Case Report

Application of rotational path removable partial dentures for a Kennedy Class II partially edentulous patient: a case report

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Abstract

This report presents a case of using rotational path partial denture design to treat Kennedy Class II patient. The designs of rotational path of insertion are different for maxillary and mandibular arches in this case. For the maxillary arch, the rotational path design belongs to category II, lateral insertion type. During inserting the denture, the undercut on tooth 23 (maxillary left canine) was engaged in an initial straight-path placement. Then the remainder of the denture rotated to its final position along with a rotation axis run through the cervical area of tooth 23 buccal surface and perpendicular to the tooth 16 (maxillary right first molar). For the mandibular arch, the rotational path design belongs to category I, lateral insertion type. During insertion of the mandibular denture, the buccal clasp on tooth 37 (mandibular left second molar) was placed first, then the remainder of the denture rotated along with a rotation axis run through the buccal clasp tip on tooth 37 and perpendicular to the direction of tooth 45 (mandibular right second premolar). Finally, the minor connector engaged the undercut on tooth 37 mesiolingual surface, when the whole denture was completely seated.

Key words: distal extension removable partial denture, Kennedy Class II patient, rotational path of insertion

Introduction

The rotational path of insertion has been applied to removable partial denture (RPD) for over several decades[1,2]. Although many clinical situations was illustrated in the literature indicated for the application of rotational path of insertion[3-5], it is still overlooked by the dental profession. The reason may be the lack of detail discussion of the rationale of the design and the sensitivity of laboratory techniques[3]. The most common cases reported in literature are tilted mandibular molars and missing anterior teeth, and both of them are tooth-borne situation[6-12].

There is a widespread misunderstanding that the rotational path design only can be used in tooth-borne RPD. In fact, the rotational path design was initially applied to distal extension case[13]. A case report[4], published by Dr. Donovan in 2008, revealed prosthodontic rehabilitation in a Kennedy Class II patient with unilateral posterior edentulous segment. In that case report, by using rotational path RPD, unsightly clasp assembly was eliminated and a favorable esthetic result was provided. Thus it will be realized that rotational path RPD design was not restricted in tooth-borne case.

Although implant could be used in many difficult prosthodontic rehabilitations, there are still some contraindications, such as poor bone quality or quantity, uncontrolled medical condition and insufficient economic ability. Therefore, RPD is still a common treatment option for compromised patients. According to the statistics of RPD cases, the number of distal extension RPD is greater than tooth-bore RPD[14]. Generally, in removable partial denture design, conventional path of insertion is the first choice. However, in some clinical situations such as unsightly direct retainer or severely tilted abutment, a rotational path design being an optional choice may provide a better clinical result.

Case report

The patient, 52-year-old male, was a 30-year heavy smoker with obstructive sleep apnea and received treatment in the Department of Chest Medicine, Keelung Chang Gung Memorial Hospital. He had been extracted many teeth at local dental clinic (LDC) and worn a RPD, but he was unable to adapt the RPD. Then he was referred from LDC to our hospital for tooth 13 endodontic retreatment and full mouth prosthodontic rehabilitation.

The remaining teeth in maxillary dentition are tooth 16,15,13 and 23 and in mandibular dentition are tooth 37, 36, 34, 33, 41, 42, 43, 44. Occlusal analysis revealed vertical dimension loss, tooth 33, 34 distal tilting, tooth 34 migration and tooth 41, 42 super-eruption.

Tentative treatment plan was discussed with the patient. Treatment began with tooth 13 endodontic retreatment. Then the casting posts and temporary crowns over tooth 13 and tooth 23 were fabricated under the vertical dimension determined by a diagnostic wax up. Maxillary interim denture was fabricated to evaluate the lost vertical dimension and the denture adaptability of the patient. The fit, the length and the thickness of the palatal plate of the denture was adjusted. In a three-month follow up period, full mouth periodontal treatment and general dental treatment was performed. Lack of gag reflex to the interim denture was confirmed (Fig.1).

