Case Report

Management of missing incisor with tooth malposition using removable orthodontic appliances and modified design adhesive bridge: a case report

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ABSTRACT

Introduction: The loss of anterior teeth can lead to aesthetic, phonetic, and functional issues. A lithium disilicate adhesive bridge can be a good alternative and a viable compromise in cases of anterior tooth loss. The advantages include minimally invasive preparation, adhesive system, better retention, and aesthetics compared to metal materials. Removable orthodontic treatment is a preliminary option for cases of minor tooth malposition to achieve an ideal dental arch. This case report describes the management sequence for a missing incisor with tooth malposition using removable orthodontic appliances and modified design adhesive bridge. **Case report:** A 19-year-old female patient visited Dental Hospital Universitas Padjadjaran, Bandung with an issue of missing left central incisor due to traffic accident, and the right central incisor being in a crossbite position. The patient wanted to use a fixed dental prosthesis to improve her appearance but had not yet undergone correction for the misaligned tooth. **Conclusion:** The combination of removable orthodontic treatment with a final restoration utilizing a modified design adhesive bridge using lithium disilicate material for the upper anterior teeth can enhance patient satisfaction by addressing aesthetic concerns and improving phonetic function and chewing ability.

KEYWORDS

Lithium disilicate, modified design adhesive bridge, removable orthodontic appliances

INTRODUCTION

Anterior crossbite is the term used to define an occlusal problem involving the palatal position of the maxillary anterior teeth relative to the mandibular anterior teeth. [1,2] This condition can be corrected with either removable or fixed orthodontic appliances. The method of choice for correcting this condition should not only be clinically effective, with long-term stability, but should also be cost effective and have high patient acceptance, i.e. minimal perceived pain and discomfort. Removable orthodontic appliances are another safe, simple and aesthetically acceptable alternative for the treatment of anterior crossbites. [1,3]

There are several treatment options for the loss of anterior teeth. Prosthetic treatment for the anterior region needs to be aesthetically pleasing while providing good function. [4,5] Although removable dentures are often the treatment of choice, many patients find them difficult to accept, often citing discomfort as the primary concern. Conventional bridges may be a better option, but they are not suitable for younger patients due to their larger pulp chambers, which increase the risk of

pulp tissue damage during tooth preparation. Many adult patients also choose to avoid irreversibly altering or reducing adjacent teeth.[5]

Implant treatment may be the most suitable option, but its placement depends on several factors, including the amount of bone available, medical conditions, financial factors and patient preferences. Adhesive bridges are a good choice for young adult patients because they are minimally invasive, conservative and provide a viable compromise when simpler procedures are preferred.[4] Many studies indicate that resin-bonded fixed dentures, such as adhesive bridges, can provide satisfactory results with clinically acceptable survival rates.[6–12]

Adhesive bridges were introduced to the field of dentistry in the 1970s, with Rochette credited as the first to design such a prosthesis in 1973.[11] The design incorporated perforations in the metal framework of the retainer to improve retention. Initially, these dentures were intended to maintain teeth compromised by periodontal problems.[2] However, their use was eventually extended to replace missing anterior teeth in young patients. A drawback of the Rochette perforated retainer design is the potential for resin cement degradation, leading to leakage under the retainer.

Lithium disilicate was introduced as a dental restorative material in 1998. This system primarily consists of two phases: phase I consists of homogeneously distributed lithium disilicate (Li2O-SiO2) crystals and lithium orthophosphate, while phase II consists of a glass matrix.[13,14] The high concentration of lithium disilicate crystals improves the mechanical properties of the material. However, the use of lithium disilicate in the posterior region is severely limited due to its insufficient mechanical properties.

Therefore, zirconia-reinforced CAD systems have become the preferred choice for posterior restorations. The aim of this case report is to provide information on the management of a missing incisor with tooth malposition using removable orthodontic appliances and a modified design adhesive bridge. The novelty of this case report lies in its unique combination of removable orthodontic appliances and a modified design adhesive bridge for managing missing anterior teeth with malposition. Unlike conventional fixed prosthetic approaches, this method provides a minimally invasive and aesthetically friendly alternative while also addressing minor tooth misalignment before definitive prosthetic rehabilitation.

Additionally, the distinctive aspect of this case is the integration of a removable orthodontic appliance with a prosthetic function, using a Z-spring and bite risers to gradually correct the anterior crossbite while maintaining aesthetics. This approach allows for a progressive and patient-friendly transition to a final restoration using a lithium disilicate adhesive bridge, ensuring a functional and aesthetically pleasing outcome with minimal tooth reduction. This innovative combination enhances treatment predictability, patient satisfaction, and long-term stability, making it a valuable reference for prosthodontists managing similar cases.

