A novel Approach to Maxillary Long Kennedy Class II RPD Crossing Midline

Amal H. Moubarak[1,3], Walaa A. Babeer[2,3], Afaf A. Almabadi[2,3]

[1] *Professor& Consultant of Prosthodontics*

[2] *Assistant Professor& Consultant of Prosthodontics*

[3] *Department of Oral and Maxillofacial Prosthodontics, Faculty of Dentistry, King AbdulAziz University*

KEYWORDS

Class II Kennedy RPD crossing the midline, lingual retention, guiding planes.

ABSTRACT:

Statement of problem: Unilateral distal-extension removable partial dentures (RPD) have always posed a challenging situation to the clinician particularly when it crossed the midline and having a linear alignment of the abutments. In such cases, providing adequate retention and stability is problematic thus, the good selection of the direct and indirect retainers would ensure the long- term success of the prosthesis and the remaining abutments. Purpose: The aim of this study was to apply the idea of unilateral obturator Aramany class IV principles to the patients suffering from linearly aligned abutments long Kennedy class II RPD crossing the midline through using buccal retention and lingual retention with guiding plane composite build-ups clasp designs. Treatment Plan: Three patients were treated in this study. All the patients are fully dentate or with restored mandibular jaw and partially edentulous maxillary jaw (Kennedy class II) crossing the midline with a maximum of six teeth present in a linear alignment. Each patient received RPD that was retained through engaging the buccal undercut on anterior distal abutment and lingual undercut with composite build-up guiding plane on posterior distal abutment. Conclusions: Our findings suggest that buccal retention on anterior abutments and lingual retention and guiding planes on posterior abutments for linear class II maxillary RPD provided better patient satisfaction and more retentive capability than RPD with regular buccal retention design.

1. Introduction

In situations of advanced tooth loss, the number of remaining teeth may be inadequate or there is poor distribution of teeth around the edentulous arch that will make the provision of RPDs a challenging choice. These remaining teeth might be so compromised that finding suitable abutments for clasping would be a problem to get the reasonable retention. One of these situations is class II Kennedy classification especially when the edentulous area crosses the midline in the maxillary arch. In such cases, the greater the teeth lost, the higher would be the unfavorable forces acting on the remaining teeth. Consequently, RPDs supported by only a few residual natural teeth had lower survival rates than RPDs with more abutment teeth [(1).]

The load induced by RPD, particularly in Kennedy class II situation is shared between the abutment teeth and residual ridges [(2).] Where residual ridges offer little resistance to the horizontal rotational tendencies of a denture; the remaining teeth, on the other hand, will be responsible for resistance of such rotation. Thus, a correctly designed RPD will, in fact, utilize the remaining teeth to resist horizontal forces caused by rotary movement around the fulcrum of the terminal abutments [(3).] It should also be noted that when the terminal abutments are more likely to be in a linear or straight line, the fulcrum line will be the same as the tooth alignment [(4),] and as a result, the indirect retainer on the fulcrum line will be of little effectiveness, if has any. This condition is alike to cases of maxillary defect with class IV Aramany classification where the retention is needed not only to resist the displacement along the path of insertion but also to resist the rotational displacement of the prosthesis away from its place due to the force of gravity and function of surrounding tissues. This situation also results in a tendency for greater movement around the fulcrum line under function and consequently, a greater cantilever forces and mechanical disadvantage of the prosthesis on the abutments [5,6]. All these former factors can contribute to the instability of this RPD and the greater potentiality for movement, so the biomechanical principles relevant to prosthetic rehabilitation of maxillectomy defects could be utilized in this condition.

The use of mechanical principles in designing RPD could help in distributing and controlling the anticipated forces so that each element of the oral cavity could be used with maximum effectiveness without being stressed beyond its physiologic limits. In maxillary Kennedy class II crossing the midline, the expected retention of RPDs is less than ideal and stability becomes highly challenging. If the prosthesis is less stable, more movement with forces of mastication will be created (7). Consequently, the position of the direct and indirect retainers would be a critical factor, regarding the construction of an RPD design for these cases. Certain considerations were suggested to be involved in the design of these cases, such as, a mixture of retention locations on buccal and lingual surfaces and addition of guide planes to ameliorate retention and stability [6].