Then, definite prosthetic treatment was began. Preliminary impression was made by irreversible hydrocolloid (Cavex CA37®, Cavex, Holland) and study casts were poured in Type

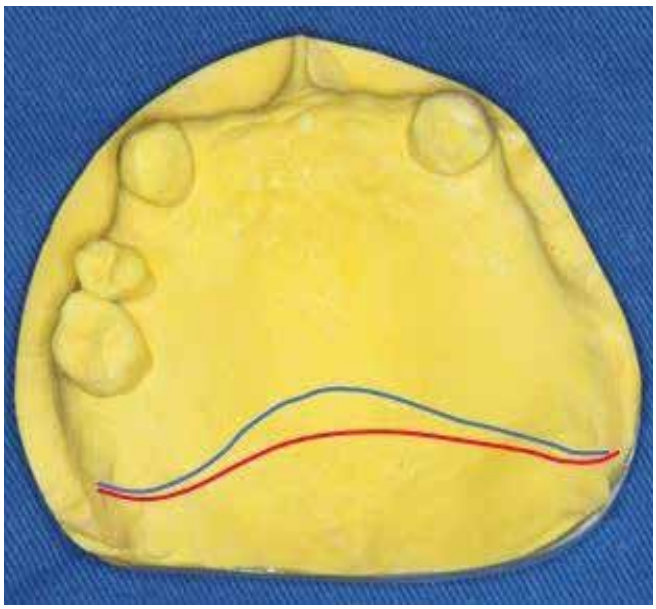

Figure 1. Red line: initial palatal coverage of interim denture; Blue line: adjusted palatal coverage.

II dental stone (Super hard stone®, Taiwan) for model survey. Final teeth preparation and final impression for tooth 13 and tooth 23 surveyed crowns with addition reaction silicone impression material (Examixfine®, GC, Japan) and master cast poured in Type IV dental stone (Silky Rock®, Whip Mix Corporation, USA) was performed. The recording base and occlusal rim was made to check vertical dimension. Then take interocclusal record with Aluminum wax (Aluwax Dental Products Company, USA) and facebow transfer for maxillary and mandibular casts mounting. After maxillary and mandibular casts mounting in articulator, resin tooth arrangement around tooth 13, 23 (Fig.2A, 2B) and maxillary cast survey (Fig.2C, 2D, 2E) was taken for tooth 13, 23 surveyed crown fabrication. Cingulum rest seats were designed on the palatal side of tooth 13, 23 and undercut was designed on buccal surface of tooth 23.

Preliminary impression was made again after tooth 13, 23 porcelain fused to metal (PFM) crowns permanent setting and study cast was poured for models survey and custom trays fabrication. After tooth preparation on abutment teeth and border molding of individual trays, final impression was made by using additional reaction silicone impression material (Examixfine®, GC, Japan). Maxillary and mandibular master casts were poured in Type IV dental stone (Silky Rock®, Whip Mix Corporation, USA).

