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MULTI-LAYERED MONOLITHIC ZIRCONIA RBFDPS WITH SINGLE LABIAL-VENEER RETAINER ON MAXILLARY LATERAL INCISORS

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ABSTRACT

Background: *The conventional fixed dental prosthesis is contraindicated in adolescence whose anterior teeth are missing. RBFDPs may be the ideal solution till the completion of growth and implant placement can be performed. Lithium disilicate and alumina RBFDPs offer pleasing aesthetics but have a high risk of connector fracture. Due to misaligned abutment teeth, it's not possible to fabricate conventional palatal retainer RBFDPs.* ***Objective:*** *This report provides a conservative yet aesthetic treatment alternative using multi-layered monolithic zirconia RBFDPs with a single labial veneer retainer.* ***Case Report:*** *A 16-year-old male came to USU Dental Hospital. He complained about his ill-fitting removable denture, unsatisfied with his smile. Clinical examination showed edentulous on 11, 21 and malposition on 12, 22 with gingival enlargement in the palatal area. Veneer preparation technique was performed on 12, 22. Two monolithic multi-layered zirconia RBFDPs with a single labial veneer retainer were cemented using the APC zirconia bonding concept. Single retainer RBFDPs have a high success rate and would not hinder the growth of dental arches. Multi-layered monolithic zirconia material has good translucency with high flexural strength to prevent connector fracture.* ***Conclusion:*** *Multi-layered monolithic zirconia RBFDPs with single labial veneer retainer would be a preferred treatment for malposition teeth, to achieve durable and aesthetically-pleasing restoration.*

Keywords: *Resin-Bonded-Fixed-Dental-Prostheses, Adhesive Bridge, Maryland Bridge, Multi-Layered Zirconia, Single Retainer*

INTRODUCTION

Loss of anterior teeth can cause mastication disorders and affect the quality of life of adolescents, especially in emotional and mental aspects of their lives. (1) Loss of anterior teeth can be congenital or occur as a result of accidents, caries and periodontitis.(2) Replacing missing anterior teeth in adolescents is a challenge for dentists. There are several restoration options, such as auto transplantation of primary or permanent teeth, removable partial dentures, adhesive bridge dentures and conventional fixed dental prosthesis (FDPs).(2,3) The treatment of choice should be the least invasive option that meets the desired aesthetic and functional goals. Non-invasive restoration using

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removable partial dentures overcomes aesthetic and functional problems but is less comfortable to use, especially for adolescents who have high physical activity.

Long-term use of removable partial dentures can also cause bone resorption and loss of interdental papillae. Conventional fixed dental prosthesis (FDPs) require extensive tooth preparation and cause pulp trauma triggering hypersensitivity.(3,4) Minimally invasive treatment using resin bonded fixed partial dentures (RBFPDs) can be an ideal temporary restoration solution until the completion growth of the jaw so that replacement with an implant supported restoration can be performed. RBFPD can be made of fiber-reinforced composite (FRC), metal, metal-ceramic combinations or of ceramic materials. Fiber-reinforced composite (FRC). RBFPDs offer quite aesthetic results but do not have good durability so they can only be used as short-term restorations. (2,5) Metal-ceramic RBFDPs provide an alternative to long-term use and have better durability when designed with a single retainer (6) but their use to restore anterior teeth can cause esthetic problems. Ceramic RBFDPs, like lithium disilicate, alumina and zirconia show excellent clinical results in terms of aesthetics and function, but in terms of durability, lithium disilicate and alumina RBFDPs have a high risk of connector fracture compared to zirconia RBFDPs which have high flexural strength and opaque appearance so that a multi-layer zirconia material with better translucency was developed.(6,7,8) This case report describes the modification of the RBFDPs retainer design in the form of labial veneers on malpositioned abutment teeth, where it is not possible to make conventional palatal RBFPDs retainers as an alternative treatment and multi-layered monolithic zirconia as the material of choice which gives excellent clinical results. , high success rate, and provide satisfaction for patients.