For conventional partial dentures, subtractive mouth preparation is usually sufficient, but with the other unconventional frameworks, additive mouth preparation is frequently required as well, and always done through the full "surveyed" crown. As for surveyed crowns, they are associated with many problems such as; marginal integrity, reduction of tooth structure, creation of esthetic veneers, and the re-establishment of occlusal surfaces. In addition, the use of surveyed crowns is often not possible due to the compromised condition of the remaining teeth or financial cost [7-9]. Therefore, using the technology of bonded contours, would eliminate many of these problems. Additive method for mouth preparation, using composite buildups is appropriate for all types of mouth preparations, particularly the creation of suitable undercuts, in addition composite buildup has greatly reduced the cost of preparing the mouth for the complex removable partial dentures [8].

The Use of composite in removable prosthodontics to overcome recontouring problems was introduced 1976 by Jenkins and Berry [10]. Several authors have addressed how composite resin use improves RPD design with respect to durability, wear resistance, and retention [11]. It was reported that the use of hybrid micro filled composite resin for the creation of undercuts provides a clinically durable structure with average of 87% of the initial undercut remained after a simulated 5-year period [9,11-17]. In 1984, well before the use of the current generation composite resins, Hebel et al [18] reported an average of 20 µm of wear over a simulated 3-year period for enamel against a chrome- cobalt I-bar, compared to 50 µm of wear for composite resin. Reduction up to 50-µm of the original basic undercut 250-µm over 3 years of service would not be a significant retention loss. Alfonso et al [9] suggested light-cured composite resin for the easy and predictable creation of desirable contours on abutment teeth for the retention and support of a removable partial denture and described a technique in which appropriate abutment tooth contours are created on a diagnostic cast, captured in a clear vacuum-formed template, and formed in resin on the abutment teeth with the template acting as a matrix. The introduction of acid-etch-retained resins has made the rapid modification of tooth contours without hard tissue removal possible [15]. Recently, a new generation of highly filled composite resins was introduced that demonstrated improved properties during the service period compared with conventional composite resins. The probability of failure of the highly filled composite resin restorations was not significantly different from that of the metal ceramic restorations evaluated [19-22].

The negative effect on the periodontal conditions of abutment teeth increased as the number of teeth supporting the removable partial dentures decreased [23,24]. Therefore, it is expected to have more increase in the movement along the rotation axis of the prostheses because of linear dental support that might lead to an increased abutment tooth mobility and put these abutments under risk. Hence, the suggested design might decrease the movements of RPD and consequently the stress placed upon the abutments and its supporting tissue condition.

Treatment Plan:

1- Participants:

Three patients were participated in this study. Their range of age was 45–58 years. They were fully dentate or with restored mandibular jaw and partially edentulous maxillary jaw (Kennedy class II) crossing the midline with maximum of six teeth present in linear alignment. All the patients came with buccally retained RPD and complaining from their instability and ineffective retention. Prior to prosthetic treatment, all the other necessary dental treatments such as periodontal and restorative treatments were carried out. All subjects were rehabilitated with RPD following all biological and mechanical general principles of removable partial denture design and construction to minimize the forces transmitted to the supporting tissues. The clasp design included two Aker clasps on anterior and posterior abutments with two extension rests on neighboring teeth was used. Complete palatal plate was used as a major connector to support the indirect retention of the prosthesis[3] and enhance the retentive capability of the design[27]. An open/hygienic RPD design was used to minimize the adverse effects of wearing RPDs on the remaining teeth and periodontal tissue [28]. RPD was retained through engaging the buccal undercut on anterior abutment and lingual undercut with composite build-up guiding plane on posterior abutment. The reciprocal clasp arms were placed on the surfaces opposing that used for retention. The undercuts engaged by the retentive arms were limited to 0.25 mm. The framework casts were made in cobalt– chrome alloy (Wironit, Bego Laboratories, Herbst GmbH & Co., Germany). At time of placement and during the recall visits, an indicator paste was used to detect any pressure areas, which were relieved accordingly and all occlusal adjustments needed were carried out. After removable partial denture placement (Fig.1), all the subjects received oral hygiene instructions. Motivation, instruction and professional oral hygiene care were instructed to prevent the progress of periodontal disease to a minimum [3,29]. Recall done after three months to address and manage any complaints.

