บทความปริทัศน์
Review Article

ฟันเทียมเซอร์โคเนียชนิดติดแน่นบางส่วนยึดด้วยเรซินในฟันหน้า: ทบทวนวรรณกรรมและรายงานผู้ป่วย

Anterior Zirconia Resin-bonded Fixed Partial Denture: Literature Review and Case Reports

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บทคัดย่อ

ฟันเทียมบางส่วนแบบติดแน่นยึดด้วยเรซินถูกแนะนำโดย Rochette ใน ปี ค.ศ. 1973 การใส่ฟันชนิดนี้เป็นอีกทางเลือกหนึ่งเพื่อทดแทนฟันหน้าที่สูญเสียไป ก่อให้เกิดการสูญเสียเนื้อฟันน้อย หากมีการเลือกผู้ป่วยที่เหมาะสมและมีการวางแผนการรักษาที่ละเอียดรอบคอบ บทความนี้ทบทวนวรรณกรรมที่เกี่ยวข้องกับฟันเทียมเซอร์โคเนียชนิดติดแน่นบางส่วนยึดด้วยเรซินในฟันหน้า ในแง่ของการกรอแต่งฟันหลัก การออกแบบ การยึดชิ้นงาน รวมไปถึงการนำเสนอตัวอย่างกรณีศึกษาสองกรณีและการนำไปประยุกต์ใช้ทางคลินิก

คำสำคัญ : ฟันเทียมบางส่วนแบบติดแน่นยึดด้วยเรซินเซอร์โคเนีย

Abstract

The resin-bonded fixed partial denture was introduced by Rochette in 1973. This alternative is a minimally-invasive treatment for replacing missing anterior teeth if patient selection and treatment planning are thoroughly carried out. This article reviews the current literature related to anterior zirconia resin-bonded fixed partial dentures in terms of abutment preparation, design considerations and bonding procedure for this type of prosthesis. The application of zirconia resin-bonded fixed partial dentures in clinical cases is discussed and two cases are presented.

Keywords: resin-bonded bridges, zirconia

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Introduction

The resin-bonded fixed partial denture (RBFPD) has been well accepted as an alternative treatment for restoring missing anterior teeth.[1,2] In early development, these restorations had higher failure rates due to de-bonding. However, advancements in technology in terms of materials, prosthesis design and adhesive techniques have resulted in limited bonding failures and have significantly improved the longevity of this type of prosthesis. The RBFPD is a minimally invasive treatment required minimal tooth reduction compared to the conventional fixed partial denture. The RBFPD is advantageous in caries-free dentitions and in young patients with large pulp chambers, or for use as a long-term provisional restoration while the patient is waiting for implant therapy.[3,4]

Indications and Contra-indications for Resin-bonded Fixed Partial Dentures[5]

The success rate of RBFPDs is high if patient selection and treatment planning are carefully carried out. RBFPD is indicated in the following situations:

- Replacement of a single missing anterior tooth.
- Sound tooth adjacent to the edentulous space.
- Abutment with sufficient enamel for bonding.
- Long-term provisional restoration.
- Surgical procedure for implant therapy is not indicated.
- Periodontal splinting.
- Excellent moisture control during bonding.

RBFPDs are contra-indicated in patients for whom one or more of the following conditions applies:

- Unfavorable occlusal scheme, such as deep bite condition.[6]
- Parafunctional habits, such as bruxism.[7,8]
- Heavily restored teeth, or teeth with extensive caries.
- Short clinical crown.
- Anterior tooth with thin labio-lingual dimension.
- Mobile abutment teeth.
- Long edentulous span.

As mentioned previously, the important advantage of RBFPDs is the minimal loss of tooth structure during tooth preparation. The margin is placed supra-gingivally, thus the preparation, impression-making, as well as the other intra-oral procedures are simplified. However, the disadvantages are it requires good alignment of abutment teeth and technique sensitive. There is a possibility of over-contouring which leads to the increased plaque accumulation.

History of Resin-bonded Fixed Partial Denture

Rochette, in 1973, first described the concept of stabilization of periodontally weakened teeth by bonding a perforated gold cast framework to the lingual surfaces of the involved teeth.[9] Howe and Denehy modified Rochette technique and introduced the first form of Rochette bridge by bonding perforated metal wings to the lingual surface of abutment teeth to support a pontic.[10] Livaditis and Thompson further introduced electrolytic etching on the intaglio surface of the metal wings to roughen the bonding surface. The etched cast restorations were attached to etched tooth surfaces with resin cements.[11] This restoration and techniques continued to evolve and have been collectively called the Maryland bridge.

Advances in RBFPD design and materials have opened up possibilities for ceramics to be chosen as framework materials, with promising results. All-ceramic anterior RBFPDs have gained popularity in order to overcome the show-through effects of conventional metal-ceramic RBFPDs due to the optical properties that closely match those of natural teeth. Metal wings frequently compromise

the aesthetic outcome of the treatment. Thin anterior abutments may lose natural translucency and present a grayish coloration.[12] Available evidence has demonstrated that the all-ceramic RBFPD can be a highly successful treatment.[6,13-15]

Early studies of metal-ceramic RBFPDs reported survival rates that varied widely from 60% in 10 years,[16] to 83% in 13 years[17] and 66% in 20 years[18] A reasonable 87.7% survival rate was demonstrated in a systematic review by Pjetursson *et al.,* in 2008, that summarized clinical studies with a medium term follow-up of RBFPDs.[19]

Interestingly, Thoma *et al.*[20] systematically reviewed the literature and included recent studies related to the performance of RBFPDs made of six different materials: metal-ceramic, metal-resin, composite, glass-infiltrated ceramic, reinforced-glass ceramic and densely-sintered zirconia RBFPDs. They reported that this type of prosthesis offers good long-term results with estimated 5-year and 10-year survival rates of 91.4% and 82.9%, respectively. The most frequent failure of this type of prosthesis was de-bonding (loss of retention). In terms of materials utilized to fabricate the restorations, RBFPDs made of densely-sintered zirconia demonstrated superior 5-year survival rates over those of the other materials. The authors suggest that three main critical success criteria for RBFPDs are their location in the jaws, design and framework material. To be specific, RBFPDs have the best results in the anterior area, with a single-retainer design, and are made of zirconia-based ceramic.

