Modification of adhesive bridge design to improve retention and good cleansing effect on loss of mandibular molars Kennedy Class III

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ABSTRACT
Fixed partial denture is preferred because it provides better comfort than removable dentures. Conventional FPD requires a lot of abutment preparation, and not all patients can perform this procedure. Adhesive bridges allow minimal tooth preparation with design modifications to increase retention and a good cleansing effect to avoid secondary caries. The purpose of this article is to provide an overview of the modified adhesive bridge design on missing mandibular molars to enhance retention and good cleansing effect. A 29-year-old male came to the Dental and Oral Hospital Unpad with desire to have FD made. Patient lostfirst molar mandibular after tooth extraction about 10 months ago and doesn't desire excessive tooth reduction. The treatment was an adhesive bridge on tooth 46 with sanitary pontic design, metal mesh, metal wings on teeth 47 and 45, occlusal rest on mesial and distal 47 and distal 45. Retention obtained was in the form of mechanical, chemical, and combination retention. It is concluded that adhesive bridge with sanitary pontic is appropriate treatment option for loss of one mandibular molar. Minimal preparation of healthy teeth and better self-cleaning effect are the advantages of this treatment.
Keywords: adhesive bridge, minimum preparation, sanitary pontic

INTRODUCTION

Loss of one or more permanent teeth can affect a person's appearance and overall health which will have an impact on his quality of life. This condition greatly affects the oral tissues, especially the function of the masticatory and esthetic system. The impact of losing anterior teeth is more visible on aesthetic and phonetic functions, while loss of posterior teeth will affect masticatory function. Loss of these teeth if not replaced immediately will cause changes in the oral cavity such as alveolar bone resorption, migration and drifting of adjacent teeth, and extrusion of antagonist teeth.[1,2] The use of denture bridges is still the patient's choice to replace the loss of one or two teeth because of the convenience, aesthetics, and relatively cheaper cost compared to dental implants.[3] Missing teeth cause the structural integrity of the dental arch to be disturbed, so it is very important to replace missing teeth as early as possible to achieve dynamic balance of the arch. Restoration of this edentulous area can be achieved either with a denture bridge.[4]

Adhesive bridge is a type of partial prosthesis with pontic elements and a non-precious metal retainer that is permanently attached to the abutment teeth by means of an adhesive material and uses an acid-etching technique.[5,6] Adhesive bridge is known as a resin bonded prosthesis/resin retained prosthesis/resin retained fixed partial denture/acid-etched bridge/acid-etched fixed partial denture.[6] Tooth preparation in conventional bridge often causes a lot of loss of healthy tooth structure, as an alternative, a technique for making fixed partial dentures which is attached by chemical bonds involves little or without removal of the surface of the abutment tooth tissue called an adhesive bridge.[6]

An adhesive bridge consists of one or two pontics supported by thin metal retainer that are placed lingually and proximally to the abutment teeth. The adhesion of the bridge depends, among other things, on the adhesive attachments between the etched enamel and the retained intermediate metal.[7]

Indications for making an adhesive bridge are short bridges that replace one to two missing anterior and posterior teeth, abutments must be solid and not wobbly, light or open bites are ideal cases, there are no bad habits such as bruxism, abutments provide adequate tooth structure that are no defects in the enamel, the patient has good will and response, and good oral and dental health and hygiene. In addition, adhesive bridges can be made in young patients where conventional bridges are contraindicated.[6-8]

Some advantages of adhesive bridges are preparation of tooth structure which is minimally limited to the enamel so prevents trauma to the pulp, does not always require anesthesia, supragingival preparation so that it does not interfere with the periodontal tissue, easier impression technique, usually does not require temporary restoration, the number of visits is usually less, and If the adhesive bridge is removed in good condition, it can be reattached or rebonding.[6,7] Thus, it is no longer nece-

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ssary to prepare abutments to involve the dentin so that the preparation is relatively easy for the patient because it does not cause much trauma.[11]

Conventional adhesive bridge designs have minimal retention because they only have retention from the cement bond, so that if they are subjected to a large chewing pressure, it will accelerate the release of the restoration. In addition to the strength of cement retention, the release of the restoration can also be caused by the process of clinical work, namely when the application of cement in mouth is contaminated with saliva.[9] To obtain macroretention on metal wings, a treatment was performed using a mesh or woven according to research by Tjandiyanto.[10]

This case report will describe an adhesive bridge in mandibular molar loss that can be an alternative treatment to conventional denture bridges with minimum preparation.

CASE

A 29-year-old male patient came to the Dental and Oral Hospital of Padjadjaran University with a complaint of right lower molar loss due to extraction approximately 10 months ago. The patient had never used dentures before and wants fixed dentures for comfort and mastication. The patient does not desire excessive reduction of healthy teeth.