Fig(1): The RPD design (buccal retention on distal anterior abutment and lingual retention on distal posterior abutment)

2- Composite build-up of palatal guiding planes for lingual retention on distal posterior abutment

On the diagnostic cast, the areas of desired additive recontouring on the lingual surface of posterior abutment was marked, waxed and trimmed on a dental surveyor to create the parallel surface of the guide plane in addition to creation of 0.25mm undercut on the distal side. Once these contours were fully established, the cast was duplicated in stone and a vacuum-formed clear template with 3mm thickness was made for this abutment to force the composite into its place before light curing[9]. The template was trimmed to retain sufficient occlusal extension in order to allow for positive repositioning. Isolation and etching steps was completed and followed by filling with nano – filled packable composite (Nanofilled Premise, Kerr, Orange, CA, USA) with the aid of the template. Composite of a slightly darker color than the tooth surface was used to make identification of the excess easier. To guarantee the ideal recontouring including the guide plane and the retentive lingual undercut that were established in diagnostic waxing , a check-up cast made from an alginate impression and poured in fast-setting stone was placed upon the dental surveyor and measuring the lingual retentive undercut was done[8,9].

Clinical Outcomes

Posttreatment comments of the patients about their new dentures were satisfactory and appreciated the better retentive quality of their new RPD in comparison to their previous regular ones.

Discussion

In a distal-extension removable partial denture (RPD) for a unilateral edentulous area, the retention and stability of the denture are usually gained by retainers placed in the contralateral side of the arch to the saddle [31.32]. In case of whole abutments loss on one side, expressing adequate retention and stability in this condition is problematic [33,34]. Thus, the use of diagonally opposed retention and stabilization system, which were utilized in a fashion similar to the class IV linear design Aramany classification, where Aker clasps were located on the buccal surfaces of the anterior abutment and the palatal surfaces of the posterior abutment [35-37], might help in providing adequate retention and stability.

Due to the unilateral location of the abutment, all retentive arms will be located on one side of the arch, the RPD will rotate in tissue away direction and the clasps may get out of their corresponding retentive undercuts. Lingual retention might improve the location of the clasp axis, so that fulcrum line would pass through the clasp tips placed on the anterior and posterior abutments in an angle to the abutment alignment line. Doing this would permit an increase in the effectiveness of the indirect retainer [32], mainly the bracing arm on the buccal surface of posterior abutment, through increasing the distance between it and the fulcrum. Moreover, the bracing arm will supposed to be in a more favorable lower position because the height of contour on the buccal surface is at the cervical one third. This may also promise a reasonable reciprocal effect of the lingual arm and may as well generate better retention and stability of the denture (Fig. 2&3). Moreover, the angle of convergence of the undercut on the lingual side is mostly steeper than that on the buccal side [38]. Yet, even though the depth of undercut was the same (0.02 inch), the retentive arm on the lingual side would still need to travel through a steeper incline during removal. In other words, the distance the retentive arm would travel before it was completely removed would be less on the lingual surface than on the buccal. Thus, if the angle was less, but in the same relative position, the total force necessary to remove a clasp through a greater angle and lesser distance would be more and this would be interpreted into a more retentive appliance [38]. Many studies has proven the advantages of lingual retention [38.39]. On the contrary, the use of only buccal retention might increase the movement along the rotation axis of the RPD because of linear dental support that consequently may lead to an increase in abutment tooth mobility. If we add the aforementioned factor to the fact of low expressed values of retention of the buccally retained RPD, a great substantial stress on the abutment teeth might be expected.