Anterior Zirconia Resin-bonded Fixed Partial Dentures

Zirconia RBFPDs have gained increasing attention for years. Zirconia has twice flexural strength of glass-infiltrated alumina ceramic.[21] The flexural strengths of up to 900 MPa and improvements in the optical properties of high-strength zirconia oxide ceramics have led to increased use of zirconia RBFPDs as a replacement for a metal framework for anterior RBFPDs. According to a recent systematic review,[20] among the ceramic framework materials, the included studies utilizing densely-sintered zirconia do not report any catastrophic fracture of the framework or veneering material, while other studies using glass-infiltrated, or reinforced-glass ceramic RBFPDs demonstrate a high incidence of prosthesis loss due to fracture of the framework. However, de-bonding occurs in zirconia RBFPDs, which is comparable to that in metal-ceramic RBFPDs. The authors consider de-bonding to be a simple complication that can be clinically solved, and corrected the problem before re-bonding the de-bonded prosthesis.

Single-retainer design vs two-retainer design

In recent years, the design of a single retainer bonded to one abutment tooth (cantilever-design) has been strongly suggested, instead of bonding the RBFPDs to abutment teeth with two retainers. The rationale underlying this design is to reduce the fracture of the resin cement, which leads to de-bonding, induced by differential abutment mobility under functional load, especially during protrusion and lateral excursion. The single-retainer design eliminates the shear and tensile loads that would result from the rigid connection between two abutment teeth with different degrees of movement that exist in the two-retainer design.[3] An *in vitro* study, comparing the bond strength in dynamic tests between the two designs, reported significantly greater strength in the single-retainer design.[22] Additionally, a recent finite element analysis study demonstrated significantly less stress concentration on the connectors of the single-retainer design than on those of the two-retainer design.[23] Clinical studies have pointed out the superior survival rates and reduced chance

of de-bonding and connector fracture for the anterior single-retainer RBFPDs compared with the two-retainer design.[6,13,24-26] A systematic review by Wei *et al.*[27] evaluated the clinical outcome of anterior RBFPDs, and clearly demonstrates that the single-retainer design has greater survival rates than the two-retainer design. More recent study by Kern *et al.*[28] has shown that the anterior zirconia single-retainer RBFPDs provided excellent clinical longevity with a 10-year survival rate of 98.2%.

In addition to the data obtained from the above-mentioned studies, the single-retainer RBFPD is also advantageous compared with the two-retainer design. It is, indeed, a less invasive treatment, since preparation involves only one tooth. The likelihood that errors might occur during abutment preparation and impression-recording is reduced. When de-bonding occurs in a single-retainer situation, the RBFPD simply falls out. Thus the risk of developing secondary caries is reduced.

Abutment selection when using a single-retainer design

When the lateral incisor is missing, the canine is the ideal abutment of choice for a single-retainer design.[5] The longer root of canine distributes the additional forces when supporting a pontic of lateral incisor. Moreover, retention is enhanced by a greater bonding surface area. In contrary, the lateral incisor fails to demonstrate these attributes due to its shorter root and smaller clinical crown.

The central incisor is also a good candidate for the abutment. This has been proven by a recent study,[28] using central incisor as an abutment for anterior zirconia single-retainer RBFPDs, which demonstrated an excellent survival rate after 10 years. If the central incisor is to be selected as an abutment, the available bonding area on sound enamel needs to be at least 30 mm^2, and it must be free from periodontitis.

Patient selection

A clinical examination should be thoroughly conducted in the following areas including abutment condition, edentulous area, periodontal status and occlusion. Occlusion is critical and must be carefully examined both in maximum intercuspation (MIP) and excursive movements. In addition to the clinical examination, diagnostic mounting and diagnostic wax-up in the articulator give more detailed information associated with occlusal analysis. The retainer should be designed to be in light occlusal contact in MIP. The pontic must be in light contact in MIP, and out of contact in any excursive movements. If parafuntional habit is suspected, post-treatment protective occlusal device is recommended due to higher rate of RBFPD de-bonding.[7,8]

Tooth preparation and zirconia framework design

Up to now, there is still no consensus for the ideal preparation for zirconia RBFPDs. Different preparation designs for zirconia RBFPDs have been published.[14,29,30] In general, tooth preparation should follow the preparation guidelines proposed for conventional metal-ceramic RBFPDs, involving minimal lingual veneer preparation.[12] Since the retention of zirconia RBFPDs exclusively relies on the preparation design and resin cement, the preparation must be strictly limited only to the enamel. Exposure of dentine should be avoided. The finish line must be shallow and located above the gingival margin. Retentive features, such as shallow proximal grooves or boxes, may be added to enhance the retention form. Additional a small lingual indentation, or rest seat, may be placed in the center of the lingual preparation on cingulum to facilitate the correct seating of the framework. The preparation guidelines for anterior zirconia RBFPDs are summarized in Table 1.

