

Zirconia Based Resin Bonded Fixed Partial Denture: Future Outlook

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Abstract: This article describes a case of rehabilitation of a missing lateral incisor using a Zirconia based resin bonded fixed partial denture. An 18 year old female patient with the agenesis of lateral incisor and a peg lateral incisor in the other side presented to prosthetic department. This aspect was compromising the self satisfaction of the patient. She desired a more attractive appearance. After a comprehensive examination, adjacent teeth to edentulous area were sound with a suitable height. Implant therapy was excluded. The treatment plan included a Zirconia based resin bonded bridge in the right side. The peg lateral incisor was reshaped using a provisional restoration until growth achievement and tissues maturation

Keywords: non invasive; resin bonded fixed partial denture; bonding; Zirconia ceramic ; missing lateral incisor

I. Introduction

Restoring a single missing tooth, especially in the anterior region remains usually a serious challenge confronted by such clinicians mainly when adjacent teeth are sound ¹. It's obvious that, minimally invasive modalities with a minimum tooth structure removal should be preferred, especially when adjacent teeth do not require prosthetic restorations ². In this case tooth mutilation via extensive reduction seems to be inappropriate ^{1,3}. For that, dentistry has focused on more conservative treatments because with such options pulp irritation has to be decreased preserving a healthy tooth. To improve esthetics and function, a wide variety of treatment modalities is available thanks to new technology ⁴. Dental implants or adhesive techniques can be used in such applications ⁵.

When it comes to implant supported prosthetic approach, it is the most appropriate treatment for a single missing tooth. In addition to its high rate success, which is proved by scientific literature, it leaves adjacent teeth untouched ⁶. Whereas, the optimal conditions to place an implant require a three dimensional bone evaluation where a minimum of 1.5 mm of bone thickness is essential ².

As absence of teeth conduct to bone resorption, a knife shaped bone in the anterior region seems to be frequent. This has made implant postponing a challenge which can be complicated by grafting techniques ². In such cases, and with the improvement of both preparation designs and clinical performance of bonding systems, resin bonded bridge seems to be a suitable option and a good alternative for implant therapy ^{1,5}. In fact, results showed that it has, esthetically, reached the same rate success as implant. Due to a minimally invasive preparation which is limited to enamel it has been considered as a conservative treatment option ⁶.

In fact, it has been introduced since 1973 as a temporary procedure. This system was conceived by ROCHETT as a splinting system using retainers in a periodontally compromised incisor and it was limited to the mandibular anterior region ⁷. Whereas, it has been proved by recent studies that, when it is used to replace a missing tooth it offers an acceptable survival rate which has been evaluated between 81.6% and 91.9% after 5 years ⁸. It might, when well indicated and performed, satisfy final outcomes in terms of strength and esthetic requirements.

However, performing a resin bonded bridge is not an easy procedure; it requires clinical skills and basic knowledge concerning prosthetic materials and bonding systems via a careful treatment planning ⁸. It begins with the case selection which plays a great role in long term success where young patients with small edentulous ridge are the elective candidates. A vital and non mobile tooth which is free from fillings and caries with sufficient enamel surface for bonding is considered as an ideal abutment ^{6,10}. Faced with short clinical crowns achieving a resistant connector becomes a challenge where this option may be rejected. As occlusion relationship is one of the most important factors for long term success, it is recommended not to involve the framework during dynamic occlusion to avoid possible debonding ⁵. For that, patients with limited inter occlusion relationship or deep overbite, and when it is essential to re-establish canine guidance, this treatment is contra indicated. ^{8,9,11}

Despite its high survival rate, debonding and wing fracture are the most frequent complications. Recent studies has shown that debonding seems to be higher in the posterior region than the anterior one . It can be avoided by the use of well performed bonding systems and may need a deep reflection in terms of preparation designs and concepts.

According to literature, fracture was frequent between the retainer and the pontic in bridges fabricated by unfiltred alumina ceramic. So, the use of a resistant material such as zirconia may be the solution. Thanks to micro structural changes defined by a transformation from tetragonal to monoclinic phase which gives a resistance at the tip of the micro crack; this offers a high resistance to its propagation when zirconia framework is submitted to stress¹².

Despite the importance gained by single retainer bonded bridges using the lithium disilicates in terms of survival rate reported to 100% after 6 years⁶, as it avoids the debonding, Cantilever bridge requires favorable root length, shape and crown length¹³ and is not required when splinting is indicated to stabilize post orthodontic treatment⁶.

