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Case Report

Rotational Path Removable Partial Denture with Attachment: A Case Report

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Abstract

Currently, removable partial denture (RPD) is a desirable treatment option in partial edentulous patient to restore function and esthetic. Efficient function and esthetic of fixed partial denture and implant options are superior to RPD. However, they require more financial. In case of mesial shift posterior abutment, the RPD design is difficult to fulfill the requirement concept of conventional RPD. Therefore, the rotational path RPD with precision attachment is the design that gain proper retention and acceptable esthetic outcome than the conventional RPD design. This case report was shown the rotational path RPD design with precision attachment in clinical method and laboratory technique.

Keywords: partial edentulous patient, precision attachment, removable partial denture, rotational path RPD

Introduction

Prosthetic dentistry involves the restoration and maintenance of oral functions, comfort, appearance, and health of the patient by the replacement of missing teeth. Rehabilitation of partial edentulous patient can be done by several methods. Fixed partial denture and implant are preferable options. However, they are alternative limit due to economic reason. Therefore, removable partial denture is restored for patients faced with financial, anatomical, and esthetic limitations.[1,2]

Rotational path designs may minimize periodontal problem from removable partial denture by reducing plaque accumulation and may be applied in esthetically demanding situations. In addition to, rotational removable partial denture with extra coronal precision attachment is a proper treatment that gain retention of denture by using of rigid retentive components in undercut area and reducing the conventional clasps.[3]

Principles of rotational removable partial denture

Designing the components of rotational removable partial denture that differ from conventional removable partial denture are

1. Proximal plate that likes retentive component, is designed to gain retention at undercut area of mesial surface of posterior abutment teeth. Proximal plate of rotational removable partial denture is rotated following path of rotation, allowing the rigid components access to undercut adjacent to the edentulous spaces. Then, the other components are rotated into its final position.[3,4]

2. The rests should extend more than half the mesiodistal dimension of the posterior abutment tooth, and its buccal and lingual walls should be nearly parallel. The walls of the rest seats should be parallel bilaterally across the arch to permit seating of the rests.[6,7]

3. Designed abutment tooth like as direct retainer requires.

3.1 Support is achieved through proper rest design.

3.2 Retention is provided by proximal plate.

3.3 Encirclement to prevent tooth movement is accomplished through the design of the rest seat such as dovetails, mesiodistal extension, and minor connector.

3.4 Bracing is achieved through the intimate contact of rigid rest and minor connector with the relatively parallel walls of the rest seat and the proximal tooth surface.

3.5 The retentive component is passive when all components seat without generating active forces on the tooth.

3.6 Reciprocation is not a consideration in the absence of a flexible retentive component.

Rotational path designs can be divided into two categories.

1. The rotational center of the framework is located at the end of a long rest and is seated first. The other components are rotated following path of rotation and seat. This design is used to replace missing posterior teeth in Kennedy Class III which mandibular mesially tilted molars serve as distal abutments.[3,4]

2. The rotational center and the proximal plates are located at the most gingival extension and first intimate contact with the proximal tooth surface. Then, through a rotational path of insertion the remained of framework is seated. This design is used in the maxillary arch for esthetic reasons such as in Kennedy Class IV patients.[3,8]

Indications[3,4]

Rotational path design is considerated for replacing posterior teeth in Kennedy Class III especially tilted mandible molars and anterior teeth in Kennedy Class IV. This design may help overcome esthetic problems of conventionally designed removable partial dentures by eliminating the need for some clasps and decrease tooth coverage, which lessens the tendency toward plaque formation.

Contraindications[8,9]

Distal extension removable partial denture for example Kennedy Class I and II are not recommended to design the rotational path. Wax trimmer with divider is a necessary instrument for designing path of rotation and surveying the parallel of abutments so lack of it cannot design rotational removable partial denture. Rotational removable partial denture does not apply in case of replacing one anterior tooth because of inadequate space for proximal plate and the cingulum rest intimate contacts at center of rotation and cingulum rest seat respectively.

Case report

A female patient aged 52 years old reported to the dental department of Thayang hospital with chief complaint of masticatory efficiency. She gave a history of absence molars more than 5 years. She had worn metal removable partial denture 2 years ago but clasps retainers had made dislodgements of resin composite restoration at buccal surface of left and right second mandible premolars several times. Other patient's chief complaint was the sensitivity of upper left maxillary molar when chewing.

Patient's expectation in this treatment was the solving of sensitivity of upper left maxillary molar and improve the masticatory function and esthetic appearance of removable denture.

The patient had healthy medical history and no drug allergy. Her oral hygiene was good level.

Clinical extraoral examination did not find TMJ and masticatory muscles problems. Facial form was ovoid shape. Facial profile was straight.

Clinical examination

Maxillary arch (Figure 1A)

• Right second maxillary molar (17) had marginal leakage surface of full metal crown.

• Right first maxillary molar (16) was root canal treated tooth with large resin composite and amalgam restorations.

• Right second maxillary premolar (15) had occlusal marginal leakage of OM amalgam restoration.

