seated simultaneously,[10,11] but the rotational concept permits the rigid retentive components to gain

access to the undercut areas of the abutment teeth through a rotational path of insertion.[10,11] The rigid retentive components are the minor connectors and proximal plates that substitute for certain conventional clasp retainers[11,17] and in each case, one or two rigid retainers are used on one side of the framework in conjunction with one or two clasps on the opposite side of the framework.[17] Rigid retainers, as any direct retainers, must satisfy six biomechanical requirements: retention, bracing, support, encirclement, passivity and reciprocation,[17] but the last requirement cannot be considered in the absence of a flexible retentive component.[10] Whenever a rotational path is used, the segment that sits first uses a rigid retainer and the second segment uses a conventional clasp for retention.[20]

CATEGORIES

Many classifications have been made for the rotational path. The first classification is based on the center of rotation. The center of rotation could be at the end of the long-occlusal rest seats[10,11,17] or at the gingival extension of the minor connectors that also serve as rigid retentive elements.[11,13,21] Classification could also be made on the basis of the type of seating. The first type is anterior-posterior sitting; in this type, the anterior abutment, which could be an abutment of class IV edentulous arch or a posterior edentulous arch, sits first.[21] The second one is the posterior-anterior sitting in which the rigid retainer on the posterior abutment sits first and then, the remaining of the prosthesis [Figure 1]. The third one is lateral sitting in which the mesial and distal undercuts of the abutments on the either side of a unilateral edentulous space serve as a retention for its first segment and rotates toward the contralateral side.[22-24]

Another classification is based on the number of paths of insertion. In some categories, the prosthesis sits in a rotational manner; however, in the others, the prosthesis sits in a dual path. (The first path is a straight path and the second one is a rotational path). The latter can be seen in anterior-posterior prosthesis in Kennedy class IV edentulous spaces.

ADVANTAGES AND DISADVANTAGES

Long-term clinical success in the rotational path technique has been demonstrated in several patients. Various authors have discussed the advantages of the rotational path technique in relation to the reduction of the clasps within a prosthesis and enhancing esthetics.[10,11,13,14,16,25-27] This design in comparison to the conventional clasp design, often reduces the tooth coverage; therefore, it decreases the tendency for plaque formation and minimizes the adverse periodontal responses.[10,12] Furthermore, the elimination of some flexible clasp arms reduces the probability of the clasp distortion.[10,12] By providing access to the retentive undercuts located on the proximal tooth surfaces, this design may be helpful in the absence of the buccal and lingual undercuts.[10]

Beside these advantages, the design also has some drawbacks; mainly, it is sensitive technique with very small margin of error and also the complete assistance of a skilled dental laboratory technician is required.[10,12] Moreover, the dentist should provide adequate tooth preparation for special rest seats and occasionally for the conventional restorative treatment.[10,28] The procedures required to improve the deficient retention of rigid retainers differ from those applied to the conventional clasp arms.[12]

PROBLEMS

While performing a rotational path, some problems might be encountered that require proper management to attain success. The finishing and polishing of the proximal surface should be minimized so that the rigid retainer is in close contact with this surface.[12] In this design, long rests that are more than half of the mesiodistal width of the abutment with nearly parallel walls should be used and planning of the rests must be carried out in such a way that the proximal surface used for the retention and the walls of the rest seat are parallel to permit the initial straight path of insertion [Figure 2]. This parallel arrangement is easily checked with a surveyor. Without this relation, the insertion even for a conventional path is impossible.[12] The other area that must be analyzed to accommodate the rotational path is the surface of the prosthesis adjacent to the proximal surface of the abutment that will receive the conventional clasp.[21] This area and the undercut for a rigid retainer must be analyzed by using a divider and by surveying the cast in an appropriate position to determine the necessity of the block out and reshaping, if required[12,20,29] [Figure 3].

Restorations for modifying the proximal contour to receive rigid retainers have been advanced by several authors,[12,23] but the shearing forces generated by the rigid retainers while moving occlusally can easily break the restorations with inadequate bonding strength.[30-33]

The vertical discrepancy between the centers of rotation can affect the retention.[12] This implies that the path of insertion of the conventional clasp may be offset so that what appears to be a proper retentive undercut is not really one since the walls of the rest seats will not be parallel. Binding can also occur between the rests.