CASE REPORT

A 16-year-old male, came to the USU Dental Hospital complaining of discomfort while wearing removable dentures throughout everyday activities and lack of confidence in his smile. He lost two maxillary central incisors due to incident 4 years ago. On clinical examination, there were edentulous space in regio 11, 21 and teeth 12, 22 were malpositioned with gingival enlargement in the palatal area due to removable dentures usage. Based on clinical considerations and patient's needs, rehabilitation was made with a multi-layered monolithic zirconia RBFDPs with a single labial veneer retainer on the maxillary lateral incisors. At the diagnostic examination, clinical photography (Figure 1) and panoramic radiographs were taken. Dentofacial analysis and tooth color selection were performed using an A-D shade guide (Ivoclar Vivadent).

Figure 1: Intraoral Photograph

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The aim of this treatment is to restore the edentulous area and modify the contour of the malpositioned tooth by the most conservative method. Patients were given informed consent about treatment procedures. The maxillary and mandibular diagnostic models were obtained from irreversible hydrocolloid impressions. Wax-up was made in the anterior region of the maxillary diagnostic model. The silicone index of the wax-up was then made as a mock-up and preparation guide.

Teeth 12, 22 were prepared according to the all-ceramic veneer preparation guidelines (Figure 2). Tooth reduction was performed using a round-ended tapered diamond bur (#868 314 016, Komet Dental, Gebr. Brasseler, Lemgo, Germany). The labial surfaces were prepared to a depth of 0.7-1 mm with a cervical chamfer equigingival preparation margin. An incisal reduction of 1-1.5 mm was followed by 1 mm palatal reduction with a palatal wrap design. Finishing with a fine diamond bur (#8868 314 016, #8379 314 023, Komet Dental). After the tooth preparation was completed, the retraction cord (#00) was placed in the labial gingival sulcus for 5 minutes and the maxillary impression was made using a PVS putty-wash impression material with a two-step technique and the mandibular using an irreversible hydrocolloid impression and followed by bite registration taking. The impression was poured using type IV dental stone (Fuji rock) and sent to the lab along with instructions on the desired color, length, width, and position of the abutment teeth using a mock-up model as a reference.

Figure 2: Abutment Teeth after Preparation

A computer-aided design/computer-assisted manufacture (CAD/CAM) (Exo-CAD) system was used for the fabrication of two ceramic RBFDPs units. The stone model was scanned and the RBFDPs was virtually designed with 0,8 mm thickness of retainer and 24.5 mm^2 cross-section of connector (3.5 mm width, 7 mm height) and 15 mm^2 cross-section of connector (3 mm width, 5 mm height) (Figures 3a and 3b), with the shape and size of the pontic according to the patient's emergence profile. The RBFDPs with a single labial veneer retainer was milled from Y-TZP zirconia monolithic blank (Aidite Multilayer Zirconia Block) and sandblasted (Figure 4). After fabrication of the RBFDPs, the provisional restoration was removed and a try-in visit is made to verify the path of insertion, marginal adaptation, interproximal contact, shade and texture matching with adjacent teeth and the absence of black triangle in the gingival area (Fig. 5). After try-in, rinse the restoration thoroughly with water and dry. Apply a cleaning agent (ZirClean®, Bisco Inc.; Schaumburg, III), leave for 20 seconds, rinse with water and then dry. Final cementation of the RBFDPs were carried out following the APC concept: (A) air-abrasion particles, (P) zirconia primer, and (C) resin cement.