Compared to silica based ceramic material, bonding of zirconia seems to be a subject of concern. It requires elaborated surface treatments to increase its suitability for adhesive techniques. These treatments include many procedures such as surface abrasion, application of a tribochemical silica coating and the chloro-silane treatment¹²

Currently allying the performance of bonding systems Zirconia based frameworks are resistant, enough, to provide viable connectors in double retainers bonded bridges. Moreover, it can also, solve the aesthetic problem caused by metal retainer in metal ceramic concept; which is a basic problem confronted by both clinician and patients⁷.

II. Clinical report

An 18 year old female patient was referred to the Department of Prosthodontics at Monastir University. She had unilateral congenitally missing lateral incisor. Her medical history was non relevant while the dental history revealed that an orthodontic treatment was set up with a space opening leading to a correct spacing for the right missing lateral incisor. The patient was wearing ESSIX appliances and was looking for a symmetrical aspect for a pleasing full smile. An extra oral examination revealed Symmetrical face, straight to convex profile and a normal facial musculature (fig1)

Intra oral examination showed a peg lateral incisor in the left side. This can complicate the treatment and compromises the symmetrical final aspect. Soft tissues were healthy and oral hygiene was evaluated as good .After a careful occlusion evaluation, canine guidance was noted without any remarkable occlusion anomalies. The edentulous ridge was measured and it was suitable for adequate dimensions of lateral incisor. The adjacent teeth were vital, free from caries and fillings with a suitable crown volume and height. Full face smiling, retracted smile, a resting smile and profile photographs were taken to assess the final result .A radiographic exam had been established for a diagnosis and a treatment plan. A diagnostic wax up incorporating all desired requirement was created. Its aim was the assessment of the proposed treatment option and predicting problems that could arise during treatment. Tomographic dental scans analysis revealed that implant therapy was not suitable in this case .In addition, the patient was refusing any surgical intervention which made grafting techniques rejected. Moreover, cephalometric radiographs indicated that she had not reached full physical maturity and thus was not yet candidate for single crown to reshape the peg lateral incisor .

The decision of a zirconia based all ceramic resin bonded fixed partial denture to replace the missing lateral incisor and an all ceramic crown in the left side was suggested and accepted by the patient. This bonded bridge will be considered, on one hand, as a splinting system which can limit periodontal rebound .It will stabilize the orthodontic treatment inhibiting recidivism from occurring¹⁴. On the other hand, it was indicated as a final prosthetic treatment restoring missing lateral incisor. A heat polymerized provisional restoration would be useful in the left side until the achievement of soft tissues maturation. Then the final ceramic crown would be placed in optimal conditions of periodontal integration. This will offer an improvement of the desired aesthetic outcome.

Figure 1. Missing lateral incisor



III. Clinical procedure and discussion

Occlusion was examined, intraorally, with a piece of articulating paper. Tooth reduction areas were evaluated and delimited via a thin colored line marking its limits. These areas included the lingual and the proximal surfaces (fig 2). A reduction of 0.6mm was performed, thanks to mechanical resistance of Zirconia framework¹⁰, to receive retainer wings. It begun by the outer limits then extended to proximal region. To provides a support to the connector, 3(Vertical)*2 (Horizontal) mm of thickness is required⁶. The abutment preparation consisted on lingual veneer preparation. First, using a ball shaped bur a groove should be prepared on central region of the lingual enamel. Second, a chamfer bur was used to prepare the proximal box. Finally, smoothing sharp edges was required^{5,6,10}. Coronal extension of the retainer is dictated by overbite amount and margins were supragingivally placed. This preparation design does not offer mechanical retention but only the seating of the restoration. All efforts should be done to maintain the preparation in the enamel surface for a strong bonding. The translucency of abutment teeth has no impact on retainer design because zirconia provides high esthetic restoration. In this case, we have no metal retainer which can appear through translucent enamel. For that, only occlusion scheme should be verified when placing wing limits avoiding stress which may lead to debonding or zirconia fracture⁹.

Figure 2: Intra oral view; preparation areas



Figure 3: Final result



After preparation, provisional restoration was not necessary because the Essix appliance continued to be used. A full arch impression was made using a silicon material and without gingival retraction. The shade was selected using the color scale of VITA. The framework was then milled using Zirconia ceramic with the help of CAD/CAM technology.

During the try in stage, the passive insertion, the pontic/ ridge relation-ship, the accuracy of the fit, and a three dimensional seating of the wings were checked. Once the framework was valid, feldspathic porcelain was selected for veneering according to the appropriate shade. Then, aesthetic result should be controlled¹⁰.

The internal surfaces of the retainer wings were abraded with 50 µm aluminum oxide particles at a pressure of 1.0 bar^{6,15}. Reducing the pressure during air abrasion and using particles up to 50 µm in size is beneficial to avoid structural defects of zirconia¹⁵. A special care should be given to protect the feldspathic veneering porcelain from abrasion¹⁰.