• Right first maxillary premolar (14) had occlusal marginal leakage of OD amalgam restoration.

• Left first and second maxillary premolars (24, 25), second maxillary molar (27) were abutments of porcelain fused to metal bridge (24-27) with abrasion and cavities at cervical of teeth.

• Left third maxillary molar (28) had large cavity, sensitive to exam by explorer instrument and cold water.

Mandibular arch (Figure 1B)

• Left and right third mandibular molars (38, 48) had occlusal leakage of amalgam restorations.

• Left mandibular second premolar (35) which had attrition, sensitive to sweet and sour food.

• Right mandibular second premolar (45) had resin composite restoration at cervical, OM amalgam restoration.

• Right mandibular first premolar (44) had OD amalgam restoration.

• Left, right first and second mandibular molars (36, 37, 46, 47) were missing. Width of alveolar ridge at edentulous area was average and ridge's height was medium. Resiliency of gingival soft tissue was normal.[11] This edentulous area was classified to Kennedy's classification III modification I.[2]

Occlusal analysis

In centric occlusion, It was unclassified Angle's classification because of absence of left and right first mandibular molars.[11] Right first and second maxillary molars were extruded teeth. Interocclusal distance when physiologic rest position at right edentulous ridge was 3 mm (Figure 1C), left edentulous ridge was 4 mm (Figure 1D).

Periodontal status

Gingival recession was found at right first, second maxillary premolars and molars (14-17), left first and second maxillary premolars (24, 25), lower left second mandibular premolar, right second mandibular premolar and right mandibular canine (35,43,45) about 2-4 mm. Overall pocket depths were 2-3 mm.

Intraoral radiograph (Figure 2)

Periapical radiographs were found that

• Right second maxillary molar (17) which restored by full metal crown, was root canal treated and did not had apical lesion.

• Right first maxillary molar (16) which was root canal treated, had OM and OD restorations.

• Left first and second maxillary premolars (24, 25) and left second maxillary molar (27) were abutments of bridge. Left second maxillary molar had marginal leakage at distal. Left first and second maxillary premolars were root canal treated teeth.

• Left third maxillary molar (28) which had large cavity, was nearly pulp chamber but did not found periapical lesion.

• Left and right third mandibular molars (38, 48) had large and leakage of restorations and did not found periapical lesion.

• Right maxillary lateral incisor which was root canal treated tooth with fiber post reinforced, had distal restoration.

Clinical crown to root ratio (C:R)

• 38, 48, 45 C:R = 1:1

• 34, 35 C:R = 1:1.5

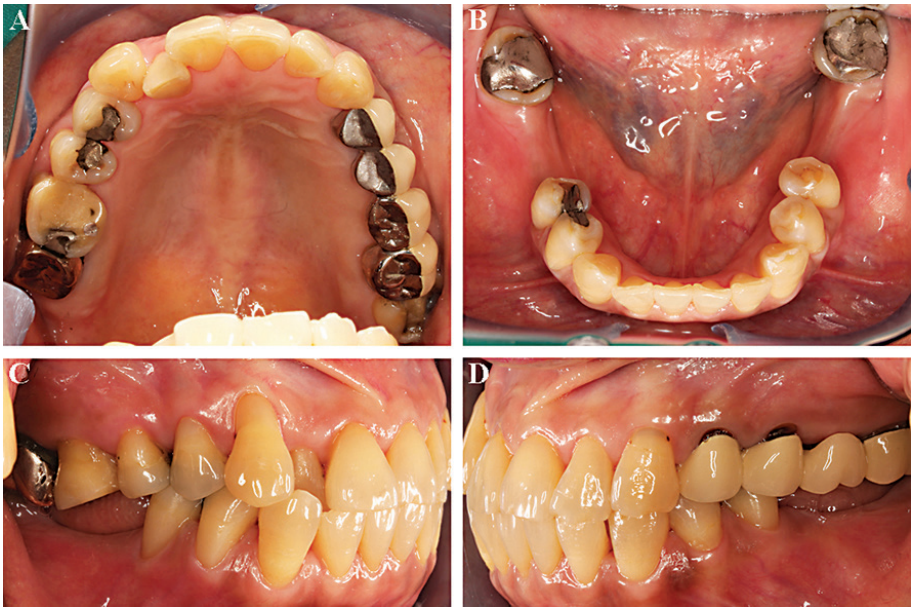

Figure 1: The intraoral examination. (A) The occlusal view of maxillary arch, (B) The occlusal view of mandibular arch, (C) The right lateral view of centric occlusion position, (D) The left lateral view of centric occlusion position.

Oral rehabilitation was the treatment's plan for this patient. Due to occlusal plane discrepancy in the form of supraeruption (16, 17, 27, 28) made occlusal interference when lateral movement and attrition in remaining posterior teeth of lower arch, adjusting proper occlusal plane was done.[12] Vertical dimension evaluated by freeway space and closet speaking space were 2 and 1 mm showed that patient did not loss of vertical dimension.[13] In addition, the goal of treatment's plan including the esthetic, fit to soft tissue in edentulous area and not disturb adjacent teeth.

