Case report

A Technique for Fabricating Indirect Resin Composite Teeth on a Metal Removable Partial Denture Framework

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Abstract

The use of metal removable partial dentures (MRPD) represents a treatment choice that replaces natural dentition. The aim of this article is to purpose an alternative technique for creating a prosthetic tooth using indirect resin composite on the MRPD framework. This technique has been applied for two patients. The first patient has lost her 3 upper anterior teeth. She has a history of frequently fractured dentures and high esthetics expectation. The second patient needs to replace only 1 - 2 teeth in her mandibular arch but has limited space for placing acrylic denture teeth. In this study, surface treatment was done to enhance the mechanical and chemical bond between resin composite and metal framework by using alumina blasting and metal primer application respectively.

Key words: custom-made tooth, denture tooth, indirect resin composite, metal framework, removable partial denture

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Introduction

Replacing a missing tooth depends on many factors. For example, the number of tooth that needs to be replaced, esthetics concern, longevity, comfort, function, and the patient's socioeconomic status. Each factor is almost equally important; therefore, it is crucial to plan the right treatment for each individual.[1]

Currently, there are many treatment options available, ranging from implant, fixed prosthesis, acrylic removable partial dentures and metal removable partial dentures (MRPD), depending on the dentist's planning and the patient's approval of the given treatment plan.[2]

MRPD stands as a common treatment choice for a patient with partial edentulism and requires cost-effective treatment.[3] Cobalt-Chromium (Co-Cr) alloys are usually used to fabricate MRPD framework because of their rigidity and relatively inexpensive.[4] The structure of most artificial teeth in a denture-base is acrylic teeth, made from polymethyl methacrylate.[5] However, in some situations, this technique cannot provide the desired expectations, for example, having limited space to use prefabricated prosthetic tooth or high esthetics concern.

Nowadays, modern hybrid composite materials that are both durable and esthetic and can function effectively when used to fabricate a prosthetic tooth on the MRPD framework.[6] This case report describes an alternative way to fabricate the custom-made resin composite teeth on the MRPD framework for patients with limited occlusal space, a history of frequently fractured dentures and high esthetics concern.

Case report 1

A 65-year-old Asian female patient presented at the dental clinic complaining about the appearance of her smile, poor fitting, mismatched color of the acrylic teeth, and a history of 3 sets of fractured dentures at the upper anterior region (Figure 1). The patient's goal of treatment was to receive a comfortable, durable and functional prosthesis with no surgical intervention. Her medical history revealed no significant medical findings and her general health was good.

Figure 1 Pre-treatment intraoral photographs with dentures

During the oral examination: teeth numbers 17, 11, 21, 26, 36, 37, 44 and 46 were missing. Tooth 25 presented with existing porcelain fused to metal surveyed crown and tooth 47 presented with a 2 mm space between the upper anterior edentulous area and the lower incisors without loss of vertical dimension. Spacing of approximately 3 mm was found between tooth 32 and 33. Generalized moderate physiologic attrition without any symptoms was also found on the clinical examination (Figure 2).

Figure 2 Intraoral photographs pre-treatment without denture

Upon periodontal examination, no pocket was detected. There was generalized gingival recession and the patient's fair oral hygiene was verified.

According to the Kennedy's classification system and Applegate's rules, the maxillary partially edentulous arch was classified as Class III modification 2 and the mandibular arch as Class II modification 3.

The treatment goal was planned to meet the patient's expectations; therefore, the metal removable partial dentures (MRPD) using custom-made composite teeth were chosen as the treatment of choice due to its esthetics and durable properties.

After the removable partial dentures (MRPD) design, a metal tooth was used for limited space of posterior teeth and metal backing for anterior teeth, to minimize instances of fractured dentures as given from the patient's history.

The procedure was to fabricate an individual tray, tooth alteration, border molding, and functional impression with polyvinyl siloxane, pour the master model with gypsum type IV, and then send to the laboratory for fabricating the MRPD framework.

Framework Try-in

The metal framework was tried in the mouth to check proper seating of the RPD around the rest seats, guide plane, major connector and clasps and occlusion of the framework (Figure 3).

Figure 3 Try-in framework shows adaptation of framework to abutment teeth

Shade mapping

The shade and shape of the custom made artificial teeth were selected by evaluating the patient's remaining dentition as a guide. The selected shades were A3.5 at cervical, A3 at middle and Translucent at incisal area of incisor via Vita classic shade guide (Figure 4).

