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Esthetic improvement using maxillary immediate denture and mandibular overdenture

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ABSTRACT
Loss of teeth in adult needs to be replaced with dentures to restore masticatory and esthetic functions. Dentures are made immediately before extraction and used immediately after extraction, so that they do not change in appearance or function. If patient has restorable teeth, the teeth can be used as denture support. Overdentures supported by one or more restored teeth or implants as periodontal and mucosal support to improve durability of the denture. This article discusss maxillary immediate denture and mandibular overdenture on a woman who felt uncomfortable with the denture that has been used for 4 years. Patient wants a new denture without changing appearance. Intraoral examination found tooth 17, 16, 26 GIC fillings, 13 dowel crown, 31, 32 PFM crowns, 42 composite filling with mobility grade I, and 44 caries. This case was managed with extraction teeth 16, RCT 26, and extraction 13 before insertion the maxillary immediate denture with cusil #17 and overdenture 26, and also RCT was performed on 44, 42, 32, 31 followed by insertion the magnetic overdenture 44, 42 and metal coping overdenture 31, 32. It is concluded that immediate denture and overdenture provide optimal results for esthetic improvement and patient satisfaction.
Keyword: immediate denture, overdenture, magnetic overdenture, metal coping overdenture

INTRODUCTION

Tooth loss in adulthood needs to be replaced by dentures to restore esthetics, masticatory, and phonetics function. Immediate dentures are made before tooth extraction which are used immediately after tooth extraction so that the patient does not experience changes in appearance and function. Advantages of immediate denture, that is maintain the appearance, minimize changes in speech and mastication function, facilitate adaptation of prostheses, reduce alveolar bone resorption, protect post-surgical area, and facilitate transfer of patient's natural jaw relationship, shape, and arrangement of teeth to be reproduced. The disadvantages are cannot replace natural tooth and require longer treatment after iextraction (i.e relining, occlusal adjustments, and addition of labial flange).[1,2]

If a patient has teeth that have been endodontically treated with good supporting tissue, these teeth can be used as denture supports. Tooth extraction may cause loss of periodontal tissue as part of the sensory mechanism, which alter the acceptance of strain and pressure loads on alveolar bone becomes greater. This condition leads alveolar bone resorption process, which will affect the area of the denture support. Preventive prosthodontic treatment emphasizes the importance of delaying or eliminating problems that may interfere prosthodontic treatment. Overdenture treatment is a preventive prosthodontics which preserves one or more natural teeth to prevent resorption of the alveolar ridge. An overdenture is a removable denture that covers and rests on one or more natural teeth, natutural tooth roots, or implants. The advantage of overdenture treatment is to maintain the condition of the alveolar ridge, both in height and volume. Presence of natural teeth affect a significant difference between overdenture and conventional dentures, sensory function of periodontal ligament provides psychological benefits. Proprioceptive sensors provide information about direction and magnitude of the loads/forces. This improves patient's coordination and ability when using denture.[3,4] This case report discussed treatment of maxillary immediate denture and mandibular overdenture complete denture.[3,4]

CASE

A 64-year-old female came to the Dental Hospital of Universitas Padjadjaran to get a new denture because the patient felt uncomfortable with the denture that had been worn for 4 years and some teeth were extracted due to fractures. Patient has been using valplast dentures on maxilla and mandible. The last history of tooth extraction was in January 2020 on right mandible tooth due to fract-

Figure 1 Intial extraoral condition

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Figure 2 Initial intraoral condition

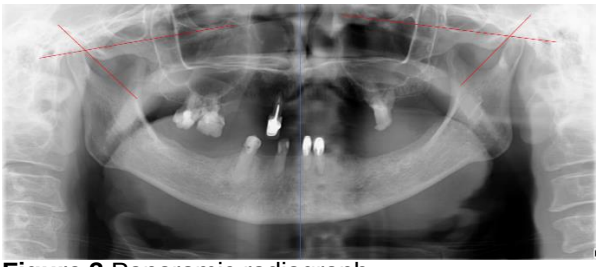

Figure 3 Panoramic radiograph

ure. Intraoral examination, teeth 17, 16, 26 were filled with GIC, 13 post crown, 31 and 32 PFM crown, 42 composite filling with mobility grade I, and 44 secondary caries (Fig.1,2,3).

MANAGEMENT

The patient was managed with maxillary immediate complete denture with cusil 17 and attachment supported overdenture teeth 26 and mandibular complete denture with attachment supported overdenture on teeth 44, 42 and tooth supported overdenture on teeth 31, 32.

At the first meeting, make impression of maxilla and mandibula to fabricate bite rims and measure vertical dimensions (occlusion was 57 mm and rest position was 59 mm), and determine centric relations. Bite rim was transferred to adjustable articulator to make a mock up (Fig.4).

Mock-up was made and tried in on the patient by

Figure 4 Measurement of vertical dimensions and centric relations.

Figure 5 Mock up try In

changing class III relation to class I relation (Fig.5). Patient agreed with this new condition. Next step was mouth preparation started from the maxilla, tooth 17 was repaired with composite fillings, tooth 16 was extracted, tooth 13 was also extracted because the crown and post could not be removed and there were complaints of pain, tooth 26 was treated endodontically (Fig.6) and restored with magnetic posts. In the mandible, teeth 32 and 42 treated endodontically and restored with metal coping posts, tooth 31 treated endodontically and restored with magnetic posts (Magfit 400) and also tooth 44 restored with magnetic posts (Magfit 800) (Fig.7).

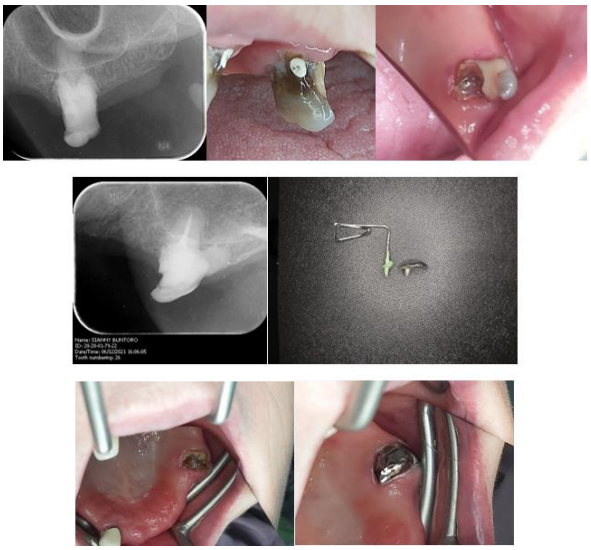

Figure 6 Treatment of tooth 26

Figure 7A Treatment of teeth 32, 31, 42, 44, **B** teeth 31, 32; **C** teeth 42, 44

After mouth preparation was done, muscle trimming and physiological impressions were performed. Furthermore, re-checking the vertical dimensions and centric relations using previous bite rim. After that, facebow transfer was done, right horizontal condylar angle (H) was 54˚ and left was 55º, and the bennet angle (L) was calculated by Hanau formula resulting in a right angle of 18.75˚ and left

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Figure 8 Try in denture

Figure 9 Insertion

Figure 10 Final result of maxilla and mandibula denture

18.87°. After that, trial of dentures until patient comfortable. Denture wax pattern was packaged using acrylic. Prior to insertion, tooth 13 was extracted (Fig.8,9,10,11)).

DISCUSSION

Procedure of making dentures is generally carried out within 8-12 weeks after tooth extraction, because alveolar bone resorption generally occurs. Therefore, periodic control is needed on the installation of immediate dentures, considering changes in alveolar bone which may cause the denture unstable. Relining procedure is generally performed 3-6 months after placement of immediate denture to fill the gap formed by alveolar bone resorption.[5,6]

Figure 11 Final extraoral condition

The success of immediate dentures supported by several factors, such as case selection, diagnosis, planning, careful surgical protocol, modification of impression, manufacture of dentures, and patient expectations. Selection of the right case plays an important role in success because not all cases can be made an immediate denture.[7]

Retention and stabilization problems often occur in mandibular dentures due to smaller supporting tissue area than maxilla. Making overdenture in mandible will reduce this problem by maintaining height and shape of alveolar bone. Conventional overdenture has advantages over implant support due to the presence of tooth roots and periodontal tissue that produce proprioceptive sensors that provide sense of comfort, mastication, and better psychological function.[8]

It is concluded that treatment of immediate dentures and overdenture can be combined to produce esthetic improvements in edentulous patients.