Treatment options

Option 1. Crowns on Right maxillary first and second molars (16, 17), Left maxillary first premolar (24) and third molar (28), Left and right mandibular second premolars (35, 45), Left and right mandibular third molars (38, 48)

Bridge on left maxillary second premolar to second molar (25-27)

Implants on left, right mandibular first and second molars (36, 37, 46, 47)

Option 2. Crowns on right maxillary first and second molars (16, 17), left maxillary first premolar (24) and third molar (28), left and right mandibular third molars (38, 48)

Crowns with attachment on left and right mandibular second premolars (35, 45)

Bridge on Left maxillary second premolar to second molar (25-27)

Metal removable partial denture in lower arch edentulous area at left, right mandibular first and second molars (36, 37, 46, 47)

Option 3. Crowns on right maxillary first and second molars (16, 17), left maxillary first, second premolar (24, 25) and third molar (28), left and right mandibular second premolars (35, 45), left and right mandibular third molars (38, 48)

Upper metal removable partial denture for replacing Left maxillary first molar (26), lower metal removable partial denture for replacing left, right mandibular first and second molars (36, 37, 46, 47)

Treatment plan that patient decided was option 2 because of esthetic and financial reasons.

Clinical procedures

1. Diagnostic impressions were made using irreversible hydrocolloid. Maxillary cast was mounted on semi-adjustable articulator using a face bow while the mandibular cast was mounted by using interocclusal records.

2. Recorded bite registration in centric occlusion (CO), protrusive, and lateral movement by elastomeric bite registration material. These bite records were made for adjusting custom condylar guidance of patient in the articulator.

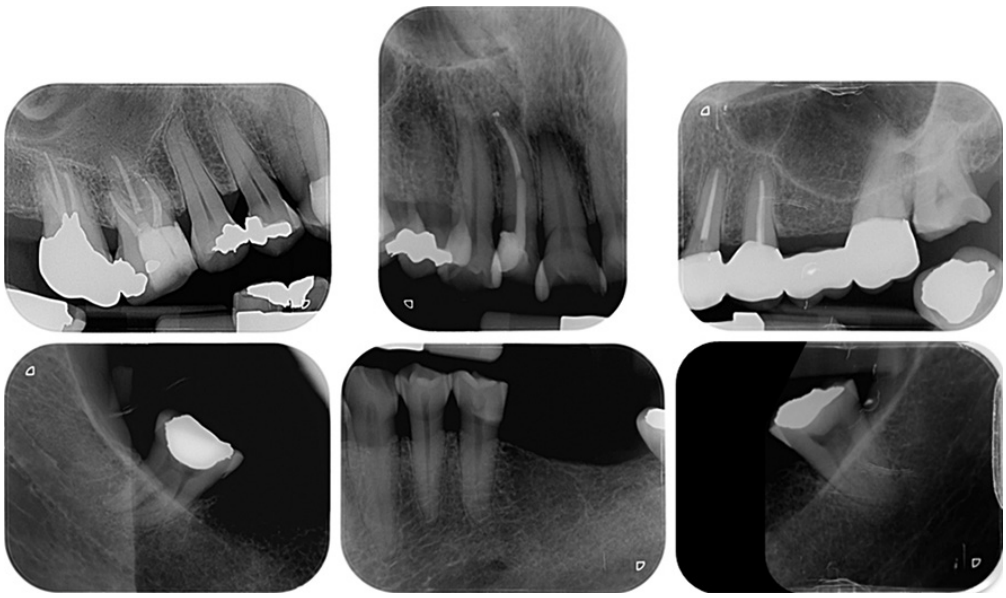

Figure 2: The periapical radiographs for treatment planning.

3. Mounted the study casts in the articulator and then adjusted condylar guidance by bite records. For this patient, right condylar guidance, Bennet's angle in the articulator were 50 and 10 degree. Left condylar guidance, Bennet's angle were 45 and 15 degree.[12,14]

4. Clinical and diagnosis cast examination revealed supraeruption of posterior teeth, a custom made Broadrick's occlusal plane analyzer was fabricated to altered proper occlusal plane. A favorable occlusal plane from Broadrick's analysis was a reference point for waxing up full contour of posterior teeth.

Broadrick's analysis

• The record card was placed on the upper member of the articulator.

• A pencil core was inserted on to the divider and it was adjusted to a selected radius. The radius of sphere of Monson was suggested to be at 4 inches in skeletal Class I relationship (Figure 3A, 3B).[14]

• The center point of the divider was located on distobuccal cusp of the lower last molar. Another pencil core bow of divider was used to create the posterior survey line (PSL) on the record card. The anterior survey line (ASL) on the record card was created by pencil core bow of divider and pointed the center of the divider at distance between cusp tip and distal marginal ridge of lower canine. Intersected point of PSL and ASL, which would be located on the record card, was called the occlusal plane survey center (OPSC). OPSC liked a center of radius of customed occlusal plane.