Figure 1 Initial clinical condition of the patient

Extra-oral clinical examination showed no abnormalities. Intra-oral examination showed missing 18, 28, 46, 48, impacted 38, mesioincisal enamel caries on 13, jaw relation malocclusion angle class II (left intermolar) with overjet: 6 mm and overbite: 4 mm (Fig.1). A saddle gap of 8.5 mm between teeth 45 and 47 was obtained by measuring the caliper on the study model (Fig.2). From the radiographic examination, missing 18, 28, 46, 48, chronic apical periodontitis on 24 teeth with crown, root, alveolar crest-furcation, periapical conditions within normal limits.

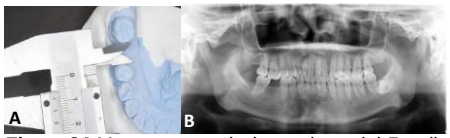

Figure 2A Measurements in the study model, **B** radiographic features

Based on the results of the history, clinical examination, and radiology, the treatment plan that will be carried out is the manufacture of an adhesive bridge denture on the tooth 46.

MANAGEMENT

In the first visit, taking photos of clinical dental conditions, making model studies with stock tray and alginate impression materials, taking panoramic x-rays, and examining the clinical condition vitality and mobility of the teeth. Next step is to select the design that will be used. Design principles taking into account several factors, including area of enamel coverage, interproximal cover, occlusal clearance and rest, contour height, proximal extension. Treatment in this case was with an adhesive bridge 46 with a sanitary pontic design for better self-cleaning, mesh on the surface of the wing facing the teeth, metal wings on teeth 47 and 45, and occlusal rests on the mesial and distal 47 and distal 45. Retention was obtained in the form of mechanical, chemical, and combination retention (Fig.3).

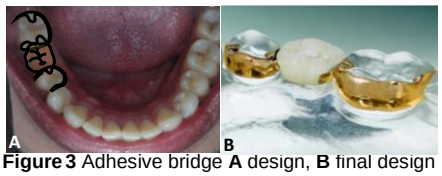

Figure 3 Adhesive bridge **A** design, **B** final design

In the second visit, it was conducted preparation stage which begins with creating a single tidal direction, namely the vertical direction. Using a tapered diamond bur, the preparation with a depth of 0.3-0.5 mm was started by modifying the proximal surface to be parallel or at an angle of 6°, proceeding to the lingual surface. The preparation is approximately 1 mm from the gingival margin.

Then, creating a form of resistance in the proximal. The preparation extends to the mesiobuccal and distobuccal abutment teeth to create a form of resistance. Proximal resistance can be made by forming a proximal groove or by making a box.

To form a proximal *wrap around*; the preparation is made extending to a shape of about 180^0 or more in order to allow the metal frame to mechanically bond the abutment teeth. Then forming an occlusal rest using a round diamond bur, the occlusal tooth was taken 1.5-2 mm in the buccolingual direction, 1.5-2 mm in the mesiodistal direction and with a depth of 1 mm. Shape of this occlusal rest follows the shape of the tooth structure that runs from the marginal ridge to the abutment dental fossa. Occlusal rest design mechani-

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cally secures the metal frame to the rest teeth during function. Forming the cervical edge is made into a chamfer on the abutment teeth and is located supra-gingival (Fig.4).

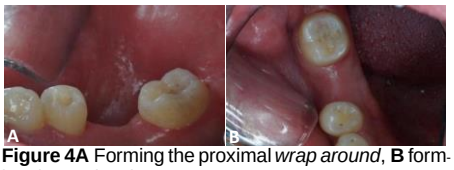

Figure 4A Forming the proximal *wrap around*, **B** forming the occlusal rest

After the preparation was completed, the impression was conducted using a double impression technique using polyvinyl siloxan impression material. After bite registration stage, the working model is sent to the laboratory for the manufacture of metal coping. On the inner surface of the retentive sleeve is meshed to increase cement retention.

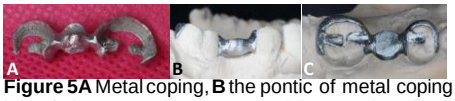

Figure 5A Metal coping, **B** the pontic of metal coping lateral view, **C** occlusal aspect of the metal coping

On the following visit, the trial of metal coping was conducted to determine the adaptation of coping with preparation and to ensure adequate space for porcelain. The metal used as the bridge coping is Ni-Cr alloy. The inner surface of the retentive arm was meshed to increase cement retention. A sanitary pontic was chosen for better self-cleaning, mesh on the surface of the flank facing the teeth, metal wings on teeth 47 and 45, and occlusal rests on the mesial and distal 47 and distal 45. The fit of metal coping, occlusion, pontic distance with the soft tissue underneath were examined.