ตารางที่ 1 *สรุปแนวทางการกรอแต่งฟันหลักสำหรับฟันเทียมเซอร์โคเนียชนิดติดแน่นบางส่วนยึดด้วยเรซินในฟันหน้า*[5,59]

Table 1 *Summary of preparation guidelines for anterior zirconia RBFPDs.*[5,59]

Preparation design	Conventional Zirconia RBFPD	Zirconia RBFPD as a provisional restoration
Incisal finish line	Light incisal shoulder 2 mm short from incisal edge to avoid esthetic impairment of incisal translucency	
Gingival finish line	Light cervical chamfer 1 mm supra-gingival for optimal hygiene and to maintain tissue health	
Lingual reduction	0.5 mm reduction in enamel to allow adequate strength of zirconia retainer	Uncut enamel (if occlusion allows)
Inter-proximal finish line	- Finish line ends at the center of contact area. - Proximal grooves are needed to compensate the lack of proximal wrap-around	- Slightly recontour - 180 degree wrap-around - Proximal walls should be parallel if possible to enhance retention form
Rest seat preparation	In the cingulum area: - Resist tissueward movement of the restoration. - Aid in correct seating during bonding procedure	Follow the contour of the cingulum

The occlusion should be examined intra-orally using an articulating paper prior to the abutment preparation procedure. The tooth reduction area is then limited by a thin color line marked by articulating paper. Hence the zirconia retainer is properly placed within the area where the stress is minimal to avoid de-bonding or zirconia fracture.

It is the authors' opinion that the preparation design of a zirconia RBFPD can be modified from the above mentioned guidelines, depending on the clinical situation of each patient. The least invasive technique is to do no tooth preparation, as long as the occlusion permits that and there is sufficient restorative space. However, the clinician should keep in mind that preparing palatal or lingual surfaces of abutments allows the prosthesis to maintain proper tooth contour without lingual/palatal bulk. Moreover, tooth preparation also serves as a seating guide during trying in and bonding procedures.

There is a still controversy in the literature whether the additional retentive feature is necessary in the preparation of anterior single tooth zirconia RBFPDs. An *in vitro* study pointed out that the non-retentive preparation increased the frequency of de-bonding.[29] However, a clinical study reported the preparation of zirconia RBFPDs without any retention forms with a survival rate of 93.1% after a 55-month follow-up period.[14]

In case of the zirconia RBFPDs to be used as provisional restorations, or when implant therapy is not indicated, the preparation must be minimally-invasive only to allow acceptable results both for esthetics and strength of the restoration. The preparation does not provide any mechanical retention, but permits the definite seating of the prosthesis during bonding.

The zirconia frameworks are fabricated using a computer-aided design/computer-aided manufacturing (CAD/CAM) process. As with other

CAD/CAM ceramic restorations, tooth preparation should be smooth and rounded without any sharp edges or internal line angles. The framework design must follow the manufacturer's recommendations. The thickness of the zirconia wing should be 0.6-0.8 mm. The connector area must be 2.0 mm in bucco-lingual width, and 3.0 mm in inciso-gingival height to provide adequate strength to the framework. If small retentive grooves are included in the preparation, their dimensions must be properly designed to accommodate the capability of the CAD-CAM milling machine.[2]

Zirconia RBFPDs try-in and delivery

During the try-in appointment, the zirconia RBFPDs should be evaluated in terms of esthetics, framework fit, marginal adaptation, proximal contacts, static and dynamic occlusion. The retainer and pontic must be in light contact in MIP against the opposing teeth. Any other contacts on pontic during excursions must be eliminated.

Moisture control is highly important to obtain the optimal bonding between the abutment and zirconia RBFPDs. The most effective way to isolate the working area and prevent contamination is rubber dam application. However, if isolation by using rubber dam is not feasible, cotton roll isolation is an acceptable alternative.

Bonding zirconia RBFPDs

Since the zirconia RBFPDs rely mainly on the adhesive bonding between prostheses and abutments, proper pre-bonding treatment on both sides is critical. The attachment complex between zirconia RBFPDs and abutments consists of three main parts, including enamel to resin bond, cohesive bond of the resin cement, and resin to zirconia framework bond. When enamel is etched by phosphoric acid, the bond to resin is enhanced via micro- and macro-resin-tag interlocking.[31] A study by Ballyram and Preez revealed that pre-etching the enamel with 34% phosphoric acid for 20 seconds prior to bonding significantly increased the bond strength up to 61% for uncut enamel, and up to 76% for cut enamel.[32]

Many studies have accepted that optimal bond to zirconia can be obtained by using resin-based cements.[33,34] Although there is no consensus regarding how to prepare the zirconia surface before bonding, a recent meta-analysis concluded that airborne-particle abrasion and tribochemical silica coating are highly recommended methods to treat the zirconia surface before bonding.[35]

Airborne-particle abrasion is commonly used to treat surfaces of metals and oxide ceramics in order to increase mechanical lock and contact surface area.[36-41] Abrasion with aluminum oxide particles (Al_2O_3) is probably the most commonly used method. However, there are wide ranges of particles size, and differences in working time, pressure, the distance from tip to zirconia surface, and impact angle, all of which would result in different degrees of surface roughness.[41-45] Differences in the composition of the zirconia material also influence the effectiveness of the airborne-particle abrasion in creating a rough surface and affect bond strength.[41-45] Su *et al.*[46] have recommended sandblasting the zirconia surface with 110 μm aluminum oxide particles under 2 bar pressure for 21 seconds. Similarly, Kern[33] has recommended using 50 μm aluminum oxide particles under 2.5 bar pressure (35 PSI), or less, to create a rough surface without damaging the zirconia surface, along with either using methacryloyloxy-decyl dihydrogen phosphate (MDP) monomer-containing resin cement, or MDP/phosphate metha-acrylate-containing primer in combination with any resin cements. Phosphate groups in MDP form a chemically-stable covalent bond to the zirconia surface and significantly improve the bond strength.[47,48]