• The occlusal plane index was fabricated by auto polymerized acrylic resin and pink wax. Applied inner surface of occlusal plane index contacted to buccal surface of lower posterior teeth. Placed the center point of the bow divider, still adjusted to the 4 inches radius, at OPSC on the record card. Wax trimmer was placed on another sides of divider, was then swept over the occlusal surface of the occlusal plane index. The ideal occlusal plane would follow the curve of Wilson and the curve of Spee (Figure 3C, 3D).

• The new occlusal plane was altered by reducing the height of crowns right maxillary first and second molars (16, 17) that supraerupted from the occlusal plane and adding wax on buccal cusps of left and right mandibular third molars (38, 48) (Figure 4).[14,15]

5. Wax set up occlusal plane of posterior teeth followed the occlusal plane index then duplicated wax-up study model by irreversible hydrocolloid impression. The template for temporary crowns and bridge were made over the duplicated wax-up study model.

6. Right maxillary second molar full metal crown (17) and left maxillary Bridge (24-27) were removed. After the removal of the upper left bridge found large carious dentine on the left maxillary second molar (27), so removed carious dentine of left maxillary second and third molars (27, 28) and prepared teeth (16, 17, 24, 25, 27, 28) for the new crowns and bridge. Left maxillary first and second premolars that were root canal treated teeth, were fixed fiber post and core build-up before tooth preparation.

7. Left, right mandibular second premolars and third molars were prepared for abutment teeth of removable partial denture. The template was taken to check space for the new crowns and fabrication all temporary crowns and bridge were followed. And then final impression all prepared teeth were done by elastomeric impression material in both upper and lower arches. Interocclusal record was made by bite registration material.

8. Face bow was made to transfer relations to the semi-adjustable articulator. Temporary crowns and bridge were cemented using temporary cement (Temp bond NE).

9. Impressions were poured by stone type IV for making master models. And then mounting the master models on semi-adjustable articulator were done. Following which crowns and bridge in the upper master model had been waxed to full contour.

10. The wax-up full contours of lower master model was seated on the dental surveyor to create parallelism of occlusal plane. The distobuccal cusps of left and right mandibular third molars were located the center of rotation at the end of occlusal rest seat.[3,4]

11. The occlusal rest seat were made by wax trimmer (Figure 5A, 5B). The width and depth of occlusal rest seat was 1.5-2 mm with rounded internal line angle and paralleled axial walls that eliminated undercut and unsupported enamel. The rest should extend more than half of the mesio-distal dimension of the abutment tooth.(3,4,17) The center of rotation located at the terminal end and the most occluso-cervical depth of occlusal rest seat (Figure 5C, 5D).[4,16]

12. The divider applied for creating guiding plane at mesial of left and right mandibular third molars. The tip placed at center of rotation (DB surface). Another tip was wax trimmer, placed at mesial surface of teeth. The

wax trimmer was trimmed wax of posterior abutment to achieve guiding plane following the path of rotation. The wax trimmer was moved both bucco-lingual and occluso-cervical dimension.[3,4,16]

13. The guiding plane of distal surface of left and right mandibular second premolars were determined by the same procedure. One tip of the divider was placed on the center of rotation. Another tip that was wax trimmer, moved occluso-cervical dimension at distal surface of mandibular second premolar. The determined guiding plane of mesial of mandibular third molar and distal of second premolar followed the part of rotation at the same center of rotation (distobuccal cusp of lower mandibular third molars) (Figure 6A, 6B).[3,16]

For this case, patient decided to reduce the clasps on left and right mandibular premolars for esthetic reason. Therefore, the male attachments were placed on distal guiding plane of the teeth. The model was checked the wax-up full contour and then processed to the laboratory for casting crowns (Figure 6C, 6D).

14. The occlusal plane of all porcelain fused to metal crowns were analyzed by Broadrick's analysis (Figure 7). Tip of cusp of left and right mandibular premolars and third molars were equal to occlusal plane of occlusal plane index. The occlusal plane of the upper arch was in the plane of occlusal plane index.[14,15] The guiding plane of mesial of left and right mandibular third molars and distal of left and right mandibular second premolar followed the path of rotation.

15. Try in porcelain fused to metal crowns and bridge, check contact, occlusion, and polishing. All of porcelain fused to metal crowns and bridge except left and right mandibular second premolars were cemented by resin cement.

16. Left and right mandibular second premolar crowns were picked up by elastomeric impression and then the impression was poured by stone type IV. The lower cast that had left and right mandibular crowns were delivered to laboratory for making the framework of rotational path of removable partial denture (Figure 8A, 8B).