Figure 4 shade mapping

Techniques for fabricating indirect resin composite teeth on metal framework

1. Cover the part that does not need to be sandblasted by white plumber tape (Figure 5A). Sandblast the metal framework with 50-micron alumina particles by alumina blasting machine (Airborne-particle abrasive unit; Basic Classic, Renfert GmbH, Hilzingen, Germany) at a distance of approximately 10 mm (Figure 5B) until the surface of metal framework become matte. Then, stream the metal framework with the streamer (Silfradent, Steam jet EV1 SJ, Forli, Italy) to reduce contamination.

2. Apply metal primer (Kuraray noritake, Alloy primer, Okayama, Japan) to the metal framework with a micro-brush and allow it to dry gently (Figure 5C).

3. Choose an opaquer that is compatible with the chosen shade of resin composite (Meta Color Prime Art Body Paste A3.5, A3 body shade: IC, Sun Medical Co. Ltd.) to mask the color of the metal. Then, apply the opaquer to cover all surfaces that will be bonded to composite and polymerized by the light curing unit (Demi^{PLUS}, Kerr Corp, Orange, CA, USA) for 40 seconds according to the manufacturer's instructions (Figure 5D).

4. Apply a cervical layer of composite first, followed by the body of the tooth to produce a custom-shaded appearance of dentin (Figure 5E). Each layer of composite should not exceed 2 mm and light polymerization for 40 seconds for each layer. Repeat the steps until the dentin shade is satisfied (Figure 5F).

5. Place a layer of enamel and translucent shade to produce the natural-like appearance of the tooth (Figure 5G). Polishing with conventional composite polishing techniques followed by the polishing wheel (Figure 5H).