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The influence of salt solution as curing media towards curing time and compressive strength of heat cured acrylic resin

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ABSTRACT
Heat-cured acrylic resin is commonly used as denture base materials. The time needed for its polymerization makes the process less efficient. The salt solution has a higher boiling point and more stable molecular bonding, which is expected to shorten the curing time of HCAR. This article determines the influence of salt solution as curing media on curing time and compressive strength of HCAR. This experimental laboratory study used 25 samples of HCAR with 25.4x12.7x12.7 mm by dimension. Samples were boiled in water at 74ºC for 120 minutes as a control, in 35% salt solution at 74ºC for 30, 60, 90, and 120 minutes as treatment groups, and then all groups were boiled at 100ºC for 60 minutes. The compressive strength of each sample was tested using an *Autograph AG-10TE*. The highest compressive strength and fastest setting time were shown in samples boiled in a salt solution for 60 minutes. One-way Anova followed by a post hoc Tukey-HSD test showed no significant compressive strength differences in each group ($p>0.05$). It is concluded that salt solution usage as curing media fastens the curing time and results in the same compressive strength within all groups.
Keywords*:* heat-cured acrylic resin, salt solution, curing time, compressive strength

INTRODUCTION

Losing teeth can cause loss of mastication, speech and aesthetic function and cause many psychological problems. According to *Riset Kesehatan Dasar* (Riskesdas) data Ministry of Health Indonesian Republic, in 2013, it was reported that tooth loss was found at 5.65% in the group of age 45-54, 10.13% in age 55-64 and 17.05% for group age above 65 years old. The denture was made to rehabilitate intraoral function.[1]

The denture has two essential parts; the base and the artificial teeth. The denture base gains support through direct contact with the underlying intraoral tissue. A denture base can be made from acrylic resin or metal. One of the most popular materials for denture base is heat-cured acrylic resin. The most widely used material for denture base is polymethyl methacrylate HCAR because it has several advantages such as easy to get, cheap, non-toxic, not irritating, not soluble in oral fluids, easily manipulated, significant aesthetical aspect, biocompatible, easily repaired and slightly changed in its dimensional aspect.[2]

The HCAR needs to be heated at a specific temperature to help the polymerization process. The widely used method for curing is by boiling the resin in 74ºC water for about 120 minutes, and then the temperature is raised to the boiling point of water 100°C for 60 minutes. This traditionally curing cycle needs a long time to reach the perfect setting phase of the acrylic resin. This condition should be reached so that there will be no dimensional change and mechanical strength decrease in the acrylic resin. The dimensional change in acrylic resin will disrupt the denture base making and the free monomer formed due to not achieving the setting phase of acrylic resin can irritate the oral mucosa.[3,4]

The problem over the curing cycle of the HCAR is the long time needed for the polymerization process that makes curing cycle and production cost of the HCAR being less efficient.[5] Salt solution has a higher boiling point than water because of its colligative properties.[6] Solutions' colligative properties depend on the concentration of molecules or ions of the solute but not on the identity of the solute. Besides boiling point elevation, colligative properties include lowering vapor pressure, depression of the freezing point, and osmotic pressure.[7] Salt solution has a stabler molecular bond, so it is assumed that salt solution can shorten curing time of the HCAR.

This article determines the influence of salt solution as curing media on curing time and compressive strength of HCAR.

METHOD

This is a post-control group design and experimental laboratory design. The HCAR used was 25 specimens with the size of 25.4x12.7x12.7 mm.[8] The specimens met criteria such as flat surface, not pored, and smooth.

This research was conducted at the Skill Laboratory Faculty of Dentistry Brawijaya University to produce the HCAR sample and *Laboratorium Dasar Bersama* (LDB) Airlangga University Surabaya

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for the compressive strength testing of the samples. The procedures were began with acrylic resin sample making. The molds were made by flasking the wax master model by the sample size in the cuvette filled with dental stone. After the mold was ready, the mix of PMMA and mono methyl methacrylate (ADM) was taken in a closed porcelain mixing jar for polymerization according to the manufacturer's instruction (polymer 4 grams : monomer 2 mL) at room temperature ±20-25°C. Mold was coated with a thin layer of petroleum jelly to remove the samples quickly. After reaching the dough stage phase at room temperature, the mold was filled with acrylic resin dough. The top and bottom part of the cuvette was put together, and was pressed with a pressure of 900 psi with hydraulic bench press. The cuvette was opened, and the excess material was removed during the closure trial that was done several times until there was no excess material and formed a metal-to-metal contact of the cuvette. Then, the cuvette was pressed by the manual hand press and ready to be cured.[9]

The 35% salt solution as curing media was done by dissolving kitchen salt (*Kapal Api, Indonesia*) in water with a mass ratio of 7:20 or calculating 350 g of salt in every 1 L of water. The salt solution used has a concentration of 35% because the maximum solubility of salt in water at room temperature is 357 mg/mL.[10]

The curing of the acrylic resin samples was carried out according to the treatment group. There are 5 groups of samples; they are the control group, the samples were cured 120 minutes in 2 L of water at 74ºC and continued for 60 minutes at a boiling water temperature. The treatment groups A, B, C, and D were cured for 30, 60, 90, and 120 minutes in 2 L of 35% salt solution and followed by 60 minutes at 100ºC for each group. The cuvette was immersed in curing media where a thermometer was set to measure the temperature of the water; then, the time was recorded accordingly with the help of the stopwatch. After the curing cycle, the cuvette was allowed to bench-cool before deflasking. Following the bench cooling procedure, the flask was opened, and acrylic resin samples were carefully retrieved. A laboratory micromotor trimmed the excess of the sample with fraser burs and polished stone burs.

The evaluation of compressive strength of all the specimens in this study was tested using Autograph AG-10TE. The load was applied to the center of the standing samples until they broke. The value listed on the tool was then recorded, then calculates the compressive strength by using the following formula:[11]

$$C = \frac{P}{A}$$

C = *compressive strength* (kg/mm^2)
P = *force shown on the tool* (kg)
A = *surface area* (mm^2)

The compressive strength data obtained are tabulated in tabular form. The normality of data was tested using the *Kolmogorov-Smirnov* test, while the homogeneity of the data was carried out using *Levene statistic* test. The study results were then analyzed using the *one-way* Anova statistical test to determine the difference in compressive strength values between the treatment groups. Then, a further difference test (*post hoc test*), namely Tukey HSD, was carried out to find further the value difference of compressive strength between each treatment group.

RESULTS

The compressive strength was obtained in units of kg/mm^2 using the Autograph (*Shimadzu, Japan*). The data is obtained from the magnitude of the load that presses the test sample until just before the sample breaks. After the data is obtained, the data is entered in the formula for compressive strength.

The results of the compressive strength test listed in table 1 show that there are differences in compressive strength between the treatment groups. The lowest average compressive strength is in group D of 6.982 kg/mm^2, while the highest average compressive strength is in group B of 7.896 kg/mm^2. The results also show an effect between curing time and compressive strength of HCAR. To clarify the effect of curing time on the compressive strength of HCAR (Fig.1).

The results of the study were then analyzed using several statistical tests. Based on the normality test of the data using the Kolmogorov-Smirnov test in this study, a significance value of p=0.2

Table 1 Mean of compressive strength value of HCAR with variation of curing time with water and 35% salt solution

Group	Curing cycle	Curing time	Average compressive strength ($^{kg}/_{mm^2}$)
Control	74ºC + 60 minutes at 100ºC in water	120 minutes	7.866
A	74ºC + 60 minutes at 100ºC in 35% salt solution	30 minutes	7.24
B	74ºC + 60 minutes at 100ºC in 35% salt solution	60 minutes	7.896
C	74ºC + 60 minutes at 100ºC in 35% salt solution	90 minutes	7.274
D	74ºC + 60 minutes at 100ºC in 35% salt solution	120 minutes	6.982

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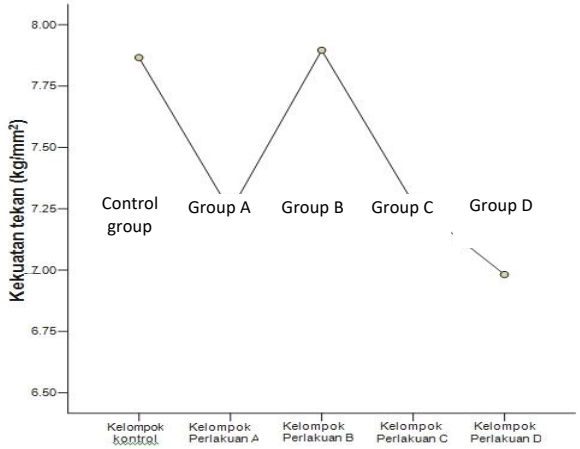

Figure 1 Line diagram of the effect of curing time on the compressive strength of HCAR

0.2 (greater than 0.05) in all groups was obtained. While testing the homogenity of variance with the Levene Statistic test, the significance value of p = 0.486 (greater than 0.05). Thus, it can be concluded that the data has a normal distribution and homogenous, so the data can be tested using one-way Anova.

The one-way Anova method was analyzed to determine the difference in compressive strength values between treatment groups. Based on the one-way Anova test in this study, the significance value of p = 0.118 (greater than 0.05), so it can be concluded that there is no significant difference in the value of compressive strength between the treatment groups.

The results of further analysis using the Tukey-HSD Post Hoc Test serve as a further difference test to determine the difference in the compressive strength value between each treatment group. From the results of statistical tests obtained p-value > 0.05, it can be concluded that there is no difference in the value of significant strength between each treatment group.

DISCUSSION

Based on the measurement results shown in the table and graph above, there are differences in compressive strength value between each treatment group. The slightest difference in compressive strength values was found in the control group and treatment group B, and the treatment group was cured for 60 minutes at a temperature of 74ºC and 60 minutes at 100ºC in a salt solution. This indicates that using the salt solution can accelerate the curing time of HCAR with the same compressive strength in all groups.