Prior to the cementation stage, a metal porcelain bridge was tested in the mouth to see esthetics, adaptation of the retainer edge, occlusal rest to the preparation edge, adaptation of the pontic to the gingiva, point of contact with adjacent teeth and contact during occlusion and articulation.

Surface of the abutment teeth on the etched adhesive bridge was cleaned with pumice and prophylactic paste and then polished, then dried and isolated. The application of phosphoric acid on the enamel surface for 30 seconds, then the teeth are sprayed with water to clean the etching material for 10-30 seconds, and dry with air. The primary bonding agent was applied to the inner surface of the retainer flange and to abutment teeth, the bonding agent was applied and then irradiated. Then the adhesive was cemented, apply it to the inner surface of the retainer flange and the abutment tooth surface. After that, the adhesive bridge was attached to the abutment teeth in the direction of installation and fixed in place using fingers. Excess cement was removed, then irradiated from the edge of the restoration and on the abutment teeth, rechecking the occlusion and stabilization.

Figure 6A Adhesive bridge; **A** buccal view, **B** lingual view, **C** occlusal view

Control was carried out one week after the insertion. An examination of the condition of the tissues around the pontic and abutment teeth was carried out, as well as the occlusion. Subjective examination, there were no complaints and the patient was satisfied with the denture. Objective examination, there was no gingival inflammation, no food impaction, and good retention, stabilization, and occlusion. Patient was instructed to keep his oral cavity clean and perform periodic checkups (Fig.7).

Figure 7 Cleaning the pontic area with super floss

DISCUSSION

The main goal of prosthodontic treatment is to restore the patient to a normal state and function. In this case, patient wanted a fixed denture so that his masticatory function could return to normal. Patient does not want preparation of healthy tooth tissue, so an adhesive bridge was chosen.

Adhesive bridge became more popular because of the reliable resin-metal bond by electrolytic acid etching of the base alloy cast.[12] As Besimo et al.[13] concluded in their study, the adhesive bridge technique is currently considered a clinically reliable treatment if the design of the tooth preparation provides results that match mechanical retention, and if alloys and bonding agents are selected and used carefully. Proper mechanical retention of resin retainer bond with enamel micropreparation is essential; however, specific tooth preparation, better composite luting agents with better bond to metal and tooth allow a significant reduction in failure.

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To increase retention in this case, the abutment teeth were prepared. This is consistent with several authors recommending abutment preparation.[18-24] Most studies have suggested rest seats, parallel grooves and adjacent parallel teeth so that the adhesive bridge can be inserted in the unique and longitudinal axis of the abutment direction. Mechanical retention is critical to the success of restorative treatment because it holds the retention of adhesive bridges in line with the axis of the rest seat. Flexural/flexibility of the lingual metal of the proximal teeth causes cement fatigue and retention loss.[20,24-28]

Rammelsberg et al,[14] reported the success of adhesive bridge was not related to the anterior or posterior quadrant, maxillary or mandibular arch, but statistically related to the abutment preparation. Abutment preparation was carried out with 1.0 mm deep parallel grooves and seat rest. This study reported 4.0% of failures in adhesive bridge with retentive abutment preparation and 63% in adhesive bridge without tooth preparation.

Another corroborating study was conducted by Behr et al. reported a 95% long-life span rate for adhesive bridges after 10 years using a strict preparation protocol.[36] A 10-year long-life span rate of 83% was reported in the Samama study for adhesive bridges replacing 1 or 2 teeth.[37]

De Kanter et al focused on posterior adhesive bridges and reported that the long-life span rates were 65% for maxillary prostheses and 40% for mandibular prostheses. In this study, resin-bonded prostheses used in the posterior mandibular region suffer from a higher risk of failure due to the heavier posterior occlusal demands.[38]

To increase the retention strength of the adhesive bridges, modifications were made to the design, the area supporting the metal on the lingual surface was made as wide as possible, taking into account the tooth preparation with proper convergence.[15] The convergence in metal-ceramic crown should not be exceeded. This is in line with the study of Sarafianou and Kafandaris[16] who reported that when the convergence was 10-15°, the retention decreased 15.4-17.4%, which is very important because total contact area is very small. An adhesive bridge retainer with 10° of convergence has adequate clinical retention.[17]