6. Occupy the space between tooth 32 and 33 by fabricating the same method as mentioned above.

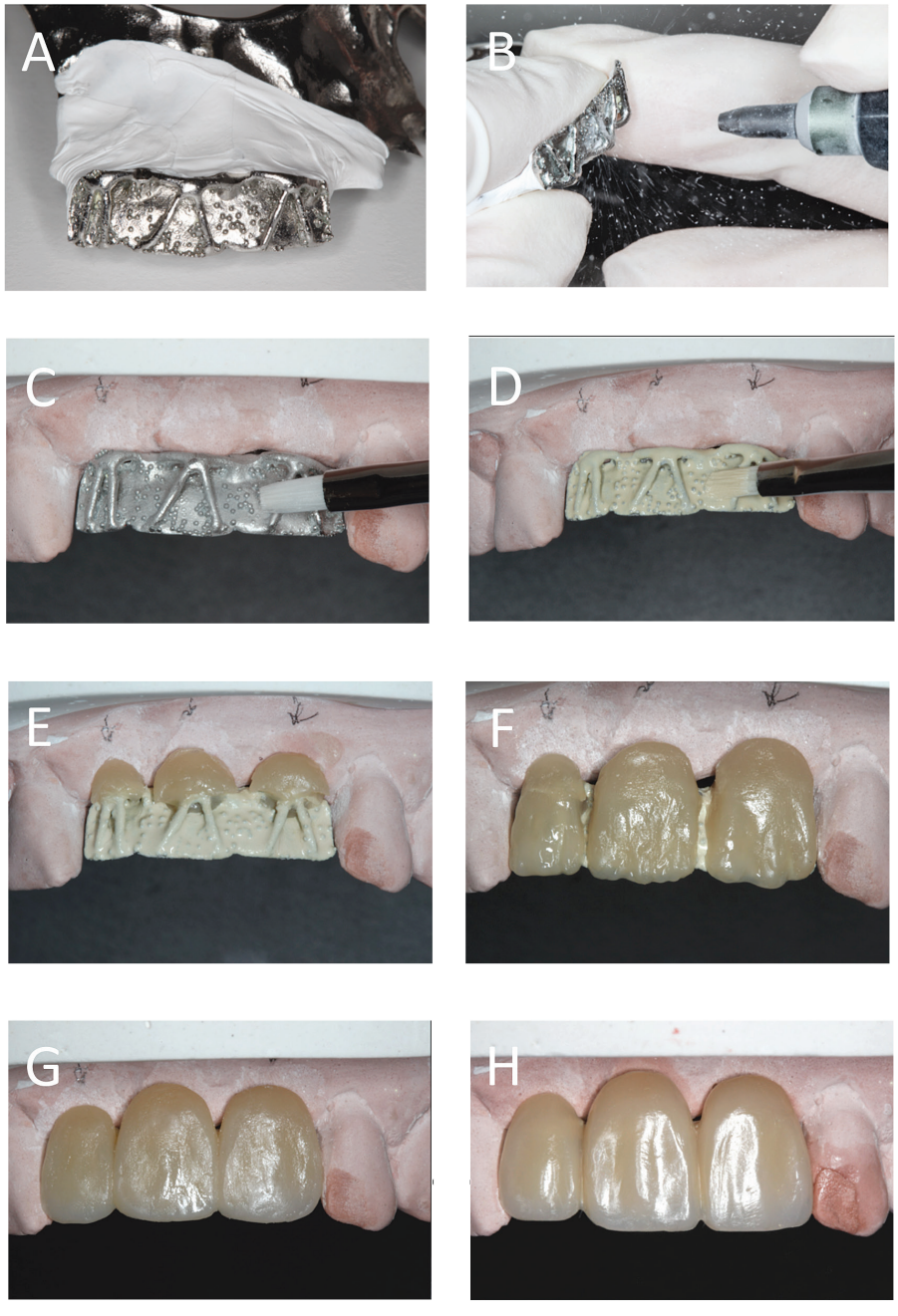

Figure 5 Steps for fabricating composite teeth on metal framework

A) Plumber tape-cover the unwanted area of the metal B) Alumina blasting C) Metal primer application, D) Opaquer application E) Cervical composite application F) Body composite application G) Finished composite filling and H) Polished composite teeth

Denture delivery

Upper and lower removable partial dentures were delivered to the patient. Occlusal adjustments were done on this visit. The patient was satisfied with the prosthesis delivered and the improvement of mastication ability was also noted (Figure 6).

Figure 6 Intraoral photographs post treatment with dentures

Case report 2

A 53-year-old Asian female patient presented at the dental clinic complaining about the color of metal and poor fitting of her existing denture (Figure 7). She denied having ever undergone a bridge, implant or orthodontics treatment. Her medical history revealed no significant medical findings and her general health was good.

Figure 7 Pre-treatment intraoral photographs with and without dentures

During the clinical examination, no tooth loss was detected on an upper arch and all of the teeth on the upper arch revealed no significant findings. While the following problems were noted: tooth 35 and 45 were missing, spacing of approximately 3 mm was found between tooth 36 and 34. Spacing of approximately 5 mm was found between tooth 46 and 44 (Figure 7).

Upon periodontal examination, no pocket was detected and the patient's good oral hygiene was verified.

According to the Kennedy's classification system and Applegate's rules, the mandibular partially edentulous arch was classified as Class III modification 1.

The shade and shape of the artificial teeth were selected by evaluating the patient's remaining dentition as a guide. To get a better view of what the eventual outcome will be, the utilization of a composite mock-up was used. Composite mock-up can be done by a direct application of the selected shade of composite directly on the tooth surface without preparation (Figure 8). The selected shade was A3.5 at cervical area and A2 at occlusal area via Vita classic shade guide.

Figure 8 Composite mock-up

After MRPD design, tooth preparation and final impression, the master model with gypsum type IV was poured and sent to the laboratory for fabricating MRPD framework.

The framework was tried in the mouth to check proper seating of MRPD around the rest seats, guide plane and clasps, the fit of major connector and occlusion of the framework. The result shows that all of the components were seated correctly in their positions.

The steps for fabricating composite teeth at the area of tooth 35 and 45 on metal framework are shown in Figure 9. The same steps were applied from case 1.