Several things can also affect the setting level of HCAR, including polymerization temperature and molecular weight of HCAR.[12] Polymerization of HCAR can occur when heated above 60ºC. At this temperature, the molecules of benzoyl peroxide contained in the acrylic resin polymer/powder, which function as initiators, will be separated to produce molecules with a neutral electrical charge and containing unpairs electrons called free radicals. These free radicals rapidly react with the monomer molecule to stimulate polymerization.

In addition, at this study, the terminal temperature of the control group could not reach 100ºC. The water terminal temperature only reaches 94.5 ˚C. Meanwhile, the terminal temperature of treatment group B, which was heated using 35% salt solution, could reach 100ºC. This is due to the difference in air pressure at the water surface, which can be influenced by the altitude of an area above sea level.[11] This research was conducted in Malang City, which has an altitude of about 400-667 meters above sea level with an air pressure of 1015 hPa or equivalent to 0.01 atm. The higher a plateau, the lower the air pressure and the lower the boiling point of water in that area.[13] The boiling point is also affected by the type of substance dissolved in the water. The addition of salt, in this case, can increase the boiling point so that the terminal temperature of the treatment groups A, B, C, and D can reach 100˚C. The optimal temperature can produce a perfect HCAR dress polymerization reaction.

As the curing time of the HCAR was increased using a salt solution, the compressive strength of acrylic plate decreased. This shows that the addition of curing time of HCAR plate does not have a linear relation to its compressive strength. When the HCAR plate was heated for more than 60 minutes with a salt solution at a temperature of 74˚C, there was a decrease in the compressive strength of the HCAR due to the nature of the salt that can absorb the water content in a material, resulting in a decrease in the density value of the material.[14]

The salt content in water, both seawater, and rainwater can cause erosion of various materials in the wild. Erosion is the erasure of solids (sediment, soil, rock, and other particles) due to the transport of wind, water, or ice and the characteristics of rain.[15] In this study, the sample group of the HCAR cured in 35% salt solution for 120 minutes at 74˚C and added 60 minutes at 100˚C had the lowest average compressive strength compared to the other four treatments, which was 6.98 kg/mm2. This is because if a material is exposed to salt at high temperatures and for a certain period, salt can cause erosion of the material to become more brittle. [14]

It is concluded that curing time using salt solu-

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tion media affects the compressive strength of HCAR, which can accelerate curing time with the same strength in all groups. The most effective curing time for the HCAR is 60 minutes at 74°C plus 60 minutes at terminal temperature (100°C) in 35% salt solution.

For further research, it is suggested 1) preparation of HCAR samples should use molds from metal plates so that the sample size is more uniform; 2) before the compressive strength test, the HCAR sample should be weighed first to ensure that the mass of the entire sample is the same; 3) it is necessary using a curing time interval of 30-60 minutes in a salt solution at a temperature of 74°C plus 60 minutes at a temperature of 100°C to see the relationship between the increase in curing time with the set level and the compressive strength of HCAR; 4) to examine the effect of using a salt solution as a curing medium on the transverse strength, impact strength, and discoloration of HCAR; 5) to examine the effect of different concentrations of salt solution as a curing medium on the curing time of the HCAR.

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Modified sculpted composite resin iris pattern for customized ocular prosthesis

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ABSTRACT
Patient with loss of eye demands natural ocular prosthesis for self-esteem and social intercourse. Iris texture and coloring technique are crucial procedure to recreate natural iris like the remaining eye. The purpose of this paper is to explain sculpting method using composite-resin to achieve natural iris pattern. A 29-year-old male came to Dental Hospital Universitas Sumatera Utara with chief complaint of demanding new ocular prosthesis because old ocular prosthesis had been used for 12 years, iris position was not good and not aesthetically pleasing. The modification is the use of a 12 mm diameter iris base made from light-cured composite resin then a thin layer of composite resin is placed evenly and texture of iris is sculpted directly on composite resin according to the designed pattern and then being light-cured again. Then coloring with acrylic paint according to the color of patient's left iris. The technique for duplicating iris is highly dependent on the operator's ability, both in color selection and iris patterning. The use of composite resin make it easier to get a good texture of iris pattern so as to facilitate coloring process with the ultimate goal of achieving an aesthetically pleasing ocular prosthesis. Patient was satisfied with his new ocular prosthesis.
Keywords: ocular prosthesis, iris pattern, sculpting, composite resin
This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

The loss of an eyeball is a particularly distressing event in a person's life since the eye is such a vital organ for vision and facial emotion.[1] Socket anophthalmia is characterized by the absence of the eyeball in the orbital cavity, as well as the lack of ectodermal and mesodermal tissue.[2] The prevalence of anophthalmia is 0.3 per 100,000 births.[2]

A congenital flaw, severe trauma, tumor, sympapathetic ophthalmia, or the requirement for histological analysis to establish a specific diagnosis can all result in the loss or disappearance of an eye.[3] Evisceration, enucleation and exenteration are the 3 main surgical treatment options.[3,4] Evisceration is the removal of the contents of the eyeball while leaving the sclera and extraocular muscles. It can be caused by a congenital abnormality. Exenteration is the removal of the complete eyeball, including the orbital soft tissues, whereas enucleation is the removal of the entire eyeball while keeping other orbital structures (connective tissue, fat and muscles).[4] Enucleation is frequently recommended for patients with intraocular malignancies because it enables for histological investigation and the determination of whether the cancer has spread intraneural or extrascleral.[3] Only in situation of orbital malignant tumors that have spread to the eyelids is exenteration performed.[3]

Because eye loss has a psychological impact on the patient and his family, replacing an ocular prosthesis as soon as feasible is critical to aid the physical and psychological healing process, as well as increasing social acceptability.[5] An ocular prosthesis is an artificial substance that simulates the anatomy of the eye.[6] The major goal of this prosthesis thesis is to keep the eye socket's volume and generate a duplicate of the *normal healthy eye*.[6] The patient's morale will improve as a result of this prosthesis, as well as his or her psychological well-being. After the eye socket has healed, the ocular prosthesis can be made as soon as feasible.[3,6]

Many writers have recommended using watercolor, gouache, oil, automotive, or acrylic paint over card paper discs, and/or pure pigments in a monomer and polymer media over acetate discs or prefabricated ocular buttons for the artificial iris.[7] The iris' size ranges 11-13 mm, and the form of the visible iris is governed by the cornea's clarity. The iris seems somewhat oval in shape, which is covered by the limbus at the top and lower limits, despite its artificial anatomical structure.[8] The iris' surface is uneven, and when examined under a microscope, it seems to be a 3-D cloud.[8] Because of a variety of factors, such as a lack of technical expertise, characteristic and color of the ocular prosthesis are sometimes not perfectly matched with the remaining eye.[9] In the fabrication of ocular prosthesis, iris pattern and coloring is critical. This paper discusses about the modification of the iris button by sculpting the iris design before painting it with acrylic paint.

CASE

The major complaint of a 29-year-old male patient who came to the Department of Prosthodon-

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tics, Faculty Dental and Oral Hospital, North Sumatra University, was that the old ocular prosthesis did not fit in its place. According to the patient's anamnesis, he was shot in the right eye by an airgun 12 years ago, requiring an enucleation procedure and the placement of a stock eyes orbital prosthetic two weeks later. The orbital cavity looks to be in a deep distal defect, although the muscular mobility is still good, according to the examination.

In this case, a new ocular prosthetic with a favorable iris position is designed. Anatomical impression was done during the first meeting using a custom impression tray and hydrocolloid irreversible impression material (Fig.1). The anatomical sclera was waxed up after the impression was filled with type III dental stone.

Figure 1A Socket impression with hydrocolloid irreversible impression material, **B** the impression.

Figure 2A Final anatomical sclera wax up, **B** final impression with light body PVS material, **C** final impression result

Both convex and well-folded eyelids were visible after the anatomical sclera wax up was adjusted to the patient and slight adjustments were made until an acceptable shape was established. Following the final convexity established, a final impression tray was produced based on the findings of the final wax up. To get good detail, final impression was done with a light-body polyvinylsiloxane impression material (Fig.2). And then, type III dental stone is used to produce a mould.

The final scleral wax up was then matched again to the patient, and the IPD ruler was used to measure the midpoint of the patient's focus. Making the 12 mm diameter iris with 1 mm thickness from a composite resin (3 m, z350XT) material, light cure then a thin layer of composite resin is placed again and the pattern is created by sculpting the iris texture step by step directly on the composite resin material using LM-Arte Fissura. After the final pattern is sculpted, the composite is light cure again. And then coloring it with acrylic paint to match the color of the patient's iris in the left eye are the modifications done in this case (Fig.3).