Appropriate prosthesis design and tooth preparation may emerge as major contributors to clinical retention. Parallelism between the proximal surfaces of adjacent teeth and the edentulous space creates an optimal insertion path.[41-44] Grooves placed on the proximal and palatal surfaces of abutments serve two main functions to define the path of insertion and to provide retention and resistance to the retainer against dislodgement forces which acts on the pontic.[39] Supragingival preparation, 0.5 mm in enamel, should extend from the facial line of the lingual angle to near the interproximal contact area of each adjacent tooth. Occlusal rest and the base of the lingual groove provide support, preventing movement towards the gingival aspect, slots or preparation boxes that replace existing restorations can be used to support the framework. When designed with the mesial and distal occlusal self-supporting, the pontic can rotate along the axis formed by the two rest seats when occlusal forces act on the occlusal inclined plane of the pontic.[40] Creating a box with slight convergence towards the occlusal aspect to lock the resin cement can improve retention.[42]

Palatal plate of retainer is primarily responsible for the retention of the adhesive bridge. This design is advantageous in that it has a large area of enamel to bind the plate to the abutment teeth. Wrap around 180° prepared encirclement allows the restoration to withstand lateral loads by engaging the underlying tooth structure.[40]

Success or failure of the adhesive bridge depends entirely on the design of each component. Design of the pontic is determined by function, aesthetics, ease of cleaning, patient comfort and maintenance of healthy edentulous ridge.[34] Large number of studies have been published on the ideal pontic design. Designs range from conical pontics that are placed directly in the extraction socket, to pontics that require large or very small receptor areas, to hygienic or sanitary pontics, which do not come into contact with soft tissues at all.[35]

In this article, the type of pontic design used is the sanitary pontic. Some of the problems that often occur in abutments are the size and shape of the pontic which can hinder sanitation, either classical or special cleaning methods so that plaque accumulation can be trapped under the bridge around the abutment teeth.[29] The presence of an adhesive bridge makes oral hygiene efforts more difficult, especially for the posterior dental arch. If the pontic design is not accurate, it will interfere with proper oral hygiene due to the accumulation of plaque. A rough surface will facilitate the accumulation and retention of dental plaque so that it is directly related to gingival health.[30]

The majority of investigators studying pontic design assume that inflammation of the lingual mucosa beneath the pontic is caused by the accumulation of plaque on the underlying surface of the

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pontic. Ceramic glaze is believed to be the material of choice for pontics because of the low level of plaque accumulation. Podshadley and Stein, however, refuted this assumption in an independent study because they found no histologic differences in soft tissue reactions for pontics made of alloy, resin, ceramic with or without glaze.[35] Critical factors are the degree of polish and smoothness of the pontic surface is more important rather than the pontic material itself.[45] There are three concepts related to the design of the occlusal surface namely reduction of the occlusal dimension, another recommends a normal occlusal width and the third concludes that the occlusal dimension has minimal significance.[45]

Stein also points out that the shape of pontic and the patient's oral hygiene measures are the most important factors to consider in the prevention of inflammation. In maintaining soft tissue health, a number of authors have advocated the use of a pontic with a smooth, convex surface that makes pressure-free contact or minimizes contact with the ridge in small areas.[35]

For these restorations, the pontic must meet the structural requirements to ensure the mechanical stability of the restoration. Requirements of pontic design including aesthetics, biocompatibility, function, phonetics, patient comfort and maintenance of healthy tissue in the edentulous ridge must be met. Pontics can be made of cast metal or a combination of metal and porcelain.[4,33]

The shape of the pontic is chosen according to the position of the edentulous space, the amount of bone resorption and the choice of the operator. Inadequate communication between dentists and laboratory technicians often results in designs that do not match the edentulous area, which makes the pontic design requirements unfulfilled.[31,32] Location of edentulous, anterior and posterior, will determine the factors that have greater emphasis.[33]

In the case of mandibular first molar loss, the sanitary pontic was chosen because it offers the most appropriate method to avoid mucosal and gingival inflammation.[46] This pontic is made in a convex fasolingual and mesodistal configuration so as to create a rounded bottom surface of the pontic without an angle allowing flossing easier.[47]

This pontic is designed to provide adequate space between the pontic surface and the mucosal tissue, but on the other hand the space can be used as retention of food debris and plaque. Another disadvantage is that this design is not aesthetically pleasing.[48] Recommended designs for the mandibular posterior region are the sanitary pontic, modified ridge lap and conical. The mandibular posterior teeth have the least esthetic value and only the occlusal surface is visible when speaking and smiling. Therefore, pontics in this region should ideally be free of gingiva to provide good hygiene and ease of cleaning.[35, 49]

Sanitary pontic design used is the conventional sanitary pontic or fishbelly, which is a convex surface design, both bucolingual and mesiodistal. This design allows for gingival cleaning and an aesthetic that is more acceptable than the sanitary bar pontic or modified sanitary pontic.

It is concluded that the success of the adhesive bridge is highly dependent on the clinician and technician in the laboratory, aesthetic, biological and mechanical considerations are very important in designing the pontic design. Suggestions for further research is the use of zirconia material as a coping adhesive bridge to get more aesthetic results.

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