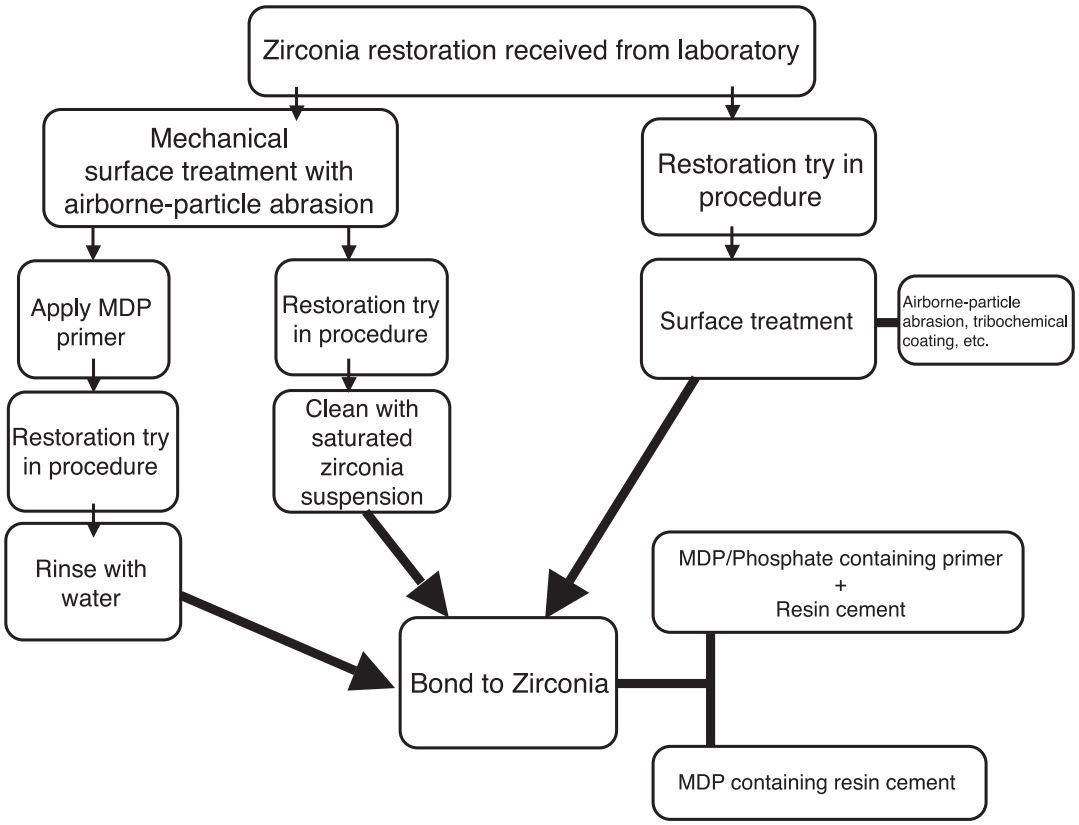
Tribochemical silica coating is a surface treatment that creates a silica layer by using

airborne particle abrasion with silica-coated alumina particles. This method is a combination of surface treatment using mechanical roughening and chemical surface coating. Studies have reported that several types of silane coupling agent enhanced the strength of the bond between the resin cement and the zirconia surface that is silica-coated by the tribochemical technique.[49,50]

Sandblasting may damage and predispose zirconia to later fracture.[51] An *in vitro* study revealed that zirconia surface treatment with 120 μm or smaller aluminum oxide particles, increases surface roughness without decreasing the flexural strength of zirconia.[52] Tribochemical silica coating and airborne-particle abrasion seem to be the most effective and the least complicated methods recommended in most studies.

Contamination by saliva also results in a negative effect on the bond strength. A study by Angkasith *et al.*[53] have revealed that application of MDP primer before the prosthesis try-in procedure prevents salivary adhesion to the bonding surface. Another recommended method to decontaminate the zirconia surface is to use a cleaning suspension consists of hyper-saturated zirconia oxide particles (Ivoclean, Ivoclar Vivadent, Schaan, Leichtenstein). When Ivoclean solution is applied to the contaminated zirconia surface, the salivary phosphate contaminants are more likely to attract to the cleaning solution instead of the restoration surface. Therefore, zirconia restoration surface is left cleaned, and ready for bonding. Various studies have proved that cleaning zirconia surface with Ivoclean prior to resin bonding provide effective bond strength.[54,55]

Zirconia bonding procedures are summarized in Figure 1.



รูปที่ 1 *แผนภาพแสดงการยึดขึ้นงานเซอร์โคเนีย*[34,35,53,56-58]

Figure 1 *Diagram presenting zirconia bonding procedures.* [34,35,53,56-58]

Case Report

Case 1 Zirconia two-retainer resin-bonded fixed partial denture

A 15-year-old female patient presented with a chief complaint of a missing maxillary right central incisor due to a sports accident. The tooth was avulsed and could not be found for replantation. She had just completed orthodontic treatment before the accident. A pediatric dentist had placed a flexible splint to stabilize the involved anterior teeth for two weeks, and the patient was referred to see an endodontist for root canal treatment on a maxillary right canine and a maxillary left central incisor. After the completion of endodontic treatment, she was seeking a replacement of the missing maxillary right central incisor.

The patient was physically healthy. Her dental history included orthodontic and endodontic treatment, and regular check-ups. A comprehensive examination was performed. Temporomandibular joint (TMJ) examination was conducted. Clinical examination revealed hard and soft tissue deficiencies at the edentulous alveolar ridge at the site of tooth 11. All other findings were normal (Figure 2).