Wax pattern for rotational path removable partial denture must be concerned, did not block out undercut on mesial surface of left and right mandibular third molars because proximal plate should be intact to create retention. The area that required block out was undercut below female attachment on male attachment at distal of left and right mandibular second premolars. Proximal plate of framework should intact guiding plane at distal surface of left and right mandibular second premolars.[3,18]

17. The framework of removable partial denture (Figure 8C, 8D) was tried-in with unfixed left and right mandibular second premolar crowns. The occlusal rest seat of the removable partial denture placed first on rest seat of left and right mandibular third molars, followed by seating proximal plate contact to mesial guiding plane of left and right mandibular third molars. Then the major connector and minor connector with female attachment were rotated into final position. The female attachment should intact with male attachments at distal surfaces of left and right mandibular second premolars. The crowns were seated simultaneously with all components of the rotational framework were seated.

18. Occlusion was checked in centric occlusion position, lateral movement, and adjusted interference of framework before recording bite registration. The framework was returned to the laboratory for arranging artificial teeth and processing the denture.

19. Crowns were cemented on left and right mandibular second premolar abutment teeth (Figure 9A, 9C, 9E). The excess cement was awared by applied thin petroleum jelly (Vaseline) on female attachments, adjacent framework structure and male attachments at distal of left and right mandibular second premolar crowns. The crowns were cementing while the denture was in final position. Snap set polymerization of cement at buccal surface of crowns was created. The full polymerization all surfaces of crowns were created after removed the denture. Excess cement was removed for protecting adjacent soft tissue (Figure 9B, 9D, 9F, Figure 10).

20. The rotational removable partial denture was inserted and occlusal adjustment.

21. Giving the instructions to the patient how to remove and insert the rotational removable partial denture and how to clean well the appliances. Step for insertion followed by place the occlusal rest in the rest seat at the center of rotation, the proximal plate was rotated to contact the mesial guiding plane of left and right mandibular third molars and then press the major connector and minor connector with female attachment fitted in the male attachment at distal guiding plane of left and right mandibular second premolars, finally checked the denture was intacted abutment and tissue surface. Step for remove the denture was backward step of the insertion.[3-5]

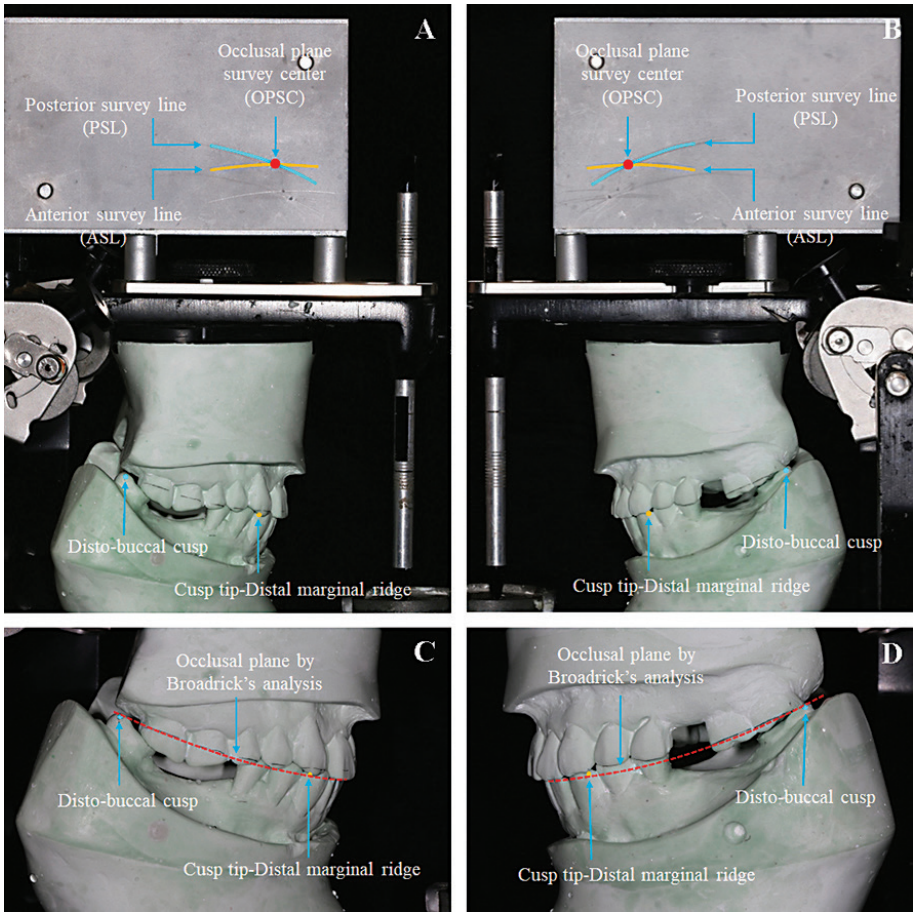

Figure 3: The occlusal plane was analyzed using Broadrick's analyzer. (A) The right lateral view, (B) The left lateral view, (C) The right lateral view of curve of Spee was created after using Broadrick's analyzer, (D) The left lateral view of curve of Spee was created after using Broadrick's analyzer.