Case Report

A 19-year-old female patient presented to the Dental Hospital at Universitas Padjadjaran with the chief complaint of missing upper anterior teeth and unesthetic appearance due to missing teeth. The patient reported a history of extraction of her upper anterior teeth due to trauma two weeks ago.[16] Intraoral examination revealed a missing left central incisor along with malocclusion of the right central incisor (Figure 1).

All treatment options, including implants, conventional fixed dentures, removable partial dentures, and resin-bonded bridges, were discussed with the patient. The patient was not ready for any invasive treatment option, so implants were excluded. She was preferred a fixed prosthesis with minimal tooth reduction, so a resin-bonded bridge were selected as the treatment option for the patient.

Figure 1. Intraoral photo. (Source: personal documentation)

The first step in this case was to correct the position of the right central incisor using a modified removable dental prosthesis with orthodontic appliances (Figure 2). This prosthesis was used as an interim solution so that the patient would not feel embarrassed about having a missing tooth, while simlutaneously correcting the malocclusion.

The appliance consisted of an acrylic removable dental prosthesis with a removable acrylic prosthesis with an artificial tooth 21, combined with a Z-spring on the palatal aspect of 11, and a bite riser on 14 and 24. The patient was instructed to attend regular weekly check-ups for evaluation and activation of the Z-spring. After three weeks, 11 had moved into position and the bite risers were removed, but the Z-spring remained activated until 11 had reached its ideal position along the dental arch. The distal aspect of tooth 11 and the mesial aspect of tooth 12 were also trimmed.

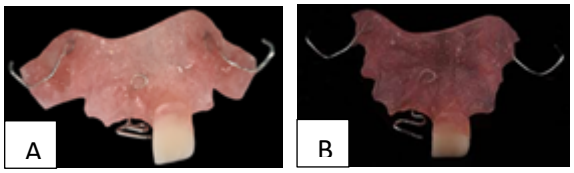

Figure 2. The interim prosthesis. A. Before activation, B. After activation and removal of the bite riser

After one and a half months of observation, the position of 11 was fully corrected (Figure 3). The next step was to take impressions for the fabrication of a digital mock-up to correct the smile line and the proportions of the maxillary anterior teeth; a modified design adhesive bridge with labial veneers and palatal wings made of lithium disilicate material was selected.

Figure 3. Tooth position alteration after using an interim prosthesis riser. A. Insertion the interim prosthesis, B. Tooth position after using prosthesis for two months, C. Occlusal view when insertion, D. Occlusal view after two months, E, F. Front view after two months.

After the digital mock-up was approved by the patient, the next step was tooth preparation (Figure 4). Minimally invasive preparation was performed on the palatal surface of abutment tooth 22 and the labial surface of tooth 11 using a deep chamfer diamond bur, followed by smoothing with a finishing bur. Once the preparation was completed, a two-step double-impression technique was performed using polyvinyl siloxane material (heavy and light body). The preparation consisted of a labial veneer 11 and a palatal wing for 22. Color A2 was selected using a shade guide with the central incisor (tooth 11) as the cervical reference and A1 as the body and incisal reference.

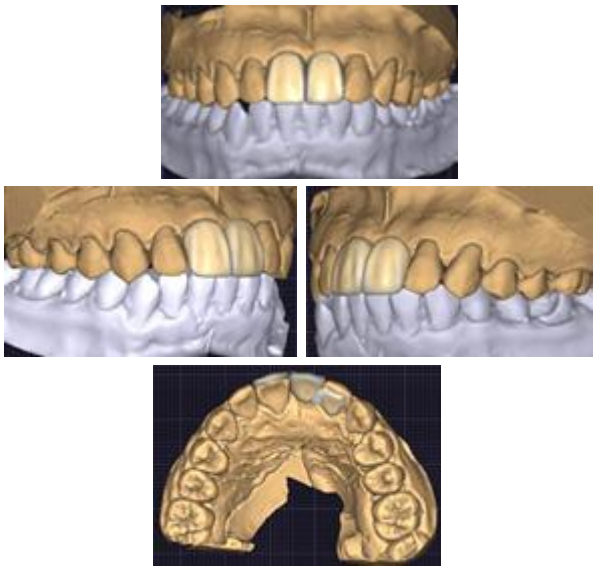

Figure 4. Digital mock-up, a modified design of an adhesive bridge with labial veneers and palatal wings made of lithium disilicate material