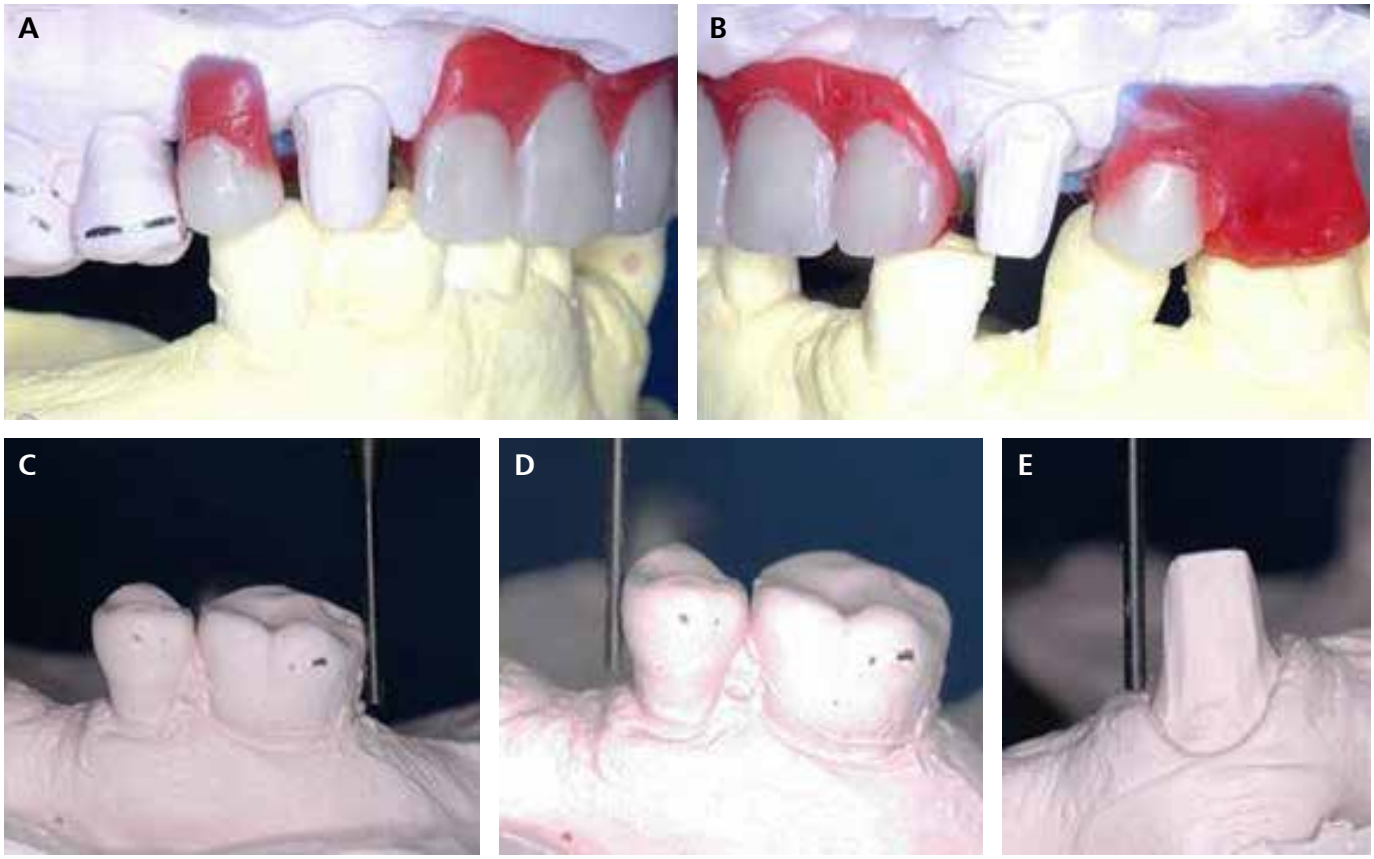

Figure 2. A, B: resin tooth arrangement to check tooth 13, 23 teeth preparation, C, D, E: survey for surveyed crown fabrication.

Maxillary denture framework was designed with circumferential clasp on tooth 16, wrought wire circumferential clasp on tooth 23 and a palatal plate as a major connector. And the palatal coverage was determined by the interim denture. The cingulum rests on tooth 13, 23, mesial occlusal rest on tooth 15 and distal occlusal rest on tooth 16 were fabricated on the rest seats (Fig.3). It is notable that the clasp tip on tooth 23 did not engage undercut, and the retention of tooth 23 buccal clasp is from the rigid portion of clasp root (Fig.3B).

Mandibular denture framework was designed with wrought wire circumferential clasp on tooth 44, embrasure clasp on tooth 36, 37 and a lingual plate as a major connector. The cingulum rests on tooth 33, 41, 42, 43, distal occlusal rest on tooth 34, mesial occlusal rests on tooth 36, 44 and interproximal occlusal rest on tooth 36, 37 were fabricated on the rest seats (Fig.4). It is notable that after surveying, tooth 45 lingual surface was blocked out (Fig.4D,4E) with a specially designed block-out instrument[15] according to designed rotational path of insertion (Fig.4A). The framework was waxed, cast in chrome-cobalt alloy and returned for framework try-in (Fig.5).

At the try-in appointment, framework stability was checked. For the maxillary framework, the distobuccal undercut on tooth 23 was engaged first and then the framework was rotated so that the clasps on tooth 16 and rest seats on tooth 16, 15, 13, 23 seated completely (Fig.6). For the mandibular framework, the rotational center on tooth 37 is seated first, followed by the undercut on tooth 36, 37, rest seats on tooth 34, 33, 41, 42, 43, 44 and wrought wire circumferential clasp on tooth 44 of the framework (Fig.7). A facebow transfer record was taken, and an interocclusal record was made. The casts were mounted in a semi-adjustable articulator and returned to the laboratory for resin tooth arrangement according to the shade determination (Fig.8). After wax dentures try-in, the casts were returned to the laboratory again with instructions for processing.

The finished RPDs were inserted with denture base and occlusal adjustment (Fig.9). The esthetic results were better with less obvious clasp assembly on tooth 23 and the other clasp assemblies were located too posterior to be visible. The use of rotational path design permitted a conservative, esthetic and stable denture for this Kennedy Class II edentulous patient.