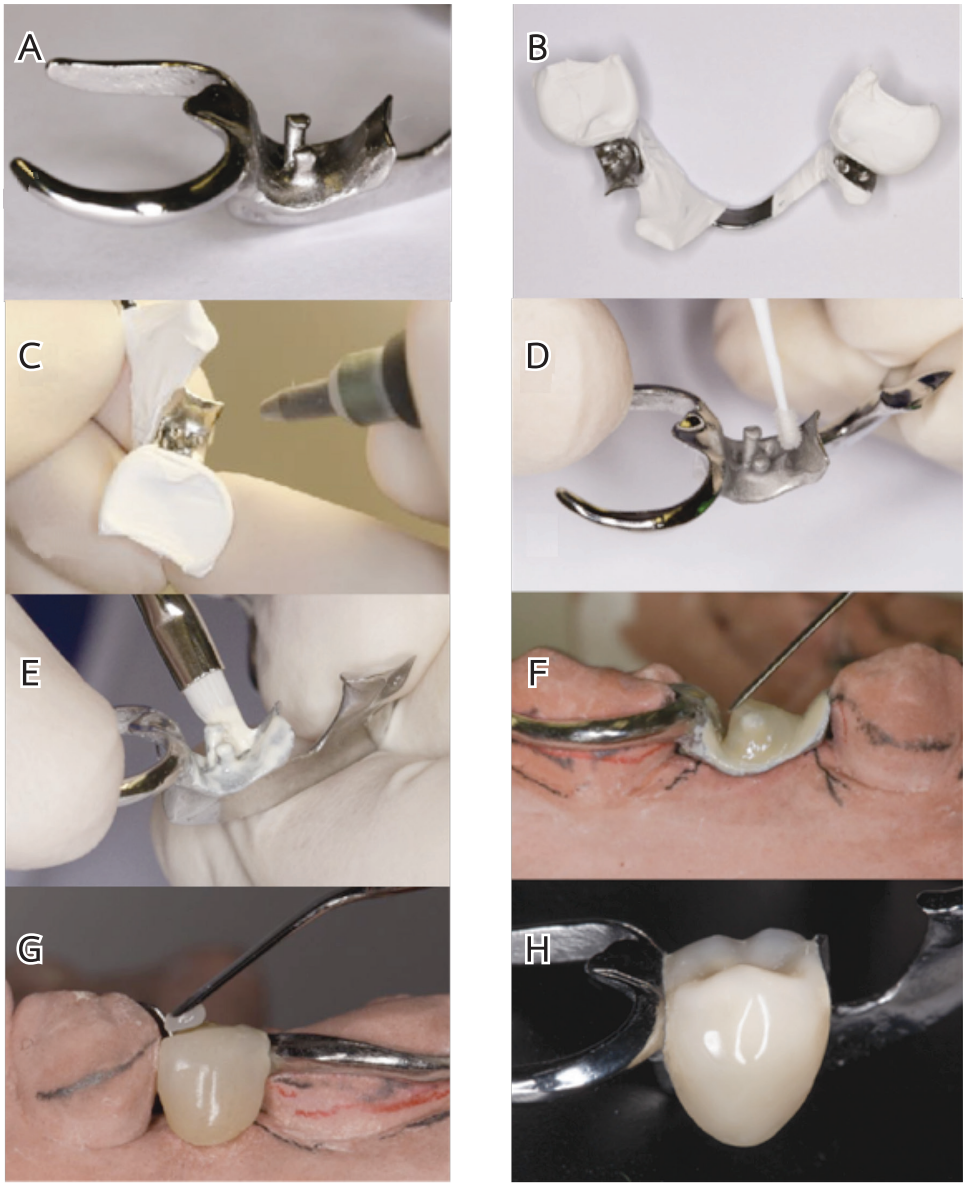

Figure 9 Steps for fabricating composite teeth (lower premolar) on metal framework
A) Metal framework with nail head B) Plumber tape covered the unwanted area of the metal C) Alumina blasting D) Metal primer application E) Opaquer application F) Dentin shade composite application G) Enamel and body shade composite application, and H) Finished and polished composite teeth.

Denture delivery

The lower removable partial denture was delivered to the patient and occlusal adjustments were done on this visit. She was satisfied with the color of the custom-made resin composite teeth and can function normally without any problems (Figure 10).

Figure 10 Post-treatment intraoral photographs with dentures

Discussion

This case report describes an alternative way to create a prosthetic tooth by using indirect resin composite to replace missing teeth other than conventional acrylic denture teeth. Planning and maintenance are required in order to carefully provide a useful and comfortable MRPD diagnosis.[3]

Initially, an analysis of an existing interarch and mesiodistal width space is required to be done in planning for the restoration of missing teeth in a partially edentulous arch.[7] Whenever there is limited space, placing a metal casting instead of an acrylic tooth may become a treatment of choice, as it requires less space than that of the acrylic tooth.

If the patient has an anterior deep bite or has limited occlusal space as shown in case 1, choosing the right denture base and framework design is very important, because it may interfere with the natural occlusal relationship. This puts the artificial teeth at risk of being detached or fractured from the denture base. Therefore, metal backing that was extended from the MRPD framework along the palatal aspects was chosen for the anterior teeth. This design was done to protect the denture teeth from being sheared away from the base by the action of the opposing teeth.[8] In contrast, metal backing may have a greyish appearance through the incisors. However, in this case, indirect resin composite with opaquer was chosen to minimize the greying effect and create a custom-made layering effect that mimics the natural teeth.

In case 2, there is limited mesiodistal space for tooth replacement, but the patient has a high esthetics concern. An alternative to metal teeth would be required to meet the patient's expectation. As a result, a customized composite tooth is used since resin composite can be used in limited space situations and can achieve optimum esthetics.

