Case Report

A Non-Destructive Bonded Prosthesis - Carolina Bridge

Dr. Sanjay Kumar Sah,[1] Dr. Minu Dhungana Joshi,[2] Dr. Lochana Acharya,[3]

Dr. Manjeev Guragain,[4] Dr. Yumei Ding[5]

[1]Prosthodontics Unit, Dental Department, National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal;

[2]Department of Prosthodontics, KIST Medical College, Lalitpur, Nepal;

[3]Guheshwori Dental Multispecialty and Implant Hub, Kathmandu, Nepal;

[4]Department of Dentistry, Institute of Medicine, Kathmandu, Nepal;

[5]Department of Stomatology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, 430022 Wuhan, China

Correspondence:

Dr. Yumei Ding. Email: dingyum@hotmail.com

ABSTRACT

The Carolina Bridge is an all-ceramic pontic etched on proximal surfaces and bonded to adjacent vital teeth with a hybrid composite resin. It is completely reversible in nature because there is no need for abutment teeth preparation except for a minor roughening of the proximal surfaces of the abutment teeth. It can be used to replace single missing incisor tooth. This article describes different treatment modalities for single missing incisors and presents a case report of replacement of a missing mandibular central incisor with the Carolina Bridge.

Keywords: Bonded prosthesis; carolina bridge; single missing incisor.

INTRODUCTION

The replacement of a single missing anterior tooth poses a clinical dilemma when adjacent teeth do not require crowns. Esthetics, preservation of remaining tooth structure, and longevity of the restoration are important factors to be considered when a treatment plan is developed. Various treatment options including conventional fixed partial dental prosthesis (FPDP), dental implants, resin-bonded prosthesis are considered with their own advantages and disadvantages.

One of such fixed dental prostheses is the Carolina Bridge.[1] It is a custom fabricated all-porcelain pontic with etched proximal surfaces that is bonded to the adjacent abutment teeth using composite resin connectors. The name "Carolina Bridge" was coined by a dental laboratory in North Carolina, USA, and was first used by Dr. Haymann in 1987. It is completely reversible in nature and has esthetic vitality. It has the added advantage of ease of placement and connector repair in case of fracture.

CASE REPORT

A 22-year-old woman came to the department of Prosthodontics, Union Hospital with the chief complaint of missing a lower front tooth, and she wanted to replace the missing tooth with an artificial one. The patient had no relevant medical history. The cause of the tooth loss was extensive tooth material loss due to caries. On clinical examination, the patient had a missing right mandibular central incisor. The adjacent abutment teeth had sound periodontium with no gingival recession. She exhibited only slight incisor vertical overlap. Posterior occlusion was stable. Inciso-gingival height in the proximal region of both abutment teeth was approximately 7 mm. (Figure 1).

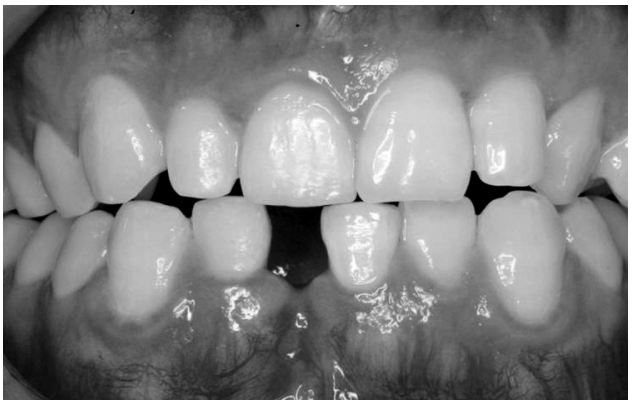

Figure 1: Patient with a missing mandibular right central incisor.

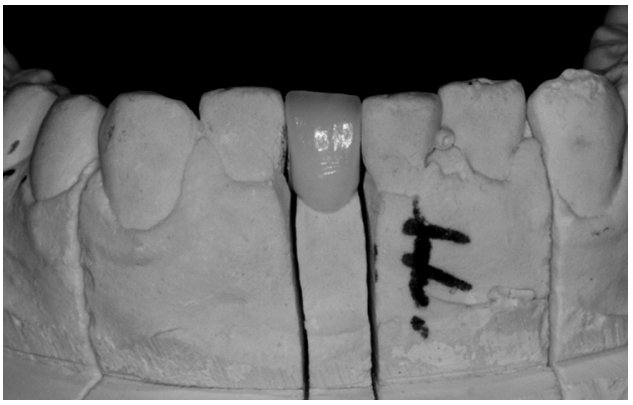

Figure 2: All ceramic pontic on the cast.