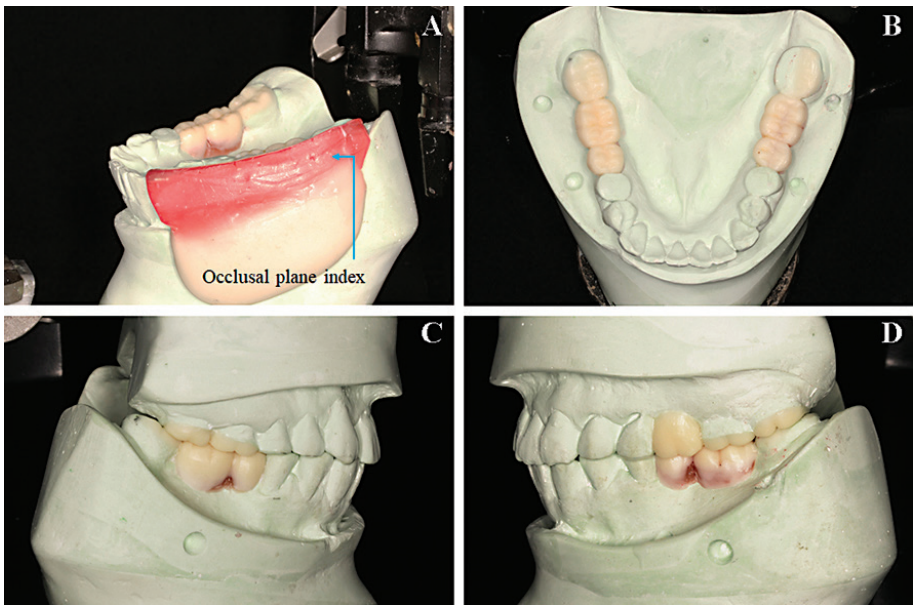

Figure 4: The wax-up full contours present in study models. (A) The left lateral view of casting wax on the buccal cusp of abutment teeth followed Broadrick's analyzer index, (B) The occlusal view of mandibular arch, (C) The right lateral view, (D) The left lateral view.

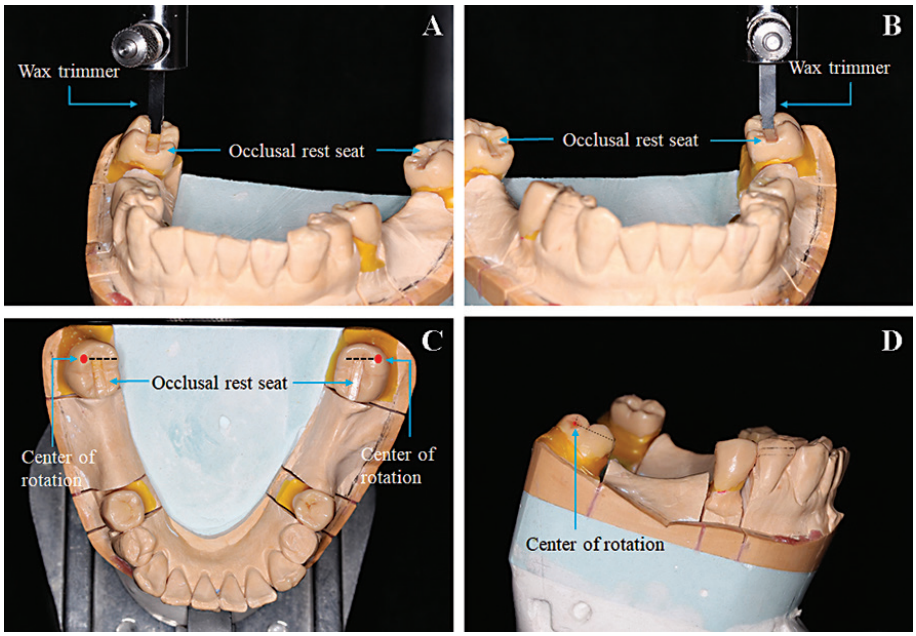

Figure 5: (A) The preparation of occlusal rest seat using wax trimmer with dental surveyor on 48, (B) The preparation of occlusal rest seat using wax trimmer with dental surveyor on 38, (C) Occlusal view: The center of rotation (red dot) located at the terminal end of occlusal rest seat (black dashed line), (D) The center of rotation (red dot) locates at the most occluso-cervical depth of occlusal rest seat (black dashed line).