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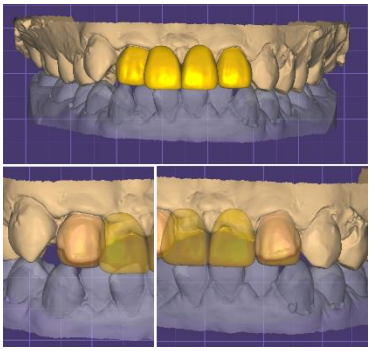

Figure 3: Computer Aided Design of RBFDP

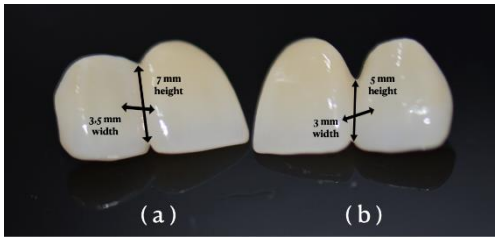

Figure 3a and 3b: Connector and Retainer Dimension of Designated RBFDP

For cementation, the abutment teeth were cleaned with pumice, rinsed and dried. The isolation was carried out using a split rubber dam to keep a dry work area. Abutment teeth was etched with 37% phosphoric acid (15 sec application), rinsed and dried. Mix equal amounts of Universal Primer^{TM} (Bisco Inc.; Schaumburg, III) parts A & B in a 1:1 ratio into a clean mixing well using a brush, mix for 5 seconds, then apply primer to abutments (Universal PrimerTM, Bisco Inc.; Schaumburg, III) then dry. Apply 1-2 coats of primer (Z-PrimeTM Plus, Bisco Inc.; Schaumburg, III) to the interior surface of the zirconia veneer retainer. Wait for 30 seconds and dry. This was followed by cementation using a dual-cure resin cement (Duo-Link UniversalTM, Bisco Inc.; Schaumburg, III) directly on the retainer with an automix dual syringe. The RBFDPs were then tack cured and the excess cement was carefully removed and completely cured for 20 seconds on the incisal, labial and palatal aspects, respectively. After cementation, the occlusion was evaluated. Minimal contact with the pontic during excursion is achieved. Instructions for proper oral hygiene and regular follow-up for 1 week, 3 months, and 6 months was given to the patient.

Figure 4: Two Unit Monolithic Multi-Layered Zirconia RBFDP

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Figure 5: *Try-in*

Figure 6: Cementation under Split Dam Isolation

F**igure 7: One Week Follow up (A) Lateral View, (B) Frontal View, (C) Palatal View**

DISCUSSION

Restoration of anterior teeth is often an urgent need and requires immediate treatment to restore aesthetics and function. Removable dentures as an alternative treatment are economical and easy to fabricate but often causes discomfort and in a long term usage can cause a gingival enlargement (papillary hyperplasia), bone resorption and loss of interdental papillae. Replacement of missing teeth in adolescents with conventional fixed dental prosthesis (FDPs) require extensive abutment preparation. The large pulp chamber of the abutment teeth was a factor that prevented the use of conventional fixed dental prosthesis (FDP) in this case. Minimally invasive RBFPDs can be a solution. (9)

An RBFDP with a lingual retainer design was contraindicated in this case because of the palatal enlargement of the gingiva due to the removable denture usage. The shape and position of the abutment teeth also required modification. The advantage of the labial veneer retainer design on the all-ceramic RBFDP is that it allows modification of the color, shape and arrangement of the abutment teeth. In addition, the RBFDPs with the maxillary labial veneer retainer received less pressure than the adhesive lingual retainer bridge. The disadvantage of an RBFDP with a labial veneer retainer is that it is slightly less aesthetic than an adhesive lingual bridge retainer because the embrasure cannot be widened. It's indicated to the short edentulous in anterior area, with normal occlusal relationships and without parafunction. (3)

Single retainer RBFDP have a high success rate and in adolescent patients who have lost central

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incisors, the use will not inhibit transverse growth of the jaws. Research by Kern M, et al (2017) showed that the single anterior RBFDP retainer made of all-ceramic zirconia material gave excellent clinical results after 10 years of use.(2) This is equal to 95.4% survival rate of single RBFDP made of glass-infiltrated alumina ceramic after 10 years. The single retainer RBFDP made of glass-infiltrated alumina ceramic did not debond, but fractured the frame. This fracture occurs in the proximal connector between the pontic and the retainer. On the other hand, in the case of RBFDP made of zirconia ceramics, overloading due to masticatory pressure and impact/trauma only results in debonding; Zirconia has a flexural strength twice as glass-infiltrated alumina ceramics. This allows the rebonding of the zirconia adhesive bridge and free of complications, whereas alumina RBFDPs with failures and fracture of the framework will require replacement restoration. (2)