The patient was informed about all possible treatment options, including their advantages and disadvantages. She was informed that an implant would be the most suitable treatment option. She was not ready for an implant due to financial reasons. She also did not want a removable dental prosthesis. In addition, she denied any natural tooth preparation that may have caused loss of the tooth structure. She agreed on replacement of her tooth with a Carolina Bridge. The patient was informed about the compromised strength of the Carolina Bridge compared to a conventional partial fixed dental prosthesis. She was also told that she had to avoid biting on very hard objects with the prosthesis, and that there was a possibility of swallowing the prosthesis if the pontic was completely detached from its abutments due to connector fracture. However, it is very rare that both connectors would fracture even while biting a hard object. Usually, patients are immediately aware if a resin composite connector fractures. Therefore, the possibility of inadvertent swallowing is rare. After getting the informed consent from the patient, the treatment was started.

During the first appointment, shade selection was done (Vita 3D-Master; Vitadent, Brea, CA) and the shade was reconfirmed by the patient and one another experienced dentist. Care was taken that the adjacent teeth were not dehydrated prior to shade determination and shade selection was quick. Shade selection was performed under natural light condition. Afterwards, elastomeric impressions (Flexitime Easy Putty; Heraeus Kulzer, South Bend, Ind) were made for maxillary and mandibular arches and working casts were generated with type IV dental stone (Dentstone; Heraeus Kulzer). These were related to each other with fast setting vinyl polysiloxane occlusal registration material (Flexitime Bite; Heraeus Kulzer). The casts and the occlusion record were sent to the dental laboratory. A polyvinylsiloxane index (Flexitime Easy Putty; Heraeus Kulzer) was made to guide the positioning of the pontic during the insertion appointment. The dental laboratory made an all porcelain pontic. Feldspathic porcelain was used for pontic fabrication (Figure 2). Feldspathic porcelain is easy to etch with hydrofluoric acid. The pontic design was of the modified ridge lap type. This is the most commonly used pontic design. The contact of the pontic with the underlying ridge is maintained only on the buccal aspect of the ridge. This limited contact in only one plane allows the area to be readily cleansed with dental floss and maintained free of inflammation. This type of pontic fulfills most of the needs of the restorative dentist in cases involving ideal edentulous ridges.

During the second appointment, the abutment teeth to be bonded were cleaned with flour of pumice in a prophy cup administered at slow speed, using a prophy angle handpiece to clear the teeth of any surface debris. The teeth were thoroughly washed with water. The area to be restored was isolated with cotton rolls and the pontic was placed for shade confirmation and evaluation of fit in the proximal region. Again, care was taken that adjacent teeth were not dehydrated before the shade was confirmed. A gauge piece was spread across the patient's mouth to prevent accidental swallowing while evaluating the pontic. After evaluation of the fit and shade of the pontic, it was prepared for cementation.

To achieve the highest bond strength, many studies have suggested etching the ceramic surface with hydrofluoric acid and applying a silane-coupling agent. Etching creates a rough surface for micromechanical interlocking between the resin and the ceramic while a silane-coupling agent provides a chemical bond between them. A 9.6% concentration of hydrofluoric acid (Porcelain Etch Gel; Pulpdent, Watertown, MA) was used for 60 seconds. Care was taken that

Figure 3: All porcelain fixed dental prosthesis after bonding. Note the long inciso-gingival length of the connectors, which is essential for its long-term success.

Figure 4: One-year post treatment follow-up image of the restoration.

all surfaces of ceramic to be bonded to the abutment teeth were properly etched. After 60 seconds, the etched surfaces were thoroughly rinsed with water for 5 to 10 sec and then dried. A silane-coupling (Silane Bond Enhancer; Pulpdent) agent was applied over the etched porcelain surfaces according to the manufacturer's instructions. Proximal surfaces of the pontic were etched to their full length, including the line angles on the lingual surface for effective bonding.

Retention is solely dependent on the micromechanical bonding; therefore, an increased surface area for bonding would provide a better retention for the denture. The abutment teeth were prepared by only slightly roughening the proximal surfaces up to the buccal and lingual line angles using a coarse diamond. This slight roughening of the teeth improves bond strength of composite resin connectors by increasing the surface area for bonding. The enamel of proximal surfaces was etched with 35% phosphoric acid etching gel (Vita etchant gel; VITA-zahnfabrik, Spitalgasse, Bad Sackingen, Germany) for a minimum of 15 sec, rinsed with water and dried with slow air jet. Subsequently, the etched teeth surfaces were kept clean and dry for effective bonding. A dual cure, radiopaque, two-component fine hybrid composite resin (Vita Duo Cement; VITA-zahnfabrik) was mixed according to the manufacturer's instructions and placed on the proximal teeth surfaces. A small amount of composite resin was placed on the proximal surfaces of the prepared pontic as well. Then, the pontic was positioned in the edentulous space. Excess composite resin was removed with an explorer. Facial embrasures were defined for cleaning, and lingual embrasures were not defined and rather slightly over-bulked for the strength of the connector. The connectors were visible light cured (Optilux 501; Kerr, Middleton, WI) from both the buccal and the lingual sides for minimum of 20 seconds each to ensure complete polymerization.

The final contours of the composite resin were achieved with the appropriate finishing burs. A series of abrasive points and cups (OneGloss; Shofu, San Marcos, CA) were used to finish and polish the composite resin connectors. The occlusion was analyzed and the pontic was adjusted to ensure that only minimal centric or functional contact was present with pontic(Figure3).