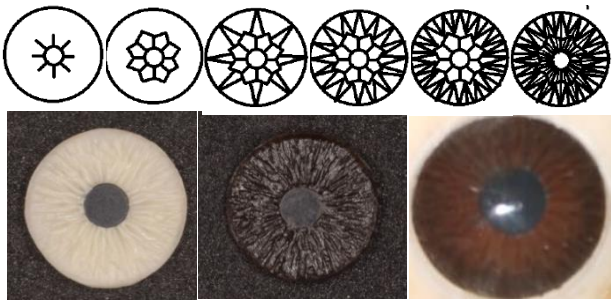

Figure 3A Step by step iris pattern sculpted with composite resin, **B** result of iris pattern, **C** coloring with acrylic paint, **D** iris button with sculpted composite resin

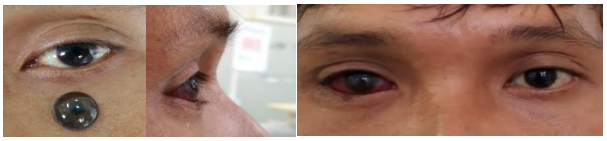

Figure 4A Iris button color matching the patient eye, **B** view from beside, **C** final check of sclera with iris button

Figure 5A Placement in cuvette, **B** dewaxing, **C** final ocular prosthesis after polishing

Figure 6 Comparison between **A** old ocular prosthesis, **B** before placement ocular prosthesis, and **C** final new ocular prosthesis

The iris button is compared to the left eye to determine the color. The color match the left eye. To confirm the position of the iris button and its convexity, the iris button was moved into the waxed final sclera with determined midline and transferred back into the eye socket. Then the waxed up final sclera with iris button is being evaluated as final check before packing procedure (Fig.4).

The waxed up sclera with iris button is then placed in a flask, and an acrylic rod is added above the iris button to keep it in place when compressed. After the dental stone is set, the dewaxing procedure is done to remove the wax and the cuvet was opened again and hot water was being poured to the mold to make sure no remaining wax is inside (Fig. 5). The first packing procedure was done with heat polymerized acrylic resin. After the packing, the 1.5

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mm thickness was removed from both clear acrylic on iris button site and acrylic from sclera site, then small red nerves were created on the acrylic sclera with red thread to mimic the blood vessels. Then, using the same flask, packing procedure was done once again with clear acrylic.

The finishing and polishing were done until the clear acrylic smooth and shine. During the insertion day, patient is subsequently instructed on how to correctly insert, remove, and clean his ocular prosthesis. To check adaptation, a recall was done one week, and a month later. The new ocular prosthesis had better aesthetic, good iris adaptation and position (Fig.6). Patient was satisfied with the final result.

DISCUSSION

The patient's psychological and physical issues would develop after the enucleation surgery. Enucleation should accomplish the following objectives: a comfortable socket can be placed on an ocular prosthesis that looks and moves like natural eye, a symmetrical appearance without superior palpebral sulcus deformity, no superior or inferior lid malposition; normal lid closure over the prosthesis.[10]

Both before and after surgery, making post-enucleation ocular prosthesis necessitates consideration. Conformer should be inserted as soon as possible following enucleation. The objective is to preserve the suture line, keep the fornix in place, avoid contractures, and make the patient as comfortable as possible.[10]

An ocular prosthesis is created after recovery, which normally takes 6-8 weeks following enucleation. The average duration of an ocular prosthesis is 5-7 years. The quality of the fitting will deteriorate as the prosthesis' lifespan increases, as will the soft tissue changes in the socket. When delamination, persistent inflammation, and significant mucus discharge develop, prosthesis should be replaced.[10]

Custom ocular prosthetic fabrication provides several advantages, better fit, retention, and the ability to match the color of the iris and sclera to other natural eye colors.[5] The color of the eye is usually not perfectly matched for a variety of reasons, including the variability of natural color and the ocularist's competence. As a result, the color of the eye must generally be colored in great detail, followed by the application of a clear acrylic coating.[9]

The iris coloring phase is a critical step in the creation of customized ocular prosthesis. The iris pattern, according to Prajwala, is extremely complex and one-of-a-kind.[11] The iris' surface is uneven, and when examined under a microscope, it seems to be a 3-D cloud.[8] The texture of the iris was achieved in this case by modifying the iris pattern with composite resin. The authors then adjusted the pattern based on these sources to make the texturing and coloring process easier. Composite resin used in this case is 3M, z350xt because composite resin was easy to be sculpted to precision detail before being light cure. The ocular prosthesis's ultimate result is good and aesthetic, and the work technique is simple to follow.

It is concluded that the goal of creating ocular prosthesis is to restore the patient's confidence, simplify things for them to socialize again, and maintain the socket health and from shrinking. To accomplish it, the ocular prosthesis must be same or similar to the other natural eye. The aesthetics of ocular prosthesis depend greatly on iris coloring. The fabrication of a thin, layered iris texture is one of the things that must be considered while coloring. As a result, changes were made to the iris pattern, which was sculpted using composite resin to create the iris texture and colored with acrylic paint in the color of the patient's iris. It is expected that this modification of the technique would make the texture and coloring of the iris easier to achieve.

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Temporomandibular disorder therapy with splint stabilization

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ABSTRACT
A 14-years-old female patient came to a hospital with a complaint of feeling swelling on the left cheek, the right jaw joint often made noises since 6 months ago. The patient had a motorcycle accident 2 years ago and hit his left cheek at the time of the accident. the patient is dizzy, nauseous, does not vomit. The patient was referred to the prosthodontics department. Bad habits in elementary school often biting a pencil, bruxism and quitting in 6th grade. Intraoral examination showed dental caries 46, with missing teeth 33 and 28, good oral hygiene, anterior deep bite, normal occlusion. A composite filling restoration of tooth 46, tooth scaling and making stabilization splints were performed to help reduce pain, to eliminate occlusal disharmony, prevent toothwear and tear, reduce bruxism and parafunction, treat masticatory muscle dysfunction and change the TMJ structural relationship. Joint disorders are symptoms of pain in the joints or muscles of mastication, with or without jaw movement. An occlusal splint is a removable appliance made of acrylic, made according to the occlusal and incisal surfaces. Occlusal splints have been used to treat symptoms of bruxism and disorders of TMJ.
Keywords: temporomandibular joint, temporomandibular disorder, splint stabilization

INTRODUCTION

Temporomandibular joint disorders (TMDs) are symptoms of pain in the joints or muscles of mastication (with or without jaw movement). The signs and symptoms of TMDs commonly include pain, joint sounds, and limited or asymmetrical jaw movement that may have an effect on the quality of life. Possible joint pain due to acute injury, chronic irritation, joint diseases (arthropathies).[1,2]

The TMDs is a group of conditions musculoskeletal pain-producing or dysfunction in the masticatory system.[3] Several methods can treat TMDs by home therapy, physical therapy, behavioral therapy, pharmacological therapy, surgical therapy, as well as the use of occlusal devices (occlusal splint, night guard, biteguard). Therapies can be used to treat symptoms, both reversible or irreversible, surgical or non-surgical.[1]

Splinting is the treatment of choice, because it is reversible, non-invasive, and less expensive than other treatments. The effectiveness of splints is very prominent compared to other therapies.[2]

According to Hart Long, splints of any design often result in a reduction in the sensitivity of the muscles of mastication in a short time. According to Pertes, occlusal splints are generally believed to reduce the load on the joint structure, thereby reducing its severity. Reducing the load on the joints can reduce muscle hyperactivity. Therefore, the occlusal splint is very helpful in reducing the symptoms of TMJ pain.[3]

Splints are often used to treat disorders of the TMJ and the masticatory system. The purpose of using a splint is to eliminate occlusal disharmony, prevent tooth wear and tear, reduce bruxism and parafunction, treat masticatory muscle dysfunction and change the structural relationship of the TMJ.[4]

Occlusal appliances were originally made from acrylic resin and cover all or most of the teeth in one arch. Now day there are recent advance in materials, designs and using occlusal appliances as therapeutic devices,[5] as described in this article.

CASE

A female patient, 14 years-old, came to the General Hospital with a complaint of feeling swelling on the left cheek, the right jaw joint often made noises since 6 months ago. The patient had a motorcycle accident 2 years ago and hit his left cheek. The patient is dizzy, nauseous, does not vomit, so she was referred from the community health center to an oral surgeon because of a suspected infecttious disorder, but after examination the patient was suspected of having a jaw joint disorder and was referred to Prosthodontics Department. The patient had bad habits in elementary school like often biting a pencil, bruxism and quit in 6th grade (Fig.1).

Intra-oral examination, 46 caries, 33 and 28 missing, good oral hygiene, anterior deep bite, and normal occlusion. Extra oral examination, observed the patient for facial asymmetries of one side and profile type. It may have occurred following injury, such as a fall, and the patient presents to the dentist with deranged occlusion and facial asymmetry. Extra oral TMJ examination, unilateral clicking noted while opening of the jaws, deviation towards

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the right side while closing the mouth. No muscle tenderness was noted at the moment (Fig.2,3).

Closed mouth transcranial radiograph showed the right condyle is in the fossa, in a superior anterior position (+1), the left condyle is in the fossa, with anterior superior position (+1). Radiograph with the mouth open on the right side the condyle moves anteriorly but has not yet reached the peak of eminence (Grade 1). The left condyle moves anteriorly and reaches the apex of eminence (Grade 2). The right lateral movement is about 10 mm and the left lateral movement is about 11 mm (Fig.4).

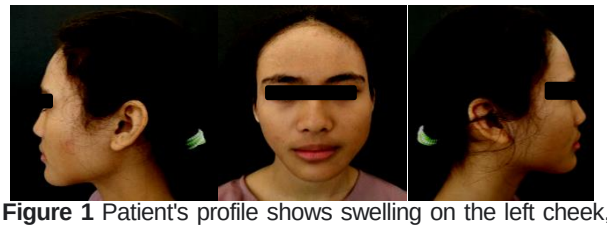

Figure 1 Patient's profile shows swelling on the left cheek, swelling on the left cheek.