รูปที่ 2 *แสดงรูปภายในช่องปากก่อนการรักษาในตำแหน่งสบสนิทที่สุด*

Figure 2 *Pre-treatment intra-oral view in maximum intercuspation.*

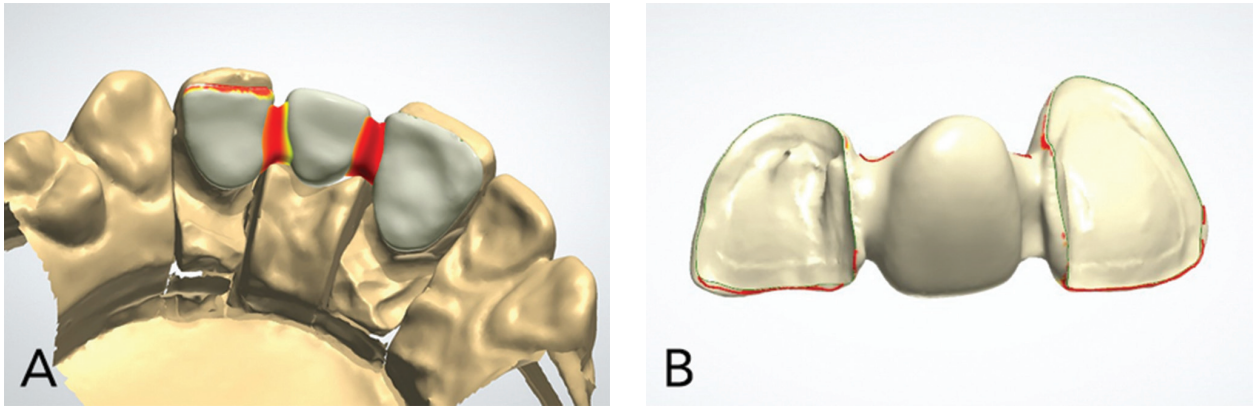
All possible treatments options were discussed with the patient and her parents. At this point, implant therapy was not recommended, due to the patient's incomplete growth. The treatment plan included tooth a zirconia RBFPD, as a long-term provisional restoration, which allowed for definitive treatments, such as implant therapy or conventional fixed partial denture, at a later time.

Clinical treatment

Preliminary impressions were made. Study casts were fabricated, and mounted in an articulator for diagnostic wax up and treatment planning. Teeth 21 and 12 were selected as the abutments for a two-retainer zirconia RBFPD. The aim is to splint the abutments. The cantilever-design is not recommended due to short conical root of 21. A resin composite tooth (Filtek Supreme, 3M ESPE, St. Paul, MN, USA) was fabricated in the laboratory, and was used as the provisional restoration while the patient was performing tooth whitening. The resin composite tooth was directly bonded to the proximal surfaces of teeth 12 and 21, using flowable resin composite.

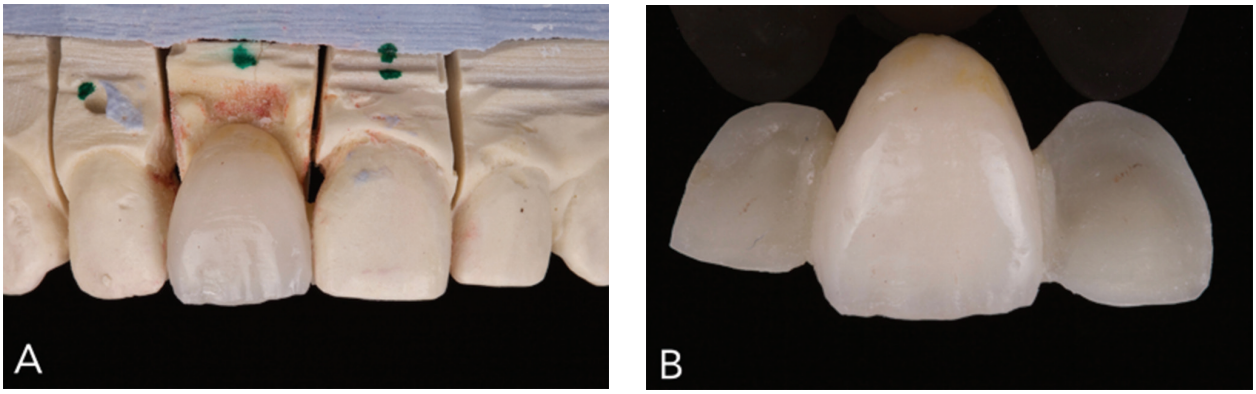
The patient returned one month later. The resin composite tooth was removed, and tooth preparation was carried out. A 0.6 mm palatal reduction on the abutment teeth was performed. A thin chamfer finish line was placed above the gingival margin. Shallow, 2.0 mm proximal grooves were added at the mesial surfaces of both abutments to increase the framework strength in the connector areas, and to enhance the retention form. The final impression was made using medium-bodied and light-bodied polyvinylsiloxane (PVS) (Aquasil, Dentsply, York, PA, USA). An opposing arch impression was made using alginate. An interocclusal record was registered using PVS registration material (Regisil, Dentsply).