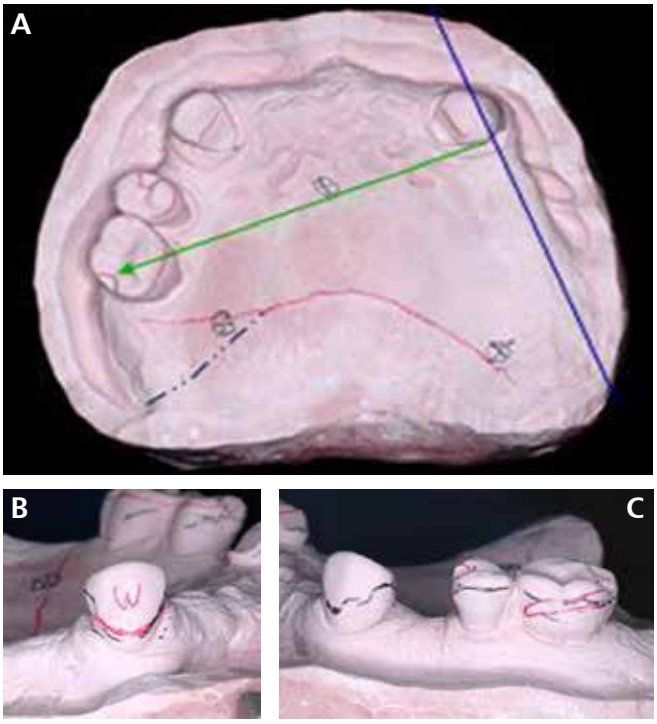

Figure 3. A: Path of RPD insertion;
B: wrought wire circumferential clasp design on tooth 23;
C: Circumferential clasp design on tooth 16.

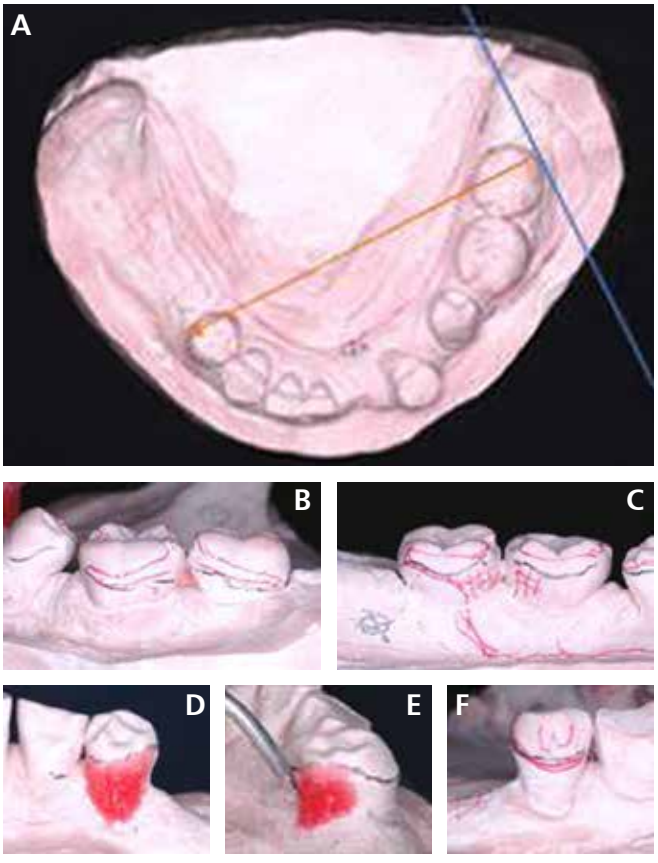

Figure 4. A: Path of RPD insertion;
B: Circumferential clasp on tooth 36, 37;
C: undercut on tooth 37 lingual side stay intact;
D, E: block out on tooth 45 lingual surface;
F: wrought wire circumferential clasp on tooth 45.

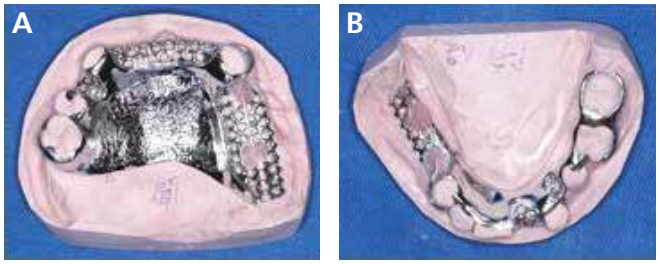

Figure 5. Maxillary and mandibular RPD frameworks.