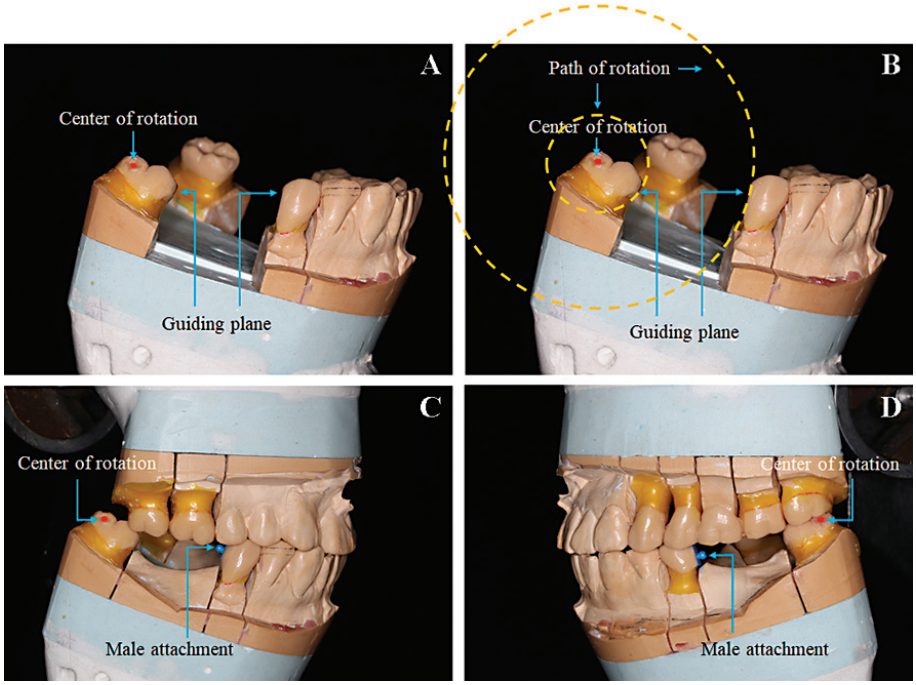

Figure 6: (A) The proper mesial and distal guiding planes ware on the posterior and anterior abutment, (B) The proper guiding planes prepared on the mesial surface of posterior abutment (small yellow dashed circle) and distal surface of anterior abutment (large yellow dashed circle) using the same center of rotation, (C) The right lateral view of the wax-up full contours were analyzed before the casting, (D) The left lateral view of the wax-up full contours were analyzed before the casting.

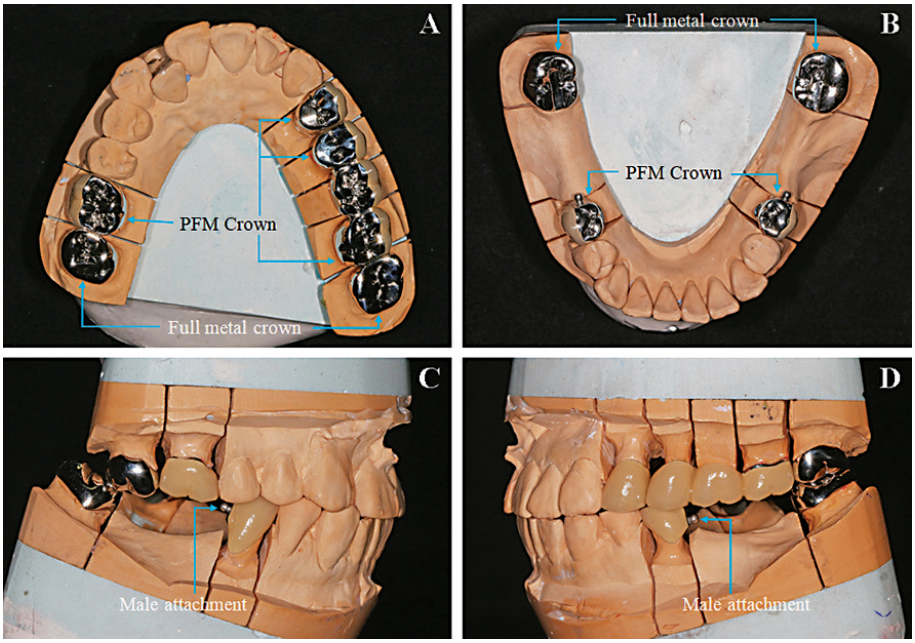

Figure 7: (A) The occlusal view of maxillary arch of the fixed prostheses after casing were in the master models, (B) The occlusal view of mandibular arch of the fixed prostheses after casing were in the master models, (C) The right lateral view of the fixed prostheses after casing were in the master models, (D) The left lateral view of the fixed prostheses after casing were in the master models.