Master casts were fabricated, and mounted in an articulator. Then the mounted casts were scanned to produce digital models. The prosthesis



รูปที่ 3 *(A) แสดงขนาดของส่วนโยงและรูปร่างของฟันแขวนถูกออกแบบในซอฟท์แวร์ช่วยออกแบบในคอมพิวเตอร์ (B) แสดงโครงเซอร์โคเนียที่มีส่วนยื่นทางด้านประชิดเข้าไปในร่องยึดของฟันหลัก*

Figure 3 *(A) Dimensions of the connector and shape of the pontic were virtually designed using the computer-aided design software. (B) Zirconia framework with proximal extensions to engage retentive grooves on abutments.*

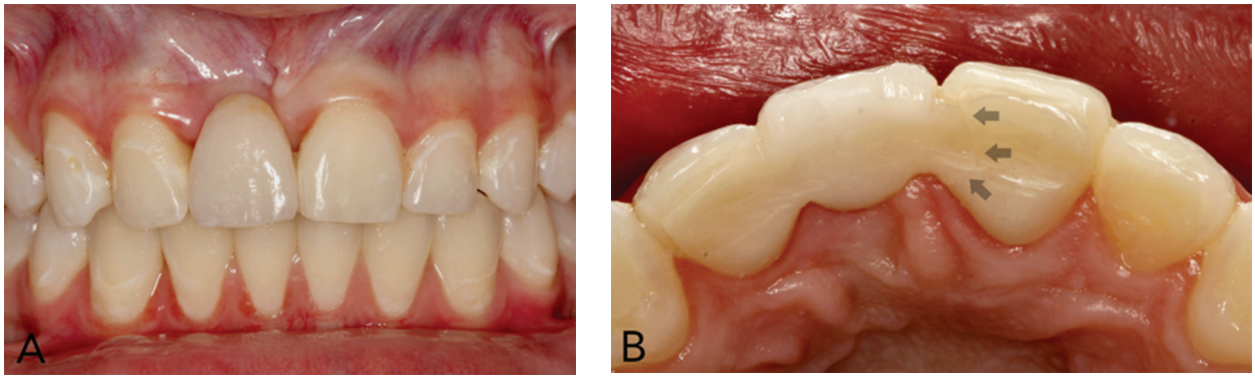


รูปที่ 4 *(A) แสดงชิ้นสิ่งประดิษฐ์จริงบนแบบหล่อหลัก (B) แสดงฟันเทียมบางส่วนแบบติดแน่นยึดด้วยเรซินซนิดเซอร์โคเนียแบบมีสองส่วนยึด*

Figure 4 *(A) Definitive prosthesis on master cast. (B) Two-retainer zirconia RBFPD.*

framework was virtually designed in the software (TRIOS, 3Shape, Copenhagen, Denmark) (Figure 3), and then was milled from zirconia. Feldspathic porcelain was fired to the framework. Staining and surface characterizations were performed to mimic the contralateral maxillary central incisor (Figure 4).

The completed two-retainer zirconia RBFPD was evaluated for esthetics and framework fit. The area was isolated using rubber dam. The bonding surfaces of the prosthesis were cleaned using Ivoclean (Ivoclar, Vivadent, Amherst, NY, USA), sandblasted with 50 μm aluminum oxide particles under 30 PSI pressure for 10 seconds at a distance of 10 mm. Scotchbond Universal (3M ESPE) was applied in a thin layer to the intaglio surfaces, and light-cured for 15 seconds. The abutment teeth were pumiced and etched with 35% phosphoric acid for 15 seconds. Scotchbond Universal was applied to the etched enamel surface, air thinned and then light-cured for 20 seconds. A dual-cured Rely X Ultimate (3M ESPE) resin cement was mixed, applied directly to the intaglio surfaces, and seated firmly on the abutment teeth. Excess cement was removed from the margin using microbrushes. Each surface of the abutment teeth was light-cured for 20 seconds. Any other remaining excess cement was



รูปที่ 5 *(A) แสดงชิ้นฟันเทียมบางส่วนแบบติดแน่นยึดด้วยเรซินชนิดเซอร์โคเนียภายหลังการยึดชิ้นงาน (B) แสดงการแตกของโครงเซอร์โคเนีย รอยแตกอยู่บนส่วนยึดของซี่ 21 เนื่องจากความหนาของชิ้นงานไม่เพียงพอและมีจุดขัดขวางการสบฟันในตำแหน่งสบยื่นบนซี่ฟันเทียม*

Figure 5 *(A) Zirconia RBFPD after bonding. (B) Fractured zirconia framework due to insufficient thickness and protrusive interference on the pontic. The fracture is located at the retainer on 21.*

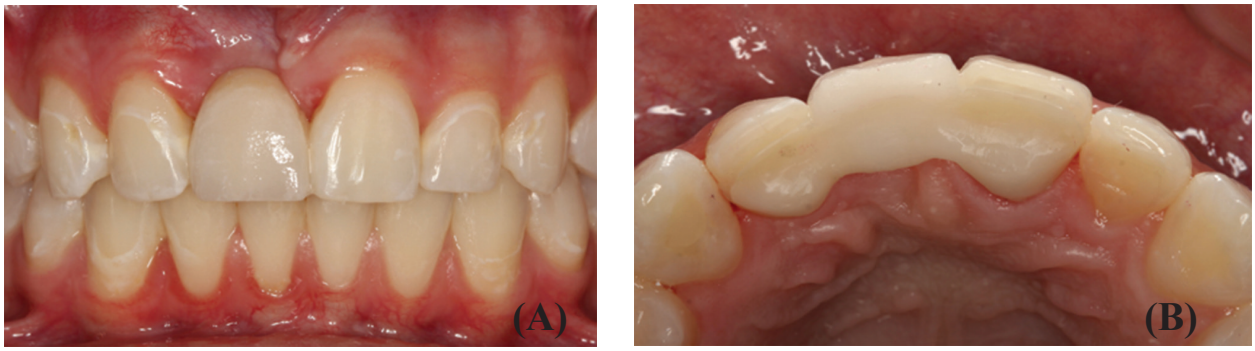
removed with an explorer and a scaler. The occlusion was evaluated in MIP, protrusive and lateral excursion. The patient was given oral hygiene instructions (Figure 5a).