The length of the posterior ridge requires special

attention in performing a block out. If two teeth have equal occluso-gingival dimensions, the tooth that is farthest from the center of the rotation will require less block out to prevent the prosthesis from binding because the arch will have less curvature and will be more vertical. The arch shape can also affect the proper seating of a rotational prosthesis. The square arch in comparison to tapered arch has bilateral centers of rotation with radii that are parallel bilaterally and pass through all the abutments perpendicularly from an axis of rotation that unites the right and left centers. Therefore, in a tapered arch, the centers of rotation and their radii must be relocated along their axes of rotation. In other words, the bilateral radii must be parallel to each other and must bisect their respective abutments for the conventional clasps.[12] Increasing the curve of Spee can increase the height of the retentive point of the conventional retainer above the horizontal plane. Therefore, the effective undercut of the proximal surface that is used for the rigid retainer will decrease.

Figure 1: Posterior-anterior prosthesis with rigid retainer in the mesial surface of the posterior abutment

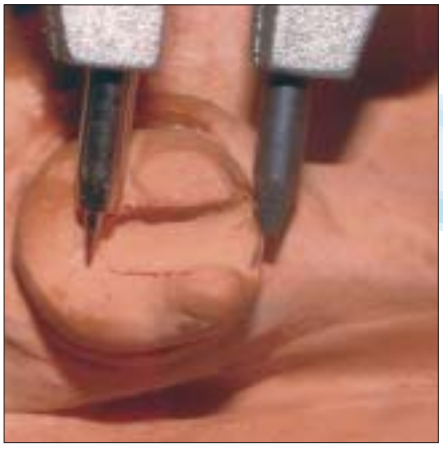

Figure 2: Usage of a divider to analyze the path of insertion

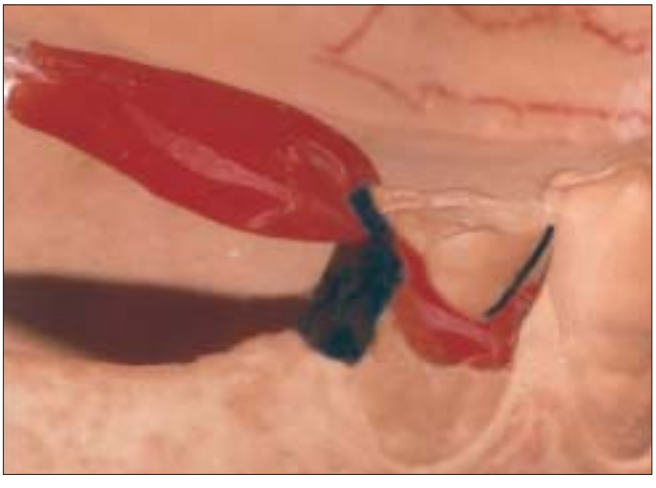

Figure 3: A custom-made device to block out proximal surfaces

The projections of the soft tissues, bone or lingually tilted teeth, can interfere with seating of a rotating framework and must be considered in treatment planning. Another problem in the laboratory phase of the treatment is the attempt to place the framework provided by bead retention on the master cast during finishing. The bead retention makes contact with the rigid edentulous ridge and prevents the rigid retainer from reaching the area of rotation and it somewhat grinds the area.[20]

The last problem occurs when an infrabulge clasp is used as a conventional clasp in treatment planning. The body of the clasp contacts the buccal surface of the anterior abutment and prevents the framework from complete seating; therefore, an additional block out will be required.

SUMMARY

When a prosthesis with a rotational path of insertion is properly designed and constructed, it becomes strong, hygienic and esthetic. This procedure can decrease the tooth coverage, which is advantageous in plaque control, caries reduction and periodontal health.

When the prosthesis with this design is properly fabricated, the abutment teeth without clasps will not change their position because of the unique design of the occlusal rest seats and the retentive minor connectors.

These characteristics along with flexibility made the clinicians to perform the most beneficial treatment for patients; moreover, this treatment avoids the restrictions in developing new techniques. We should also consider systematic investigations to compare the rigid retainers with flexible retainers that have not been developed thus far.

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