Indirect resin composite, also called prosthetic composite or laboratory composite, was introduced to eliminate failures of direct resin composite such as poor wear resistance and polymerization shrinkage, by increasing the volume of inorganic fillers and adding an additional cure. This alteration has improved flexural strength and elastic modulus of the indirect resin composite but still maintains its esthetics properties.[9] In addition, indirect resin composite showed 90% success rate after ten years of clinical function.[10]

Despite the fact that resin composite has various advantages, the limitation of the resin composite is still technique sensitivity. Therefore, using an extra-oral or indirect technique could reduce the sensitivity of the material as the contamination from intraoral environment would not occur. Additional polymerization also took place and resulted in improvement of the materials' properties; thus, the good points of resin composite are not affected.[9]

Ghazal et al.[11] investigated two-body wear resistance of different artificial denture teeth to human enamel. Wear resistance was tested in dual-axis chewing simulator up to 1,200,000 cycles to simulate the mixed wear of adhesion, attrition and fatigue. The results indicated that resin composite teeth showed improved wear resistance to human enamel, compared to modern acrylic denture teeth. Even so, the resin composite still needs an improvement for long-term wear resistance to be comparable with that of natural tooth enamel.

Still, the debonding of denture teeth from the denture base was one of the common problem for MRPD.[12 - 14] With customized composite teeth technique, retention can be achieved by mechano-chemical bond. Mechanical retention is obtained by using metal beads, mesh and pitted metal (macro-mechanical retention), or by sandblasting, chemical or electrolytic etching. While chemical retention is achieved using a chemical bonding agent (depends on type of an alloys), which helps to enhance the chemical bond through a metal-resin interface.[15-19] In this case, we chose sandblasting with 50-micron aluminum oxide to promote micromechanical retention, as it can increase surface wettability and penetration of bonding agents into those micro porosities.[20] The MDP-containing primer was applied to promote a chemical bond between metal oxide and composite resin.[21] According to Yoshida et al. 1993, using metal primer that contains MDP as a functional monomer provides more effective adhesive bond strength between Co-Cr alloy and resin composite when compared with other functional monomers.[22]

The reasons mentioned above suggest why indirect resin composite becomes the material of choice for fabricating customized composite teeth on MRPD framework in this case report. The technique that has been described to fabricate the indirect resin composite teeth is simple, yet effective and precisely meets all the patient's expectations.

Conclusion

A custom-made resin composite tooth on MRPD framework is an alternative treatment of choice to replace missing teeth with space limitations and esthetics concern. Surface treatment can be done on the MRPD framework to enhance mechanical and chemical retention between Co-Cr alloy and resin composite custom-made tooth.

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บทคัดย่อ

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การใส่ฟันเทียมถอดได้ฐานโลหะ เป็นการรักษาทางเลือกที่นำมาใช้ทดแทนฟันธรรมชาติที่สูญเสียไป บทความนี้มีวัตถุประสงค์เพื่อนำเสนอวิธีการสร้างซี่ฟันปลอมโดยใช้วัสดุเรซินคอมโพสิตชนิดทางอ้อมบนโครงฟันเทียมบางส่วนถอดได้ฐานโลหะ ซึ่งบทความนี้ได้นำวิธีดังกล่าวมาประยุกต์ใช้งานในผู้ป่วย ๒ ราย ผู้ป่วยรายแรก เป็นผู้ป่วยที่สูญเสียฟันหน้าบน ๓ ซี่ ฟันเทียมชุดเดิมมีประวัติแตกหักบ่อย และต้องการความสวยงาม รายที่สอง เป็นผู้ป่วยที่ต้องการใส่ฟันเทียมชนิดถอดได้เพียง ๑ - ๒ ซี่ ในขากรรไกรล่าง และมีพื้นที่ไม่เพียงพอต่อการใส่ซี่ฟันเทียมชนิดอะคริลิก การศึกษานี้ได้ทำการปรับสภาพผิวของโครงโลหะเพื่อเพิ่มประสิทธิภาพการยึดระหว่างเรซินคอมโพสิตทั้งทางกลและทางเคมี โดยการพ่นด้วยผงอะลูมินาและการทาสารเมทัลไพรเมอร์ ตามลำดับ

คำสำคัญ: การสร้างซี่ฟันเฉพาะบุคคล, ซี่ฟันเทียม, เรซินคอมโพสิตชนิดทางอ้อม, โครงโลหะ, ฟันเทียมบางส่วนถอดได้ฐานโลหะ