Abutment teeth were cleaned, etched with phosphoric acid (36%) for 30 sec then rinsed. The Bridge was bonded using a composite resin which was applied onto the abraded surfaces in the retainer surfaces. (Fig 3) showed an aesthetically accepted final result.

As zirconia is less suitable for bonding, using two retainer wings allows both the extension of the prepared tooth surface for bonding and splinting to avoid periodontal rebound of abutments which is not possible when using one single retainer. Besides, current surface treatments of Zirconia already cited conduct to sustainable bonding solution in one hand. On the other hand, using this material and thanks to its strength properties the proximal connector size can be reduced. It was estimated about 2.6 times smaller than the connector size made from Lithium disilicate ceramic⁶.

IV. Conclusions

Replacing missing single teeth in the anterior region is a challenge which requires a comprehensive treatment plan. When implant therapy is not indicated, Zirconia based all ceramic resin bonded fixed partial denture seems to be a suitable treatment modality. It offers, with a minimal tooth structure removal, a viable option with an acceptable result in terms of aesthetic and strength.

Conflicts of Interest

The authors declare no conflict of interest.

References and Notes

- [1]. Chris C.L Wyatt. Resin bonded fixed partial dentures: What's new? JCDA 2008; Vol 73, No 10:933-938
- [2]. Erica Dorrigatti, Rafael Scaf de Molon, Francisco de Assis Mollo, Luiz Antonio Borelli de Barros. Multidisciplinary approach for the aesthetic treatment of maxillary lateral incisors agenesis :thinking about implants ? Oral surg Oral med oral pathol oral radiol 2012; Vol 114; N 5:22-28
- [3]. Sergio Rubinstein, Alan J. Nidetz, Masayuki Hoshi. A multidisciplinary approach to single tooth replacement. Quintessence international 2004; 1-19
- [4]. Corky Willhite, Mike Bellerino, Jimmy Eubank. Treatment of congenitally missing lateral incisors with resin bonded fixed partial dentures. Quintessence international 2002; 63-72
- [5]. Yoshiyuki Hagiwara, Hideo Matsumura, Seiji Tanaka, Julian B. Woelfel. Single tooth replacement using a modified metal –ceramic resin –bonded fixed partial denture: A clinical report. The journal of prosthetic dentistry 2004; Vol 91; Num 5:414-416
- [6]. Martin Sasse; All ceramic resin resin bonded fixed dental prostheses treatment planning, clinical procedures, and outcome. Quintessence international 2014; Volume 45; Number 4:291-296
- [7]. Hiroshi Shimizu, Tomohiro Kawaguchi, Ytaka Takashashi; The current status of the design of resin bonded fixed partial dentures, splints and overcastings. Japanese Dental Science Review 2014; 50:23-28
- [8]. Bjarni E. Pjetursson, Wah Ching Tan, Ken Tan, Urs Bragger, Marcel Zwahlen, Niklaus P. Lang. A systemic review of the survival and complication rates of resin bonded bridges after and observation period of at least 5 years. Journal Compilation 2007 :131-141.
- [9]. Gregory A. Kinzer, Vincent O. Kokich. Managing congenitally missing lateral incisors Part II: tooth-supported restorations. Advances esthetics and inter disciplinary dentistry 2007; Vol 3; Num 4
- [10]. Margrit P. Maggio; Michael Bergler; Daniel Kerrigan; Markus B. Blatz; Treatment of maxillary lateral incisor agenesis with Zirconia-Based All ceramic resin bonded fixed partial dentures: A case report; The American Journal of Esthetic Dentistry 2012; Volume 2; Number 4: 226-237
- [11]. K. A. Durey, P.J. Nixon, S. Robinson. Resin bonded bridges: techniques for success. British dental journal 2011; Vol 211; Num 3:113-118.
- [12]. kosovka Obradovic, Vesna Medic, Slobdan Dodic, Dragan Gavrilov. Dilemmas in Zirconia Bonding :A review. Srp Celok Lek 2013; 1415(5-6):395-401.
- [13]. Ashu Sharma, G. R. Rahul, Soorva T. Poduval, Karunakar Shetty. Assessment of Various Factors for feasibility of fixed cantilever bridge: A case review Study. International Scholarly Research Network ISRN Dentistry 2012
- [14]. Tanaoue et al. Use of resin bonded fixed partial dentures as permanent retainers :A clinical report. Int Chir Dent 2004; 4:40-43
- [15]. Una Lally; Resin bonded fixed partial dentures past and present-an overview ;Journal of Dental Irish Association 2012; Volume 58:294-300.