Figure 2 Intra oral examination view left, right and front

Figure 3 Intra oral examination, occlusal plane with missing teeth 33, 28 and caries of 46

Figure 4 Transcranial radiograph with closed and open mouth

Based on various examinations, a diagnosis of disc displacement with reduction can be determined with myofacial pain. Treatment plan using splint stabilization is a full arch hard acrylic splint that is generally fabricated for the maxillary arch that allows condylar seating in the CR. When splint is in place provides an optimal occlusal relationship canine disclusion of posterior teeth in excursion. The treatment goal was to eliminate any orthopedic instability between the occlusal position and the joint position (Fig.5).

MANAGEMENT

It is necessary to carry out preprosthetic treatment before using a stabilizing splint to treat TMD such as cleaning tartar with scalling and composite fillings restoration in dental caries. Impression of maxillary and mandibular arches of the patient was performed using irreversible hydrocolloid materials and followed by pouring with dental stones to make the casts.

Figure 5 Mandibular splint for day wear

After the occlusal splint ready, the appliance inserted in patient's mouth. On the next visit, splint is still used in good condition functionally, and the TMJ has improved. Splints in the lower jaw are recommended for this patient use the splint 24 hours daily, because the mandibular splint is less visible and does not interfere with the speech process compared to splints upper jaw. The patient had no longer complaints of pain in the TMJ and there is no face asymmetry anymore (Fig.6).

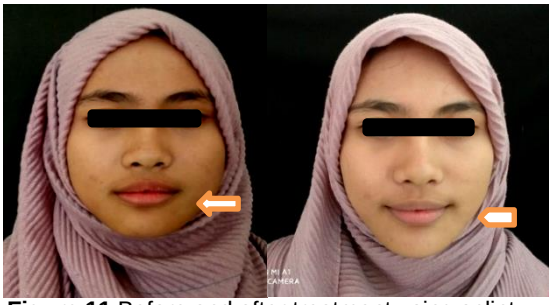

Figure 11 Before and after treatment using splint stabilization

DISCUSSION

A comprehensive general and extra oral examination of the patient can be performed without adding undue time to the dental office. Although it may seem lengthy, many aspects of the examination can be done when the patient enters the room. This, along with a thorough medical history, will provide information to enable safe and thorough treatment of the dental patient. The use of prepared questionnaires or pre-defined fields in electronic records will facilitate documentation. Dentists and dental care professionals are trained and work in areas where they can identify unknown medical conditions. They can make a difference to a patient's prognosis by timely referral or simply suggesting that the patient seek medical help.[9]

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Myofascial pain is the most prevalent disorder among TMDs, accounting for more than half of the cases. The site of pain is generally located in the area and muscles of mastication which may also extend far from its site of origin.[6]

The management of myofascial pain is generally directed at relieving symptoms and enhancing the quality of life. Identification, assessment and elimination of precipitating and perpetuating factors are important parts of the management of myofascial pain. Various manage elimination of precipitating and perpetuating factors are important parts of the management of myofascial pain. Various management techniques, mostly conservative and non-invasive have been suggested.[8] A recent systematic review pointed out the beneficial effects of cognitive behavioural therapy and self-care management. Different school of thoughts suggest various mechanisms to deal with such a common but highly debiliating issue faced as the most often disease after dental caries. Correcting the occlusal equilibration plays the significant part in the management of TMD's.[5] Disocclusion or any high contact during occlusion creates an imbalance in the relaxation of the masticatory muscles considering their role in maximal intercuspation and in centric relation. The relieve of the high contacts to attain an occlusal equilibration helps in relieving the symptoms the TMD's.[3]

In addition, intra-oral splints either alone or in combination with other approaches are often used to reduce pain and improve function in patients with myofascial pain. Among different types of occlusal splints, stabilization splints and nociceptive trigeminal inhibition splint is safer and more effective than splints with irreversible designs.[2]

The choice of an occlusal splint depends on the specific diagnosis of TMD and thorough understanding of disc anatomy, splint made on lower jaw, it will be difficult to achieve anterior contact as well as proper interior guidance usage splints in the lower jaw are recommended for patients who use the splint 24 hours a day, because the mandibular splint is less visible and does not interfere with the speech process compared to splints upper jaw. Lower jaw splint allows the tongue is in the correct position, i.e. on the palate. In the case of tongue dysfunction, jaw splint bottom really helps to lift the tongue to the most appropriate position.[7,8]

The occlusal splint must at the same time be aesthetic, comfortable, stable and functional. Treatment with using an occlusal splint should be preceded with a specific diagnosis, because appropriate treatment undiagnosed, uncontrolled or too time will cause permanent changes to the masticatory system, such as caries, periodontal disease, tooth movement, and changes in joint morphology. Every practitioner should properly understand that splint occlusal does not cure, but initial treatment of a general management comprehensive on TMD.[2]

It was concluded that occlusal splint is made to achieve balanced contact between the posterior teeth and maintain the centric or therapeutic position of the mandible through the maximal intercuspation of the splint. Every practitioner should properly understand that occlusal splint is an initial treatment of TMDs.

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Modification of custom tray and occlusal scheme in edentulous with abnormal relationship and compromised ridge

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ABSTRACT
Complete denture treatment in compromised ridges with class III jaw relationship are a challenge for prosthodontist because difficult to obtain a maximum denture bearing area in compromised ridges and to fulfil favorable functional and esthetics teeth arrangement. The purpose of this paper is to describe the modification of the custom tray, impression technique and teeth arrangement in edentulous case with flabby ridge, flat ridge and class III jaw relationship. A 58-year-old man came to Dental Hospital of Universitas Sumatera Utara with a chief complaint his loose denture was broken. Intraoral examination, full edentulous with flabby ridge on anterior region of maxilla, left and right maxillary tuberosity, flat ridge in maxilla and mandible with a class III jaw relationship were observed. The treatment planning included modifying custom tray and occlusal scheme. The modified custom tray of maxilla consists of dual tray with magnet retained which are made of autopolymerizing acrylic resin and thermoplastic vacuum formed. Cocktail impression technique was used on mandible. A modified buccalized occlusion scheme to obtain good function and esthetic in class III jaw relationship. By these modification techniques, great outcome was obtained in terms of retention, stability, esthetics and functionality.
Keywords: flat ridge, flabby ridge, class III jaw relationship, occlusal scheme, custom tray

INTRODUCTION

According to 9th of Glossary of Prosthodontic Terms, residual ridge resorption is a term used for the diminishing quantity and quality of the residual ridge after the teeth are extracted.[1] Residual ridge resorption is a chronic, progressive, irreversible and cumulative disease. It is a main concern in making treatment plan as a prosthodontist to do proper impression techniques and measures to minimize the residual ridge resorption, such as flat and flabby ridges.[2]

Flabby ridge is an excessive or mobile soft tissue on maxilla or mandile ridge.[1] Masticatory forces can move this denture-bearing tissue area, leading to altered denture positioning and loss of peripheral seal, that can make the denture become unstable in function and appearance, unless it is managed appropriately by special impression technique.[3]

Abnormalities in jaw relations exist mainly in two forms, i.e. maxillary protrusion and wider upper arch, and mandibular protrusion and wider lower arch. Abnormal jaw relationship can cause bad appearance, the replacement of teeth for people who had a class II or class III jaw relationship presents some special problems, and the occlusion will need to be planned in relation to the disharmony.[4]

Flat ridges, also called atrophic ridge, is unable to provide good resistance to vertical or horizontal movement.[3] Ridge augmentation and implant treatment are generally indicated for such patients. However, treatment option of ridge augmentation and implant procedures may not always be possible and conventional dentures can have an equivalent positive impact on the health-related quality of life. Support, retention and stabilization of denture are the fundamental consideration for prosthesis success.[5,6]

Severe resorption of the maxillary and mandible ridge results in unstable and non-retentive dentures with associated pain and discomfort. These problems are more frequently appeared in mandible due to lesser denture bearing area and other anatomical limitations.[3]

Therefore, in this case report with class III jaw relationship, flat and flabby ridges, in order to obtain good retention, stabilization, and better appearance, we will modify the impression custom tray on maxilla and mandible and used modified buccalized occlusion (BO).

CASE

A 58-year-old male patient came to the Dental Hospital of Universitas Sumatera Utara with complaint of difficulty in chewing food due to the absence of teeth in the oral cavity and had worn complete denture but the old dentures were broken. Intraoral examination showed flat ridges on maxilla and mandible (Fig.1), the presence of flabby tissue in the anterior region and tuberosity of the maxilla.

Extra oral examination showed that the patient's face was ovoid and prognathic (Fig.2A,B). Based on clinical examination and tentative vertical dimen-

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sion, the diagnosis is full edentulous with flat and flabby ridge with class III jaw relationship (Fig.2C).