The patient was instructed in proper hygiene methods, including the correct use of floss to clean the tissue surface of the pontic. The recall visit was scheduled at three months and one-year interval. During those visits, the restoration was examined. The patient did not have any problems except for some staining in the connector region, which was removed by the composite finishing cup (Figure 4).

DISCUSSION

Conventional FPDP, has been regarded as the standard of care for replacement of single, or multiple missing teeth. However, this treatment modality may lead to destruction of what is frequently sound tooth structure causing the patients to ask 'is it really necessary to cut away all that good tooth?'[2] Salinas et al reported that accepted partial fixed dental prosthesis survival is 87% at 10 years, decreasing to 69% at 15 years.[3] Missing mandibular central or lateral incisor pose yet another problem. The average width of mandibular central incisor is 5 mm in the mesio-distal height of the contour and 3.5 mm in the cervical region.[4] Whether the retainer for the FPDP is metal ceramic or porcelain, a minimum of 1-1.5 mm axial tooth preparation is required to provide

an adequate taper. Due to limited available tooth material for adequate reduction, teeth preparation may involve pulpal tissue, which would require endodontic treatment. If the tooth is under-reduced, the prosthesis has poor contour with poor esthetics and hygiene problems. Cantilever dentures that utilize single teeth as abutment, are conservative compared to conventional three-unit FPDP; however, they have a lower success rate than end-abutment partial fixed dental prostheses.[5]

Of all the treatment alternatives for the restoration of a single missing tooth, the implant restoration has definite advantages. It has become an esthetic, functional restoration with long-term predictability, and it is the ideal treatment for single-tooth replacement for pristine dentition.[6] However, economic, systemic, and anatomic factors need to be considered while planning for dental implant restoration; therefore, other treatment options need to be considered.

The development of acid etching of enamel to improve the retention of resin, which was first described by Buonocore in 1955[7] led to conservative approaches being advocated for replacement of single missing tooth. Rochette was the first to describe the attachment of acrylic resin pontic to unprepared abutment using composite bonding resin. Subsequently, the Maryland and Virginia bridge were introduced.[8,9] All of the above mentioned treatment modalities use metal-ceramic pontic and metal wing retainers that are bonded to the lingual surface of abutment teeth after enamel-only tooth preparation. When bonded properly, resin-bonded prostheses have good clinical outcome; however, they are associated with several problems. Display of metal wings as grayish discoloration through the thin enamel is one of the biggest esthetic problems when metal wings extend high incisally or when the abutment teeth are thin labio-lingually. Debonding of metal wings due to failure of the bond is the most frequent clinical complication with resin-bonded prostheses.[10] Debonding of metal wings may also be associated with dental caries, food impaction between the metal wings and the tooth and subsequent orthodontic tooth movement due to unfavorable force.

Many esthetic versions of resin-bonded prostheses have been introduced in which metal wings are replaced by porcelain wings. These include tooth-colored Maryland bridges, called Encore Bridge.[11] These prostheses are esthetically pleasing and if handled properly, perform well clinically. However, fracture of retentive porcelain wings is quite common. All of these fixed dental prostheses have been used with varying degree of success, and when properly fabricated some can provide excellent bond strengths. However, all of them share one major disadvantage, which is irreversible loss of some degree of sound tooth structure due to tooth preparation for retention and resistance of the restoration. With the exception of implants, the only completely reversible option is a partially removable dental prosthesis. Although it can provide adequate esthetics and functionality, most of the patients dislike the bulkiness of a removable appliance, hygiene problems associated with it and the discomfort experienced from wearing it. To overcome these problems, many treatment modalities have been tried. Acrylic resin tooth pontic has been used to attach to natural teeth by composite bonding resin. Natural extracted teeth or custom composite resin as pontic have also been used. These fixed dental prostheses were exceptionally conservative and relied on composite resin connectors for retention. Although resin-bonded fixed dental prostheses are non-destructive in nature, they cannot provide the strength of a conventional partial fixed dental prosthesis. Therefore, they are prescribed as provisional or interim dentures.[12] The Carolina Bridge has limitations that it cannot be used for replacement of posterior teeth or canines, patients exhibiting deep vertical incisor overlap and/or evidence of bruxism or clenching, abutment teeth that lack sufficient inciso-gingival height for composite resin connector bonding. A minimum of 5 mm inciso-gingival height is required for proper connector bonding.

Compromised strength of the denture is the main disadvantage. Therefore, it has been used as provisional or interim denture. Discoloration or staining of composite resin retainer is another disadvantage and patient needs to have regular dental follow-ups.

SUMMARY

The Carolina Bridge is an all porcelain resin bonded fixed dental prosthesis, which can be effectively used for long-term provisional or interim replacement of single missing incisors if the clinical procedures are executed properly. The main features of this prosthesis include its reversible nature and easy repair. It is recommended to inform the patient adequately about its limitations as well as about more permanent treatment modalities such as dental implant restoration.

JNDA

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