In the case of missing two central incisors, the use of two single RBFDPs bridge units can be done considering the extent of the edentulous area and the contact between the two pontices must have a wide surface contact and should have interlocks to prevent rotational movement when receiving masticatory loads resulting in debonding. In addition, the presence of minimal thickness of the connector and retainer plays a role in preventing fracture of the restorative material. The recommended thickness of the connector cross section for lithium disilicate material is > 16mm^2 while for zirconia material it is only > 6mm^2 with a retainer wing thickness of 0.7 mm. (9) Zirconia has high strength and is resistant to fracture. Flexural strength is 900-1,100 MPa and fracture resistance is 8-10 MPa but for an aesthetically pleasing anterior restoration this material is too opaque, so a new generation of zirconia material has been developed which has much higher translucency. The use of high-translucent multi-layer zirconia material, in particular, provides high esthetics for the anterior teeth. Higher translucency is achieved by slightly changing the yttria (Y_2O_3) content (5 mol % or more in place of the conventional 3 mol %) used to stabilize the tetragonal zirconia phase, leading to a higher number of cubic phase particles. Cubic zirconia offers much greater light transmission but lower physical strength. High-translucent zirconia has flexural strength values between 550 MPa and 800 MPa, depending on the degree of transparency; the higher the translucency, the lower the flexural strength. Its specific properties make it a viable alternative material for aesthetic areas if properly bonded. (10)

For high-strength ceramics, many bonding protocols work in the short term, but long-term strong and durable resin bonding is achieved only after surface treatment with airborne particle abrasion and the use of a bonding agent containing 10-methacryloyloxydecyl-dihydrogen phosphate (MDP).(9,10) Zirconia is an oxide-based substrate that requires a primer with a phosphate comonomer to covalently bond to the oxide. To bond zirconia to the tooth, a cement interface is required that cohesively recreates the dento-enamel junction between the enamel, dentin and an inert zirconia oxide based substrate. The resin cement selected must be hydrophobic and dual-cure (light-curing and self-curing), as zirconia is opaque and does not allow light to completely pass through for complete curing of the resin. Zirconia-tooth bonding interface was not possible, because hydrophobic cements did not adhere to the oxide. However, new primers have been developed (Z-PrimeTM Plus, Bisco Inc.; Schaumburg, III.). This primer utilizes the combined phosphate and carboxylate monomers to create a cohesive interface, which enables the hydrophobic resin cement to create a cohesive hydrophilic seal that is attached between the tooth and the zirconia restoration. (11, 12) In order to achieve long-term resin bonding strength to zirconia, the APC zirconia bonding protocol is recommended:" Where

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A is: Air-abraded particle (Sandblast) on the bonding surface with aluminum oxide. Sandblasting can be carried out in the laboratory or chairside using a micro etcher with small aluminum oxide particles (50 µm-60 µm) at low pressure (below 2 Bar); P is: Apply a special zirconia primer; and C: Use dual-cure or self-cure composite resin cements. (10)

CONCLUSION AND SUGGESTION

Multi-layered high-translucent zirconia has good optical properties and can be applied as a monolithic restoration for anterior teeth. A multi-layered monolithic zirconia RBFDPs with a single labial veneer retainer may be the treatment of choice for adolescents with malposition abutments to achieve an aesthetically pleasing and durable restoration. This material cannot be etched like glass ceramic therefore needs specific phosphate-monomer containing primer. The cementation material and the APC bonding protocol are mandatory to the long-term success of a multi-layered single labial veneer retainer monolithic zirconia restoration. It is recommended to use bonding, primer and resin cement products from the same manufacturer and not to combine products from different manufacturers which may not be compatible to one another causing bonding failure of the RBFDPs.

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