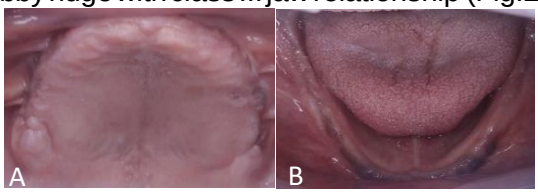

Figure 1A maxilla; **B** mandible

Figure 2 Patient's face, **A** frontal view; **B** lateral view; **C** vertical dimension tentative showing class III jaw relationship

MANAGEMENT

The initial stage was marking the flabby ridge using gentian violet. Preliminary impression with stock tray and irreversible hydrocolloid was done to get a diagnostic model. Tentative vertical dimension is to determine the patient's jaw relationship as a treatment plan requirement. Modification of the maxillary custom tray is done by using dual tray on the maxilla. Wax spacer was 2-3 mm in the first tray on flabby ridge and 1-1.5 mm in the non-flabby ridge. Stopper was made on the buccal shelf and then the wax was coated with autopolymerizing acyrilic resin (AAR). The first layer is AAR which covered the entire maxillary boundary structure except the flabby ridge on the anterior region and the maxillary tuberosity (Fig.3A).

Figure 3A Autopolymerizing acrylic resin (Tray I); **B** TVF with magnet retained (Tray II); **C** Dual tray (combination of Tray I and II)

Figure 4 Mandible's custom tray

Before AAR set, 4 magnets (4 mm in diameter, 2 mm in thickness) were placed in front of tuberosity and on the palate in tray I then 4 magnets in the tray II. Second layer was made of thermoplastic vacuum formed (TVF). Wire was placed as dual tray's handle on the palate (Fig.3B,C).

Mandible custom tray was made using AAR without spacer with cocktail impression technique. The lingual portion of custom tray is concave to facilitate tongue movement. Mandible rest in the posterior area with a height such as the vertical height of the tentative vertical dimension (Fig.4). Putty was placed on the top of mandible rest to reduce pain while taking impression.

Border molding was done using heavy body polyvinyl siloxane and definitive impression of the maxillary was done using a medium body on non-flabby and light body on flabby ridge. Escape hole in the TVF as a place for the entry of the light body impression material (Fig.5).

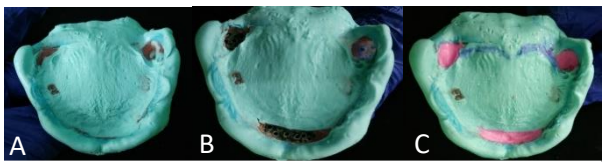

Figure 5A Medium body impression; **B** removal of wax spacer and making escape hole on tray II on flabby region; **C** secondary impression

Figure 6 Definitive impression on mandible

Close mouth impression technique on mandible; the patient is advised to close his mouth so that the mandible rests fit on the maxillary alveolar ridge and the patient was instructed to move the tongue left, right and up, sticking out the tongue and sucking in his cheek for recording the functional state of oral structures till the impression material set (Fig.6).

Figure 7A Facebow transfer; **B** modification of buccalized occlusion; **C** lower denture with a metal reinforced

Definitive vertical dimension taking and facebow transfer was done (Fig.7A). Arrangement of the teeth is done using a modified BO scheme; in which the maxillary posterior buccal cusp is in contact with the central fossa of the mandibular posterior teeth (Fig.7B). Maxilla teeth use anatomical teeth and the mandible use non-anatomical teeth. Complete denture was fabricated by conventional

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technique which the lower use metal mesh to reinforce the denture (Fig.7C). At the next appointment, dentures were delivery in the mouth (Fig.8). Follow up of patient was done and the patient was satisfied in esthetic and functional.

Figure 8 Insertion of the denture (frontal and lateral view)

DISCUSSION

The fabrication of a stable lower denture is a difficult thing for dentist especially in the compromised ridge case. The journey to successful denture fabrication starts from accurate impressions that will help the complete denture become retentive and stable which provides physiological comfort to the patient.[7] In this case, close mouth impression with cocktail technique was used on the mandible where there was a modification of the custom tray in the form of a mandibular rest.

The cocktail technique has the advantages in reducing the effect of muscle dislocation on improper extension of the denture boundaries and exploiting the possibilities of active and passive tissue fixation of the denture. Mandible rest of maxillary alveolar ridge provides the advantage of stabilizing the custom tray by preventing horizontal displacement of the tray during definitive impression.[6,8,9]

The success of any complete denture depends on three things: retention, stabilization and support. Prosthodontist's skill is needed in the application of denture cases with more complicated conditions. Impressions in the fabrication of complete dentures are not only for retention and stabilization purposes but also for the mucosal area which must be maintained without distortion especially in flabby ridge.

Management of a flabby ridge is mainly by three approaches, that is 1) surgical removal of fibrous tissue followed by conventional prosthodontics; 2) surgical correction of flabby tissue followed by implant retained prostheses which can be fixed or removable prosthesis; 3) conventional prosthodontics with modified impression techniques and no surgical intervention.

In treating this flabby tissue, a dual tray which consist of AAR as tray I and thermoplastic vacuum formed as tray II with magnet retained as retention between tray I and II was used. The purpose is to deliver mucostatic impression which minimize pressure on flat and flabby ridges.[8]

The jaw relation is the relationship between maxilla and mandible. The relationship between maxilla and mandible is class III jaw relationship which is an abnormal relationship in this case because the maxilla experiencing greater resorption than the mandible.[10]

The BO provides minimal occlusal adjustment, and minimal surface contact between maxilla and mandible. So, the pressure is lesser due to movement and better retention of the full denture provides without any empty dark space between the maxillary and mandible buccal cusps in the centric position.[11]

In this case, a modified BO was used which the buccal cusps of the maxilla posterior teeth contact with the central fossa of mandible posterior teeth. The retention and stabilization of the complete denture in this patient appeared to be good at the control after post-insertion of the complete denture.

It is concluded that by modifying the custom tray on maxilla to get definitive impression on the flabby and flat ridges, cocktail impression technique on the mandible and arranging the teeth with a modified BO, satisfactory results were obtained in the patient both aesthetically and functionally.

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Comparison of marginal fit of zirconia crown with digital and conventional impression

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ABSTRACT
Marginal fit is an important measure of the quality and clinical success of a fixed restoration. Different types of impression materials and techniques used can affect the marginal fit of the restoration. Conventional impression procedures have long been performed by dentist to duplicate patient's oral cavity, but this impression technique has several disadvantages. Currently, along with the development of the era of dental treatment, it is moving towards digital technology. Technological advances in dentistry today are able to eliminate the shortcomings of conventional impression. The purpose of this review was to evaluate the marginal fit of CAD/CAM fabricated zirconia restoration produced via conventional and digital impression techniques. It is concluded that intraoral scanner can be used instead of conventional impression procedures in denture fabrication. Many studies show that digital impression can replace conventional impression which is still widely used. The use of various types of intraoral examination tools and various systems used can give different results.
Keywords: marginal fit, zirconia crown, impression techniques

INTRODUCTION

The impression procedure is an important step in the process of making dental restorations. Accuracy in the impression procedure is an important requirement for getting accurate print so that success the right restoration manufacturer could achieve. In addition to conventional techniques that use various types of impression materials. Currently, digital impression techniques are also available for fabricating artificial teeth.[1-3]

There are two techniques for tooth impression that are conventional impression and digital impression using digital technology. Conventional impression techniques do not require expensive special machines and accurate results can be achieved if the work steps are carried out correctly. The impression material that is often used for this technique is polyvinyl siloxane (PVS), polyether or polysulphide. To obtain a perfect impression this material must exhibit properties such as accuracy, dimensional stability as well as rheological and thixotropic characteristics. Various factors such as uncontrolled salivary flow during the procedure, undercut, deep storage long time, moisture, deformation of the material and incompatibility with the material can affect the accuracy of the impression and subsequently lead to inaccuracies and mismatches of the restoration.[1]Besides that, the practitioner's level of knowledge and skills, potential distortion of impression materials, disinfection procedures, removal of impression materials from impression tray and transportation to the dental laboratory under different climatic conditions also become factors decisive important level accuracy in conventional impression procedure.[4]

New digital impression technology introduced in nature attempt to increase parameters such as accuracy, patient comfort and ease of use.[5] One of the most important steps in the fabrication of a fixed prosthesis is the final margin acceptable fit. Impression which is performed to transfer the required information from the patient's oral cavity to the laboratory, will produce a model and easy communication among dentists and technicians.[6]

Advances in the field of dentistry eliminate the disadvantages of impression conventional. In the early 1970s, Dr. Francois Duret, made a draft on how digital technology used in the industry could customized with the dentist. Digital impression system can scan teeth imagine that have been prepared later, visualize them on a computer monitor and could be fabricated. The dentist could see pictures with high resolution of oral cavity. Good visualization allow dentist for viewing and evaluating the preparation quality. Digital impression helps reduce some time-consuming steps and procedures in dental clinic, including tray selection, preparation and arrangement of materials and delivery to the laboratory, the process in the dental laboratory will be more saves time because there is no need to build or install models on articulators.[6-8]

Along with the development of technology, the use of intraoral digital scanners to create virtual impressions has enabled dentists to eliminate the use of impression materials, identify preparation margins, evaluate the interocclusal space and de-

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sign a prosthesis**.** Three factors that must be considered for the success of a ceramic restoration are marginal fit, fracture resistance and aesthetics. Of these three factors, the marginal fit is directly related to impression accuracy.[7,9]