Fig (2): Classic design with clasp axis on buccal surfaces of both distal anterior and posterior abutments

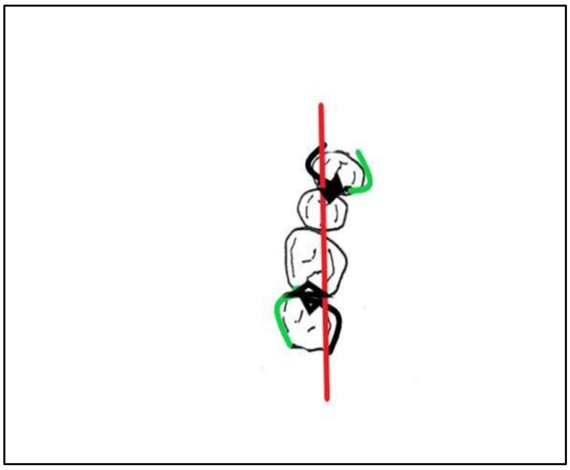

Fig (3): Suggested design with clasp axis on buccal surface of distal anterior abutment and palatal surface of distal posterior abutment

As the effectiveness of using the concept of buccal-lingual retention mixture alone might be in doubt., the addition of guiding plane composite buildup may limit the ability of RPD to rotate as if the guide plane change the survey line into survey area and when the retentive tip tried to disengage from it, more time and effort have to be exerted before this disengagement occurs [5]. In this way, guide planes may facilitate better stability (8,40-48) as proven with maxillary obturators [49]. However, our findings suggested better stability with the use of guiding planes; it might be accompanied with higher stress values on the abutments as demonstrated by Sun et al [49] who assumed that the components of the resin-bonded guide plane with attachment would be subjected to more severe stress in comparison to the conventional RPD. The biomechanical analyses of the effect of guiding planes in different design situations had rarely been found in the literature. The purpose of guide plane in addition to lingual retention was supposed to enhance the retentive capability of RPD, beside their benefit in reducing the mobility of abutments. This kind of design may prolong the life of the abutment and lead to a successful prosthodontic rehabilitation for cross-arched maxillary Kennedy class II.

Luckily, the height of contour in the lingual side is present on the middle of the surface [50-51] which accordingly allows the retentive tip to be in a better position in relation to the gingival tissue and hence, to the application of oral hygiene measures which may help in preserving the supporting structures for longer time.

Our aim was to use the biomechanical principles relevant to prosthetic rehabilitation of maxillectomy defects in order to minimize the cantilever forces in addition to reduce the rotatory movement and thus, protect the abutments from being subjected to extra load beyond their capabilities to withstand. The suggested lingual retention with guiding planes may promote the stability of RPD [52]. and reduce the mobility of abutments in comparison to the buccal retention design because of the presence of more effective indirect retainer that minimizes the risks of the denture base to move away from the supporting tissues. Many studies reported the use of indirect retention more often in maxillary Class II RPDs [53,54]. In addition, the parallel guiding planes achieved could make a substantial contribution to stability and can also aid in retention [41-47,55,56]. Furthermore, more retention was obtained from lingual side as described before which could add more to the sum of the stability of the whole design.

When the abutment is compromised in regard to its position like in our cases, the clinical decision-making of how much it could bear becomes complicated and retention load distributed to each abutment should be as low as possible to avoid damaging of this abutment, yet still can maintain adequate retention. Probably, the position of lingual retentive clasps may lead to better retentive capability and less movement and consequently, to less activation cycles of the clasp, deformation and clasp wear that may end up with more mechanically stabilized RPDs.

Conclusion

Maxillary class II Kennedy classification RPDs crossing the midline retained by lingual retention and guiding planes on distal posterior abutment may have a more favorable clinical prognosis of the abutment and reasonable higher retentive capability of the RPD than that using only buccal retention on both distal anterior and posterior abutments; however, a more longitudinal studies with larger samples are desirable to gain deeper insight into the influence of long term use of such design.

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