However, two months after RBFPD placement, when the patient returned for a follow-up appointment, mobility of the pontic was detected. Examination revealed that the zirconia wing on tooth 21 had fractured (Figure 5b) due to insufficient thickness of the zirconia retainer, and the protrusive interference on the pontic. The RBFPD was removed and enameloplasty on the antagonist was carried out. A new PVS impression was made. A master cast was fabricated, mounted and sent to the laboratory, as previously described. A new framework was designed as a two-retainer design as with the previous prosthesis.

The new RBFPD was bonded as described previously. The occlusion was carefully evaluated. All interferences in protrusion and lateral excursion were removed from the pontic. The adjusted ceramic surfaces were polished. After six months, no sign of fracture or de-bonding was observed (Figure 6).

Case 2 Zirconia single-retainer resin-bonded fixed partial denture

A 43-year-old female patient presented with congenitally-missing permanent mandibular lateral incisors[32,42]. She also presented with tetracycline-



รูปที่ 6 *แสดงรูปหลังการรักษาด้านหน้า (A) และด้านบดเคี้ยว (B)*

Figure 6 *Post-treatment frontal view (A) and occlusal view (B).*

รูปที่ 7 *แสดงรูปภายในช่องปากก่อนการรักษา*

Figure 7 *Pre-treatment intraoral views.*

stained teeth. She had completed orthodontic treatment, and she was wearing a mandibular Hawley retainer with denture teeth to occupy the space of the missing lateral incisors. She was seeking a consultation for subsequent prosthodontic treatment of the edentulous areas of the missing lateral incisors. Her medical history was reviewed, and she was unremarkably healthy. Her dental history included minor operative dentistry, orthodontic treatment and routine check-ups. A comprehensive examination was performed. Preliminary impressions and study casts were made.

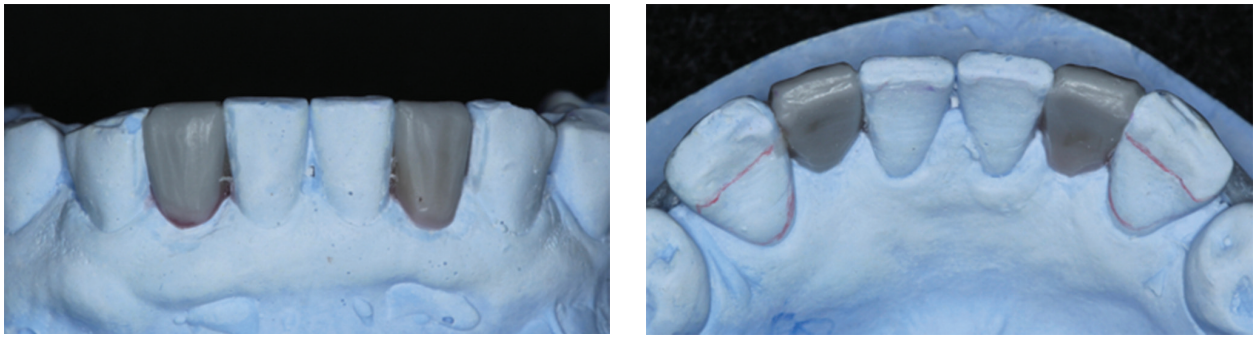
Diagnosis and treatment planning

TMJ and extra-oral findings were normal. Intra-oral and radiographic examinations revealed no carious lesions. Mild staining was seen in general. Periodontal tissues were normal and healthy. The edentulous areas at the site of teeth 32 and 42 were broad in the labio-lingual dimension. The patient had a Class I molar and canine relationship with canine guidance. All other findings were normal (Figure 7).

All treatment options were discussed with the patient, including implant therapy, removable and conventional fixed partial dentures, as well as RBFPD. Based on a conservative consideration, cost, and length of the treatment, the patient chose to pursue the RBFPDs. A diagnostic wax-up for the mandibular lateral incisors was performed on the mounted casts for occlusal analysis, preparation and framework design (Figure 8). The treatment objectives were to provide minimally-invasive treatment, to meet the patient's expectations, and to maintain stable occlusion. The treatment plan included the zirconia RBFPDs as replacements for the missing teeth 32 and 42. Mandibular canines were selected as the abutment teeth for the single-retainer design.

Clinical treatment

Pre-prosthetic periodontal treatment included scaling and oral hygiene instructions. The patient



รูปที่ 8 *แสดงการแต่งขี้ผึ้งเพื่อการวินิจฉัยสำหรับฟันซี่ 32 และ 42*

Figure 8 *Diagnostic wax up on 32 and 42.*

returned following the completion of periodontal treatment for the tooth-preparation appointment. Due to sufficient restorative space on the lingual surface of mandibular canines, no lingual reduction was performed on the cingulum of the abutments to preserve enamel thickness. A slight, 0.6 mm chamfer finishing line was supra-gingivally placed using a round-ended, tapered, diamond bur. Proximal grooves were placed at the mesial and distal ends of the preparation to enhance the retention of the prostheses, and to facilitate exact seating of the framework (Figure 9). A final impression was made using PVS putty (Silagum, DMG, Hamburg, Germany) in a perforated stock tray, and light-body PVS material was injected onto the prepared abutment teeth (Silagum, DMG). An impression of the opposing arch was made with alginate, and an interocclusal record was registered using PVS registration material (Blu-Mousse, Parkell, Inc., Edgewood, NY). The final shade was also selected.