Marginal fit is an important measure of the quality and clinical success of fixed restorations. Accuracy of marginal fit and internal fit of dental restorations created in a fully digital workflow is an important factor determining long-term clinical success. Insufficient marginal fit can lead to plaque and material retention of luting agent, causing secondary caries, periodontal inflammation and pulp or loss of restoration retention.[5,10] The marginal fit theoretically means a linear contact line or gap-free transition between the preparation and the restoration margin. For clinical use, Christensen et al. concluded that visible margins wider than 39 ηm were clinically unacceptable. However, due to various factors, it seems almost impossible to achieve this ideal value in a clinical setting. According to the literature, the *final fit is* 50-100 ηm considered technically feasible. *Marginal fit* larger ones will provide a place for oral and salivary pathogens, which can cause problems such as periodontal inflammation, secondary caries and dissolution of cement.[1]

Internal fit and *marginal fit* can be measured as the degree of closeness between the abutment and the restoration (inner and marginal surfaces). So, in general, the better the impression accuracy so the closer the degree of proximity between the restoration and the abutment and the better the interternal and *marginal fit* of the restoration.[4] Holmes et al. explain various types of measurement between casting surface and teeth so that *marginal fit* can be determined and described in the appropriate standard.[6,11]

Zirconia is widely used in fixed partial denture restorations for its high esthetic results and fracture resistance. Uses of zirconia in treatment started from 1970 's and started in the 1990s for root canal treatment. Zirconia has been introduced to dental practice as alternative restoration tooth metal ceramics. Compared with restoration metal-fused porcelain, zirconia restoration has more aesthetic, because naturally has excellent optics and especially there is no the presence of a black line on the cervical line from restoration. The overall properties of zirconia make it a first choice. Recently, zirconia also started being used as an ingredient in making dental implant. Several studies have been conducted to see marginal fit accuracy of zirconia restorations with the use of conventional and digital impression. Several studies previously been conducted with various methods and give varying results, where there is research that shows significant results or no significant. The purpose of this research is to find out accuracy comparison *marginal fit* from acquired zirconia restoration through digital and conventional impression techniques.

LITERATURE STUDIES

This paper was aimed as a *scoping review* based on the definition presented by Arksey & O'Mailey. The objective of this *scoping review* is to summarize and present the results of research that has been there being about one part certain from something topics or field science. Writing *scoping review* arranged from several stages, that determimines question study, determining type relevant research, conducting selection study, do data collection on a chart, and composing, making summary and reporting study results. This *scoping review* writing follows framework stages by Arksey and guide *preferred reporting items for systematic review extension for scoping review* (PRISMA- ScR).[12]

Research question used in composing *scoping* this review is "Is technique digital impression produces marginal fit compatibility and accuracy better than a conventional impression in making zirconia restoration?". Specimens used are natural tooth nor *typodonts* that have been conducted preparation and then conducted impression conventional and digital. The concept used are conventional and digital impression in making restoration fixed zirconnia. Whereas the context used is the marginal fit of zirconia restorations.

Literature searching was conducted using the digital database of two sources, namely PubMed and EbscoHost. Keywords used in searches in Pubmed and EbscoHost. Database is "((((marginal fit) OR (marginal gap)) AND (zirconia crown)) AND (impression)) AND (techniques)". The limitations of literature those are published 2014-2021, clinical studies and published in language English. Inclusions and exclusions criteria used for selecting literature that has been obtained could see in the table 1.

Literature searching produced 97 (33 literature from PubMed, EBSCO totaling 64 relevant kind literatures with the topic. Then from all literature obtained from the results was conducted to eliminate duplication from three electronic databases (n = 87).

Next literature the selected based on title and abstract. Several literatures were excluded because not relevant to the topics selected (n=30), were not used English language, and is not related to dentistry. The remaining literature was studied tho-

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Table 1 Criteria inclusions and exclusions used

Criteria	Inclusion	Exclusion
Period	Published start January 2016 – September 2021	Published before January 2016
Language	English	Non english
Subject	Patient's natural teeth, *typodont*	Besides patient's natural tooth and *typodont*
Draft	Comparing the marginal fit of restorations zirconia using conventional impression technique and digital scanning technique	Does not compare the marginal fit of restorations zirconia using conventional impression technique and digital scanning technique
Context	*Marginal fit, Marginal gap, vertical marginal discrepancy*	Not discuss *marginal fit, marginal gap, vertical marginal discrepancy*
Design	Laboratory, Clinical trial, *case control*	Report case, *systematic review*, *literature review*

roughly from the version *full text,* so obtained literature from journals scientific as much 11 journals (n = 8).

The aim of this *scoping* review is to review and compare the marginal fit of restorations zirconia is made using conventional impression and digital scanning techniques. After literature was selected based on title and abstract for review return topics reviewed in each literature, obtained a total of 9 related literatures with the topic. Appropriate literature with criteria inclusion in writing is studied in clinical and laboratory.

DISCUSSION

Several factors considered for success restoration of ceramic are marginal fit, fracture resistance and esthetics. In this case, the marginal suitability is related directly with accuracy impression. The marginal fit that doesn't adequate for restoration could cause accumulation plaque, causing caries and periodontal disease which ultimately results in failure restoration. Significant periodontal inflammation was happened to the crown with the marginal discrepancy is about 250-430 μm. Values from 100-120 μm proposed by Holmes et al, Fransson et al, McLean and von Fraunhofer have been used as a reference in a lot of research.[7]

Marginal fit in *casting* can be defined as discrepancies measured at various points between the casting surface and the teeth. Measurement between casting and teeth can be made from points along the internal surface, at the margin, or on the outer surface casting. The perpendicular measurement from the internal surface of the casting to the axial wall preparation is called *internal fit* and the same measurement at the margin is called *marginal fit*. Incompatibility marginal vertical measured parallel to the direction casting is called vertical marginal discrepancy. Horizontal marginal discrepancy measured perpendicular to the direction casting is called horizontal marginal final discrepancy. The overextended margin is the perpendicular distance from the marginal gap to the casting margin. The underextended margin (Fig.1) is the perpendicular distance from the marginal cleft to the cavosurface angle of the tooth. The combination of the angle of the marginal gap and the extension error (overextension (Fig.2) or underextension) is called the absolute marginal discrepancy. Specifically, it is the hypotenuse of a right triangle with sides defined as either too long or too short margins and marginal gaps. The angle combination of the vertical marginal difference and the horizontal marginal difference also defines the same absolute marginal difference.[13]

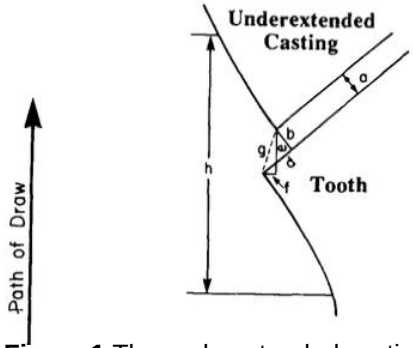

Figure 1 The underextended casting

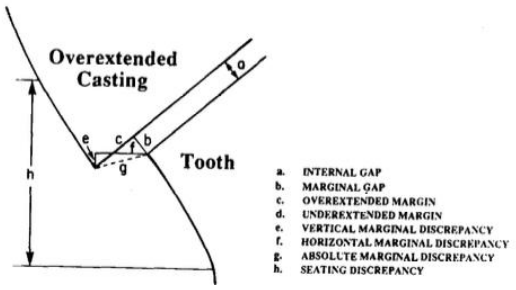

Figure 2 The overextended casting

Eight literatures discussed in *scoping review* this consist from study clinical as many as three studies and five in vitro studies. Of these eight included literatures in this *scoping review*. Three literatures use printing from natural tooth prepared, five literature use *typodont*. Various number type of system digital scanner is used in research among them is TRIOS 3 shape digital scanner, iTero digigital scanner, Carestream 3600 digital scanner, CEREC and later COS Lava compared with printing conventional with using PVS.

Evaluation of *marginal fit* could conduct with

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Tabel 2 Analysis of the articles