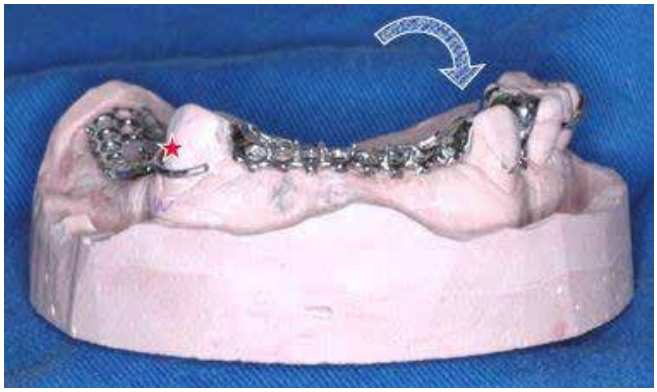

Figure 6. Maxillary: tooth 23 distobuccal undercut was engaged as the initial straight path. Then the remainder of the framework rotated to tooth 36 with the rotational center (star) on tooth 23 buccal cervical site.

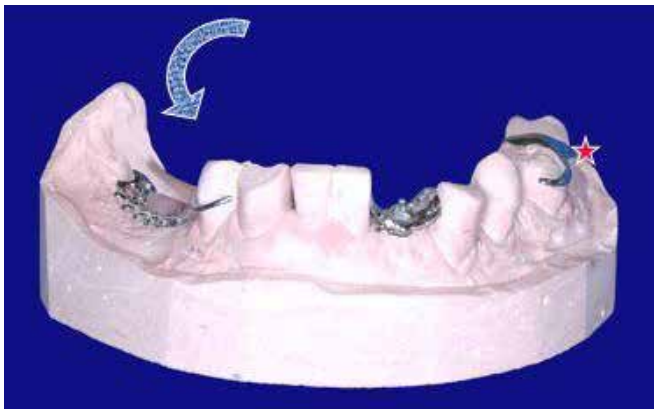

Figure 7. Mandibular: buccal clasp on tooth 37, rotational center (star), was placed first, then the remainder of the framework rotated to the direction of tooth 45.

Discussion

Rotational path removable partial dentures can be Classified in two different ways. For the first one, rotational path was divided into two categories that depend on the location of rotational centers. In category I, the rotational center is located at the terminal of extended rest. The rotational center is seated first, and the remainder of prosthesis seated into place. In category II, the rotational center is located at the gingival extension of the minor connector. The initial straight path of placement serves to

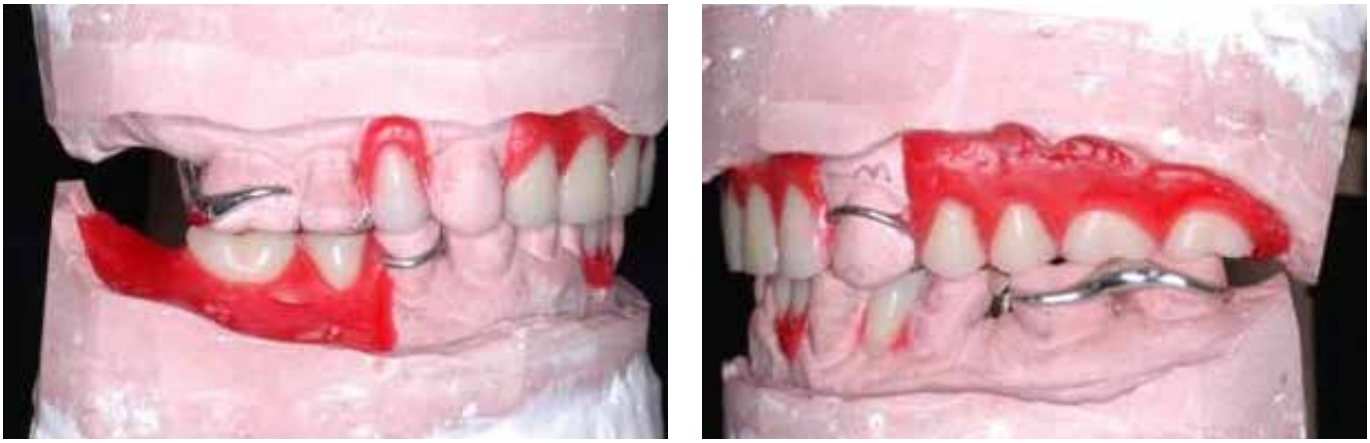

Figure 8. Maxillary and mandibular wax dentures.