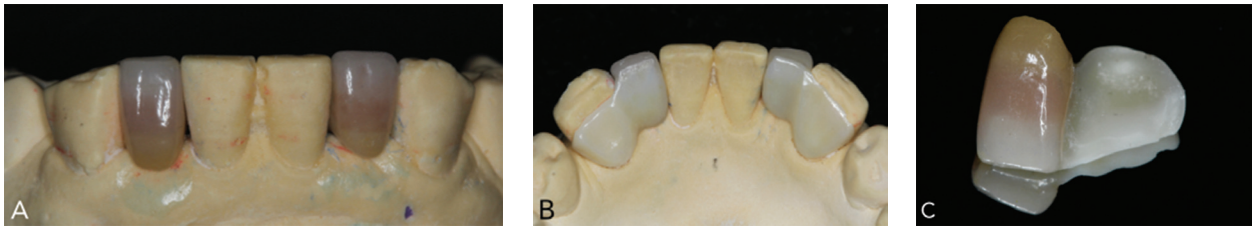
Master casts were fabricated (Figure 9), and mounted in an articulator. The frameworks of the lingual retainers on teeth 33 and 43, and the pontics were then waxed in full contour. Labial and incisal cut-backs were carried out on the pontics to create adequate support for the veneering porcelain. The wax patterns were scanned, and the frameworks were milled from zirconia. Feldspathic veneering porcelain was fired onto the zirconia frameworks. Staining was carried out to match the unique characteristics of the adjacent tetracyline-stained teeth. The definitive prostheses are shown in Figure 10.

รูปที่ 9 *แสดงการกรอแต่งฟันด้านลิ้นและมีการทำร่องยึดบนฟันซี่ 33 และ 43*

Figure 9 *Lingual preparation with proximal grooves on 33 and 43.*

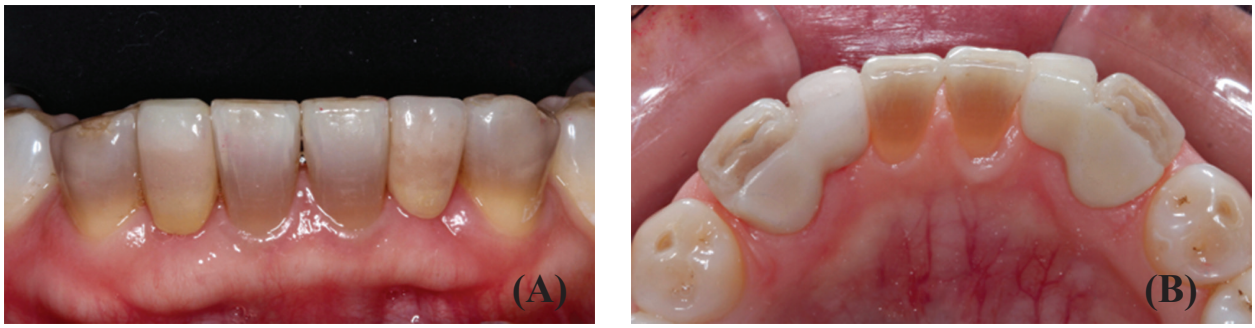
The definitive RBFPDs were evaluated for fit and esthetics. The two zirconia RBFPDs were independently bonded one after the other. The bonding procedure was carried out the same way as described for Case 1.

The patient's existing occlusal scheme was not altered after placing the RBFPDs. All occlusal contacts in protrusion and lateral excursions were removed from the cantilevered pontics. The pontics were not in contact either in centric or eccentric movements. Any adjusted porcelain surfaces were well polished. The patient was given oral hygiene instructions. The zirconia RBFPDs showed good esthetic integration with the adjacent teeth and the surrounding tissue (Figure 11).



รูปที่ 10 *(A) แสดงชิ้นสิ่งประดิษฐ์จริงบนแบบหล่อหลัก (B) ด้านบดเคี้ยว (C) แสดงฟันเทียมบางส่วนแบบติดแน่นยึดด้วยเรซินชนิดเซอร์โคเนียแบบมีส่วนยึดชิ้นเดียว*

Figure 10 *(A) Definitive prostheses on master cast. (B) Occlusal view. (C) Single-retainer zirconia RBFPD.*



รูปที่ 11 *แสดงรูปหลังการรักษาด้านหน้า (A) และด้านบดเคี้ยว (B)*

Figure 11 *Post-treatment frontal view (A) and occlusal view (B).*

Discussion

The important factors that influence the long term-success of RBFPDs are careful patient selection, a well-planned design, a precise preparation procedure, a proper bonding regimen, and periodic maintenance.[2] Improved understanding of these key components, as well as the improvement in materials and prosthetic design, as described in this article, led the clinician to adopt this minimally-invasive modality, as an alternative treatment for suitable patients.

The available evidence strongly suggests that the single-retainer design provides a higher survival rate than do RBFPDs retained by multiple retainers.[27] Occlusion is critical, as the pontic should not be involved in guidance during excursive movements. However, if this is unavoidable, the guidance on the pontic must be shared with other teeth.

The longevity of zirconia RBFPDs depends on the adhesive bonding provided by resin cement, and has become reliable. Zirconia can no longer be considered “unbondable” to tooth structure if the appropriate pre-bonding surface treatment is employed.[34] However, prosthesis dislodgement might still occur. The potential de-bonding of this type of prosthesis after time should be discussed with the patient, and informed consent should be obtained before proceeding.

Conclusions

RBFPDs are often overlooked by clinicians due to their lack of comfort with providing such a treatment. Evidence has shown a promising success rate for anterior, single-retainer, zirconia RBFPDs.[20] Therefore, it should be considered as one treatment option for a single tooth replacement. Zirconia RBFPDs have the main advantage of improved aesthetics compared to conventional metal-ceramic prostheses. To give the best chance of longevity and success, clinicians must select cases properly, make sure that the treatment planning is carefully performed, and ensure that the execution of the treatment is to a high standard.

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