The lithium disilicate-based ceramic was used in this adhesive bridge case to achieve optimal aesthetic function. The adhesive bridge was fabricated using the IPS e-max press. The retainer section of the bridge was etched with 9% hydrofluoric acid and silane. The teeth were etched with phosphoric acid (37%), rinsed with sterile water, dried and cemented using light-cured resin cement with a translucent shade (Figure 5). At the end of the treatment, the patient was satisfied with both the aesthetic and functional outcomes. A follow-up visit with the patient two weeks later revealed no complaints and the patient expressed satisfaction with both the functional and aesthetic aspects of the treatment (Figure 6).

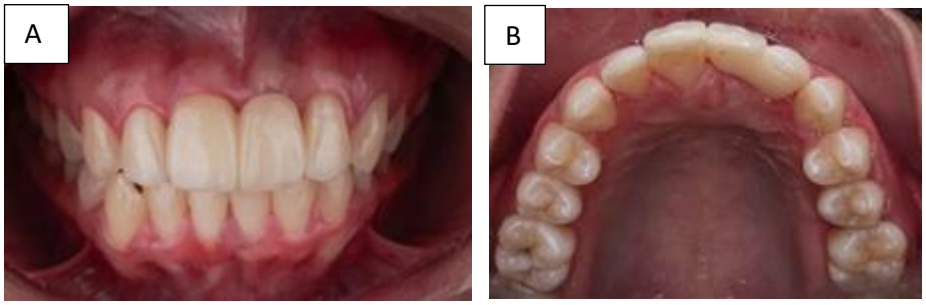

Figure 5. Post cementation A. Front view, B. Occlusal view

Figure 6. Extraoral photo before A and after cementation adhesive bridge B

DISCUSSION

The management of missing anterior teeth using an adhesive bridge has significantly advanced, emphasizing minimally invasive techniques that optimize function and aesthetics. In this case, the use of a modified design adhesive bridge with lithium disilicate material resulted in a durable and aesthetically pleasing outcome. Previous studies indicate that lithium disilicate provides superior mechanical properties, durability, and esthetics compared to traditional metal frameworks, making it a preferred choice for young patients seeking conservative restorations.[1,2]

There are several factors to consider when making a good fixed denture, one of which is a good arch or the absence of malocclusion. If the tooth that will be used as an abutment tooth is malpositioned, we need to consider a treatment plan: modify the design, fix it with an orthodontic appliance, remove it or do a PSA first. In this case, the tooth adjacent to the missing tooth has a malocclusion, specifically palatoversion, so the first step is to make a modified orthodontic appliance with an artificial tooth.[17]

Orthodontic appliances are devices that apply and/or transmit forces to individual teeth, groups of teeth, or the maxillofacial skeleton, thereby inducing bone modeling with or without tooth movement, ultimately helping to achieve treatment goals such as functional efficiency, structural balance, and aesthetics.[1,3] Removable orthodontic appliances can be taken out of the mouth and consist of acrylic and wire components. They are widely used in orthodontics, either to correct malocclusions or to maintain treatment results.[3] Removable orthodontic appliances are one of the treatment options for anterior crossbite cases and have three major advantages: (1) they reduce chair time, as they are fabricated in the laboratory rather than directly in the patient's mouth; (2) they are more cost-effective compared to fixed appliances; and (3) they are easy to clean, promoting better oral hygiene.[2]

In this case, the choice of a removable orthodontic appliance combined with a dental prosthesis served multiple purposes: it helped correct the anterior crossbite while also providing an aesthetic solution by replacing missing tooth with artificial one. The main reasons why removable orthodontic appliances are highly effective in correcting anterior crossbite in this case are the patient's young age (typically under 20 years of age), highly cooperative in using the appliance, and good oral hygiene maintenance.[1–3]

The decision to incorporate a removable orthodontic appliance before the definitive prosthetic restoration played a crucial role in improving the alignment of adjacent teeth. The use of a Z-spring and bite risers allowed for minor tooth

movement, creating an optimal occlusal relationship before the final restoration. The literature supports the effectiveness of removable orthodontic appliances in correcting minor anterior malocclusions, particularly in patients who prefer a non-invasive approach over fixed orthodontic treatment. This stepwise approach ensured that the final restoration was functionally stable and aesthetically harmonious.[3,4]