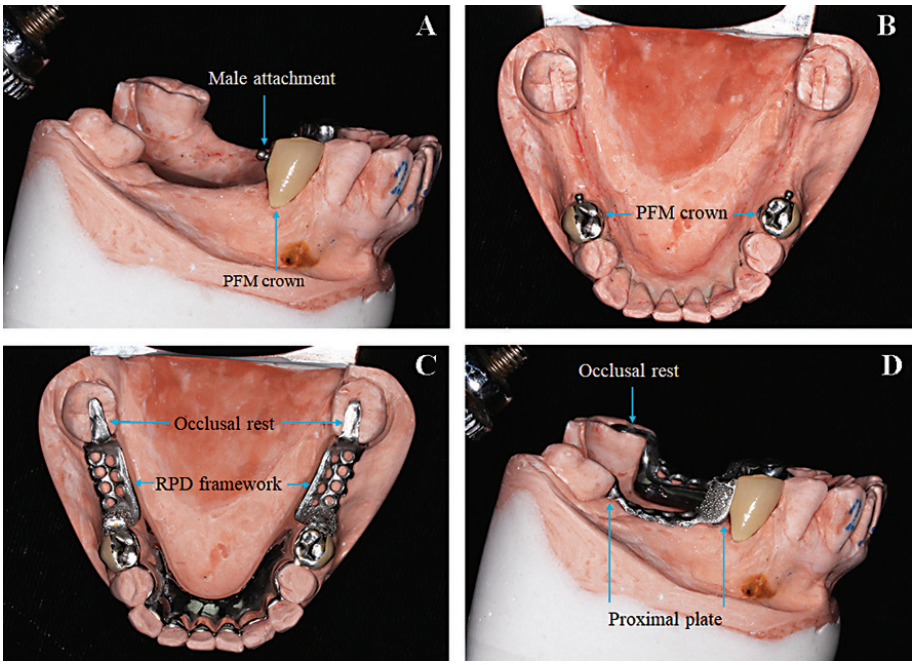

Figure 8: (A) The lateral view of the male attachments were on distal surface of crown on 35 and 45 (anterior abutment) in master model, (B) The occlusal view of the male attachments were on distal surface of crown on 35 and 45 (anterior abutment) in master model, (C) The occlusal view of the RPD framework completely seated within master model, (D) The lateral view of the RPD framework completely seated within master model.

Figure 9: (A) The occlusal view after cementation of the crowns on 35, 45 (anterior abutment) following placement of rotational RPD, (B) The occlusal view of mandibular arch of the fixed prostheses evaluated after cementation in the centric occlusion position, (C) The right lateral view after cementation of the crowns on 35, 45 (anterior abutment) following placement of rotational RPD, (D) The right lateral view of mandibular arch of the fixed prostheses evaluated after cementation in the centric occlusion position, (E) The left lateral view after cementation of the crowns on 35, 45 (anterior abutment) following placement of rotational RPD, (F) The left lateral view of mandibular arch of the fixed prostheses evaluated after cementation in the centric occlusion position.

Figure 10: The periapical radiographs after cementation of the fixed prosthesis.

Discussion

This case report presents the clinical application of rotational removable partial denture design with precisional attachments and occlusal plane adjustment in posterior teeth. Supraeruption of upper posterior teeth, loss of lower posterior teeth and all remaining worn posterior teeth that make occlusal plane not corresponding with the curve of Spee and Wilson's curve cause occlusal interference and TMJ's disorders.[12] Broadrick's analysis, is one of the methods for establishing an acceptable plane of occlusal when restorations of all or most of the posterior teeth are required. With an experience and training, dentists can make Broadrick's analysis however accurated method need specific instruments.[14,15]

Posterior abutment tooth in Kenedy class III mostly tilt to mesial that has undercut for retention only mesiobuccal of tooth. Therefore, ring type clasp, reverse action or hairpin clasp or modified T-bar clasp are used to design removable partial denture. If removable partial denture design uses circumferential or Aker's clasp, dimpling at distobuccal area need to do for making undercut. Sometimes the design only has occlusal rest for support force, it does not protect tipping or moving of posterior abutment to edentulous area, including covered the abutment tooth makes plaque accumulation that bring to caries and periodontal disease in the future.[3] Therefore, rotational removable partial denture offers some advantages by minimizing the use conventional clasps. Rotational path designs may minimize adverse periodontal response from a removable partial denture by reducing plaque accumulation and may be applied in esthetically demanding situations. The design concept involves the use of proximal plate that gain access to undercut areas through a rotational path of insertion.[3]

However, rotational removable partial denture design has limit to use only in Kenedy class III and IV that have anterior and posterior abutment teeth.[3,4] Clinicians should be known how to apply and design rotational removable denture. The removable partial dentures constructed with the rotational path concept are sensitive technique with little margin for error and require the full cooperation of a skilled dental laboratory technician. Several critical considerations must be recognized to ensure a successful rotational path design. The rest seat must be adequately prepared to prevent movement of the tooth and loss of intimate contact of the rigid retentive components. There are important laboratory considerations. Abrasive finishing of the tissue surface or the rigid retentive component should be avoided to ensure intimate contact of the casting with tooth surfaces. Relief must be provided on the refractory cast in areas that would otherwise interfere with the path of insertion. A set of dividers is necessary when determining block out.[3,13,16]

Conclusions

This case report describes the concepts of rotational removable partial denture design and how to apply in the Kenedy class III patients. There are many treatment plans for these patients such as implant supported prosthesis, fixed partial prosthesis, and removable partial prosthesis. Rotational removable partial denture with precision attachment is one of alternative plan. It gives more retention and esthetics than conventional removable partial denture. Broadrick's analysis is used to determine the occlusal plane in harmony with curve of Spee and Wilson's curve, eliminated the occlusal interferences that cause TMJ's problems. This treatment plan accomplishes the patient's expectation and offers excellent patient's acceptance.

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Conflicts of interest

The authors declare no conflicts of interest.

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