Figure 9. Intra-oral view after partial denture in place.

seat the rotational center, followed by a curved path that allows the rests and remainder of the framework to be seated. This design is commonly used in replacement of missing anterior teeth.

For the second Classification, rotational path was divided into three types that depend on the sequence of denture seating. The first one is anterior-posterior sitting that the rotational path is from front to back, The second type is posterior-anterior sitting in which the rigid retainer on the posterior abutment sits first. 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[1].

In the case presented above, the rotational path of insertion for maxilla belongs to category II, lateral type. It was inserted from tooth 23 first, then rotate to tooth 16 with its rotational axis on the cervical area of tooth 23 buccal surface. In this case, for much better retention,

we used the rotational path removable partial denture design rather than the conventional removable partial denture design. In rotational path removable partial denture, the path of withdraw is not parallel to the potential path of dislodgement. And for the purpose of RPD stability, we reserved the tooth 23 buccal clasp for bracing effect. And also the clasp was located a less obvious position, which was at cervical third area of the tooth. The direction of rotational axis is perpendicular to the guiding plane of contralateral tooth, so if the remaining dentition of this case is tooth 15 rather than tooth 16, the undercut on tooth 23 should be engaged distally. This shows that the retention of tooth 23 buccal clasp is from the rigid portion of clasp root instead of flexible clasp tip.

The conventional treatment for this case is usually with tooth 23 surveyed crown, which accommodate a distal guiding plane, adequate mesiobuccal undercut and positive cingulum rest seat. The treatment options for undercut engaged are: (1) mesial I bar, (2)T bar or (3) wrought wire circumferential clasp. But the dislodging force from distal extension case is hard to resist by the above-mentioned treatment options, so the intimate and long distal guiding plane may be more effective than clasp. However, for the limitation of tooth length, contour and path of insertion, it is also unreliable to resist dislodging force by distal guiding plane. In application of a rotational path, the rigid portion of clasp engaged the undercut on tooth 23 distobuccal to distal area was much effective to resist dislodged force because distal or distobuccal undercut does not perpendicular to occlusal plane. On the other hand, use of wrought wire circumferential clasp has an advantage that is easy for further adjustment.

For the mandibular denture, the retentive undercuts available for conventional clasping of mandibular molars are usually located on their mesiolingual surface. Although it is acceptable for denture insertion by using lingual side undercut for retention, it is difficult for patients to remove the denture. So rotational path RPD is an applicable treatment option for this situation.

After surveying mandibular master cast, it was found that the undercut on tooth 36, 37 is on mesiobuccal side and the depth of undercut is not enough. In Kennedy Class II case, retentive clasp usually dislodged when occlusion on contralateral distal extension site. And reinforced the retention on retentive clasp is not an ideal method, because that might cause harm to abutment tooth or clasp loosening after a long-time wearing.

The rotational path of insertion for mandible belongs to category I, lateral type. It is notable that the undercut on fulcrum line will be engaged with proper force and undercut in front of fulcrum line will be stressed extensive pressure when distal extension was occluded, so the undercut in front of fulcrum line should be relieved and only the undercut on tooth 37 could be engaged.

The buccal clasp on tooth 37 was placed first and the remainder of the framework rotated to the direction of tooth 45. Finally, the minor connector engaged to undercut on tooth 37 mesiolingual surface, and meanwhile other rest seats and clasps completely located. The assemblies such as lingual plate and buccal clasps functions as bracing rather than retention. The conventional distal extension and rotational path concept should be taken into consideration while designing the buccal retentive clasp on tooth 45, so wrought wire circumferential clasp is a better choice than infrabulge retainer suggested by Ivanhoe[16].

The lingual surface of tooth 45 was blocked out (Fig.4D, 4E) with a specially designed block-out instrument according to designed rotational path of insertion. It is an important step to facilitate try-in of a framework of category I rotational path RPD, such as the situation of tilted mandibular molars.

Principally, conventional path of insertion is the first choice for designing removable partial denture. However, in some clinical cases, if conventional path is not suitable, rotational path design can be an alternative design option. Properly denture design and fabrication can conduce to successful and esthetic results to the patient.

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