The utilization of both labial veneer wings and palatal wings in anterior adhesive bridges presents a strategic approach to restoring missing anterior teeth with minimal tooth preparation and enhanced esthetics. Traditionally, adhesive bridges, such as Maryland bridges, employ metal wings bonded to the palatal or lingual surfaces of abutment teeth. This design offers a conservative solution by preserving the labial enamel and maintaining the natural appearance of the teeth.[18]

The combination of labial veneer and palatal wings aims to distribute functional stresses more evenly across the abutment tooth, thereby reducing the likelihood of debonding. Moreover, this design allows for improved esthetic outcomes, as the labial veneer can be fabricated to match the hue and translucency of the natural teeth, resulting in a seamless integration with the patient's dentition.[18]

The survival rate of adhesive bridges remains lower than conventional fixed partial dentures. The main reason for failure is the possibility for debonding of the frame/retainer from the abutment teeth. In the study of Audenino et al., in which cementation was performed with or without the use of a rubber dam, the estimated survival rate probability of first debonding or failure, considering 100 cases, was 85% after 5 years. The use of rubber dam when cementing reduces the risk of debonding by a factor of ten.[7,8,19] In a study published in 2011, the success rate of an adhesive bridge with a single glass-infiltrated alumina ceramic retainer observed over 10 years was 94.4%.[19]

However, adhesive bridges are still more conservative compared to conventional bridge preparation, which typically requires the removal of approximately 70% of the abutment tooth structure during the preparation phase to receive a full coverage abutment.[9] Therefore, according to the patient's preference for a minimally invasive treatment, an adhesive bridge was the treatment of choice in this case. To achieve the golden proportion in the upper anterior teeth, we do a little modification in the adhesive bridge design, such as making two different wings on both sides, the first wing is palatal wing and the second one is labial veneer wing to correct tooth size and shape.

With the introduction of newer and stronger ceramic and non-ceramic materials, the use of adhesive bridges with non-metallic frameworks has increased significantly. Glass-ceramics, zirconia, lithium disilicate, and fiber-reinforced composites have been used by clinicians to replace traditional metal frameworks in resin-bonded fixed prostheses, commonly referred as Maryland bridges.[9,19] The use of lithium disilicate material in this case is based on the fact that the chewing load on anterior teeth is not as significant as on posterior teeth, and this material provides a more aesthetic appearance. Chen et al. found in their research that ceramic adhesive bridges had an estimated 5-year survival rate of 91.2%.[6] However, long-term data on non-metal adhesive bridges remain limited compared to metal adhesive bridges.

Resin cement possesses several clinically advantageous. Resin cements can exhibit high bond strength to tooth structures and porcelain, high tensile and compressive strength, and the lowest solubility of any available cement. Flexural properties, including modulus and strength, are critical in preventing bond failure during function, and resin cements have both high modulus and strength.[19,20] In this case, a single-cure cement resin with a translucent color was used to delay the initial setting and achieve a more natural and aesthetic color outcome. This is critical, as aesthetics is an important feature of all-ceramic restorations. As this

material relies on bonding, clinicians must be careful to follow all the steps in the correct order and within the recommended time for each step.[20]

Future research could explore the long-term performance of modified adhesive bridges compared to other restorative options, particularly in cases with minor malocclusion. The incorporation of digital workflows in adhesive bridge fabrication may further enhance accuracy and clinical predictability, reinforcing its role as a conservative and effective solution for anterior tooth replacement.[5,6]

There are potential limitations to this case report. The limitation in this case is a rubber dam is not used during cementation, although this may reduce the risk of debonding. Also, conventional bridges should be better because they can also correct the adjacent teeth and have better durability.

CONCLUSION

The combination of a removable orthodontic appliance with a modified design adhesive bridge using lithium disilicate material demonstrates an effective and minimally invasive approach for managing missing anterior teeth with malposition. This case underscores the importance of stepwise treatment planning, in which orthodontic correction enhances the success of prosthetic rehabilitation. The use of lithium disilicate provided an optimal balance between strength, durability, and aesthetics, ensuring a long-lasting and natural-looking restoration. The implication of this case report is that the combination of removable orthodontic treatment with the final restoration using a modified-design adhesive bridge using lithium disilicate material offers an effective solution for replacing missing maxillary anterior teeth. This approach enhances patient satisfaction by addressing aesthetic concerns while improving phonetic function and mastication. In addition, careful treatment planning is critical for the successful management of complex dental cases.

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