No	Author (Year)	Study	Destination Study	Aspects	Subject Study	Research results	Conclusion
1	Carrilho Baltazar Vaz & Pimmentel Coelho Lino Carracho (2020)	Laboratory test	Comparing the marginal fit of coping zirconia made using conventional impression and 2 digital scanning techniques	Marginal value discrepancy	Each 10 second premolar typodonts left jaw lower for three group technique printing	The SD of vertical marginal discrepancy were 106±87 mm for PVS group, 53±56 mm for TRIOS 3 group, and 93 ±69 mm for the CS 3600 group.	Digital scan with TRIOS 3 shows the value of lower marginal discrepancy than digital scanning with the CS 3600 and conventional prints with elastomers
2	Sakornwimon & Leevailoj (2016)	Clinical trial	Evaluating the marginal fit of the crown monolithic zirconia and patient preferences for digital printing compared printing pol y vinyl siloxane (PVS)	patient preferences and marginal differences fit	16 participants with indications for a single crown. After crown preparation, digital impressions with an intraoral scanner and PVS impressions were made.	Visual analog scale score for printing digital is statistically significantly higher than printing with polyvinyl siloxane.	No difference was found in the clinical marginal fit of zirconia crowns made from digital impressions compared to PVS impressions. Furthermor, patient satisfaction with digital printing is significantly higher than with conventional printing.
3	An et al (2014)	Laboratory test	Comparing marginal fit coping zirconia designed using an iTero digital scanner with those designed with conventional printing techniques.	Marginal value discrepancy	30 identical impressions of 1 maxillary central incisor prepared for crown restoration ceramic	Statistically significant differences were found between the printing groups conventional and group i Tero	Marginal gap between restoration and die was greater in the group using the digital printing method compared to the group using the conventional printing method.
4	Dauti et al. (2016)	Laboratory test	Seeing the marginal fit of coping zirconia already cement produced after digital printing with LavaTM COS compared to conventional impression with polyvinyl siloxane	Marginal gap and absolute marginal discrepancy were measured on mesial & distal	Prepared t y podont teeth , replicated The die was randomly divided into two groups according to the mold taking technique.	No significant difference of marginal parameters between digital and conventional groups was found	Coping produced with digital printing shows marginal parameters that are comparable to copings made with conventional printing with poly vinyl siloxane.
5	Rödiger et al (2016)	Clinical trial	Evaluate marginal and internal fit of four unit CAD / CAM manufactured zirconia fixed prostheses made with digital and conventional prints	internal and marginal gaps	20 molar teeth prepared, Conventional impression taking (CI) with PVS and intraoral (IS) scans of each preparation done.	Single crown of zirconia produced by scanning technique intraoral shows statistically better precision than internal fit only in certain areas.	CAM fabricated single zirconia crowns manufactured by CI and IS techniques provide adequate marginal and internal precision.
6	Mustapha et al (2018)	Laboratory test	To evaluate the marginal and internal fit of the zirconia fixed partial denture used different impression technique	marginal, incisal and axial discrepancy	Nissan models Typodont, including maxillary central incisors and canines with missing lateral incisors.	The T group had the smallest difference compared to the C and S groups at the marginal level.	Better adaptation was achieved with the intraoral scanning group, except at the incisal tip.
7	Cetik et al (2017)	Laboratory test experimental	Precision of digital prints (Trios, 3Shape) compared to conventional impressions with three different magnins (shoulder, chamfer and knife edge) on Frasaco teeth	Marginal	The sample consists of 60 crowns part zirconia , is divided into six groups according to the type of mold and margins.	No statistically significant differences were found between printing conventional and digital scanning , except for two of the eight points.	Zirconia crowns made from digital prints and those made from conventional molds provide similar adaptations and offer identical results.
8	Boeddinghaus (2019)	Clinical trial	Comparing the marginal fit of zirconia crowns based on three different intraoral digital printing methods and one conventional impression method.		49 teeth out of a total of 24 patients were prepared and treated with restorations with crowns full restoration.	Printing with CEREC Omnicam produce the largest value of the marginal gap compared with printing conventional and other intraoral scanners.	Based on intraoral scans and laboratory scans of conventional models of zirconia coping restorations, it was obtained results that are comparable to their marginal fit.

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measure the gap at the margin. Two common techniques that are often used is technique silicone replica then conducted direct visualisation with a mechanical device for measuring relative distortion at margins. Measurement could be conducted with to do measurement upright straight from restoration internal surface until closest preparation with the finish line. The replication technique silicone could be used for in vivo and in vitro studies. In this technique, silicon replica light body from marginal discrepancy made and cut then thickness be measured with a stereomicroscope.[1,13,14] Besides using this technique silicon replica, measurement marginal discrepancy can also be conducted using the technique of cementation using zinc phosphate.[5,6]

Research laboratory test

In a study conducted by Baltazar et *al* on typodont about the marginal fit of restoration zirconia coping, the difference marginal fit among group TRIOS 3 and CS 3600 scanners may occur because the difference in technology used in each intraoral scanner. On research about evaluation fixed restoration zirconia 3 units made by Moustapha et al, who also performed on the TRIOS 3 intraoral scanner typodont also gave results *marginal* and *internal fit* more restoration accurate compared with conventional printing.[5,8]

Measurement conducted use optical microscope. In study, this measurement of the marginal gap and absolute marginal difference with microscope optics show there is no significant difference among group technique digital and conventional impression. Next the average marginal gap value of coping for the second group is more small of 100 μm, indicating the margin that can be received clinically.[1] On research clinical previously done also with using COS Lava scanner got results that digital scanner generates more small marginal gap value compared with printing conventional. This causes the existence of difference techniques in measurement namely in the research previously mentioned use of silicon replica technique.[15]

It is different with other researches, in a laboratory tests conducted by An et al, using a prepared typodont for then conventional impression using PVS and an intraoral scanner, then fabrication zirconia coping was carried out and evaluated for marginal fit using silicone replica technique and measured at four points that is in buccal, lingual, mesial and distal, from measurement the obtained results that conventional impression give more marginal gap yield small compared to the resulting restoration through an intraoral scanner. However, the value of the resulting *gap* among second group is still within the range of score clinically possible accepted. An et al, say limitations in the research in the form of the possible use of metal dies could reflect light at the moment scan and iTero does not use powder for reducing thing the so that give different results from previous studies.[6]

Clinical trial research

A research conducted by Sakornwimon et al about comparison *marginal fit* zirconia crown with the use of conventional impression with PVS and digital printing with 3 shape D900 scanner in 16 patients obtained that *marginal fit* of clinical zirconia crown made from digital and PVS impression do not different, both are at in range that can be received through from the survey conducted use questionnaire obtained participant's results study more like digital printing. Various studies clinical has conducted to evaluate zirconia crown marginal discrepancy. Studies show that the marginal gap of 100 μm or 120 μm is still could be received clinically. This conclusion is stated by Matthias et al, in research conducted on 20 patients using TRIOS 3 shape intraoral scanner obtained results that in some point measurement digital printing provides results more *marginal* gap small if compared with conventional impression, similar with laboratory test studies on typodonts that also use TRIOS 3 shape intraoral scanner. In this study, prior to intraoral scanning and conventional print retrieval, retraction threads were placed using a double retraction technique. First, an intraoral scan was performed with the second retraction thread remaining in the sulcus. Then, the threads are removed and the conventional impression is taken. Thus, randomization was not necessary as the impression of the second technique was realized in one operation.[1,7,10,16]

Discussion about whether is resulting restoration through intraoral scan gives comparable precision or even more superior than restoration based on conventional impression still continuous. This thing supported by findings a several in vivo studies. On the other hand, there are also in vitro studies showing no there is significant difference in marginal accuracy when group digital and conventional restoration compared. There are one study clinical comparison three devices with different intraoral scans show significant differences in marginal and internal accuracy in three system tested scanner, so disclose influence significant from system scanner used. Besides that, in clinical trials other factors such as influence preparation margin

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difficulty subgingival, contamination blood and saliva or reaction patient to digital or conventional impression need to be considered.

It is concluded that data obtained in the scope of this review show existing proof scientific that procedure intra-oral scan can be used as a replacement for procedure conventional impression in fabrication tooth restoration. Many studies show that digital impression can replace conventional impression that is still many used. This is supported by a good level of accuracy that is clinically acceptable. The use of different types of intraoral scanners and the different types of systems used may result in varying accuracy. However, several studies comparing the marginal fit of zirconia restorations on digital and conventional impressions have averaged clinically acceptable results between the two procedures.

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Full-mouth rehabilitation with fixed restoration

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ABSTRACT
A 32-year-old male patient with chief complaint of difficulty chewing food due to tooth loss was referred to Hasanuddin University Dental Hospital. Intraoral examination showed edentulous teeth 15, 16, 26, 36, 37, 46 and 47. Radiograph showed no radiolucency and crown root ratio of 1:2. The treatment was full mouth rehabilitation using an adhesive bridge and a fixed bridge on the upper jaw, and a telescopic crown overdenture on the lower jaw. Initial impressions were taken for diagnostic modeling and temporary denture fabrication. Preparations were performed in a box shape on occlusal teeth 25 and 27 for the fabrication of a fixed bridge and preparation of teeth 14 and 17 for the fabrication of a fixed bridge, followed by the double impression method and bite registration. Insertion of adhesive bridges and fixed bridgework followed by preparation of 35, 38, 45 and 48 for primary denture fabrication on telescopic crowns. Secondary impressions were made using elastomeric materials. Primary crowns of teeth 35, 38, 45 and 48 were made first and cementation followed by mandibular secondary impressions. Bite registration was taken and the maxillomandibular relationship was recorded. Afterwards, metal frame try-in, posterior tooth try-in, laboratory processing and then insertion were performed. It was concluded that prosthetic rehabilitation is essential, an adequate treatment plan should be put in place to improve the patient's mastication and maintain the stomatognathic system with denture fabrication.
Keywords: full mouth rehabilitation, fixed restoration, telescopic crown

INTRODUCTION

Nowadays, the dental care enables a dentist to make a restoration and try to keep the natural teeth as the abutment. There are many types of dentures, such as dental bridge, a combination of fixed and removable dentures, partial removable denture, and overdenture. The use of denture is not only to improve the mastication, phonetic and aesthetic function, but also to maintain the health of the rest of the tissues.[1]

The magnitude and direction of the partial removable denture movement for functioning were influenced by the natural supporting structure and the denture design. Functional load will be distributed to the supporting teeth through the occlusal, the guiding plane and the direct retainer. An optimal design can maintain the abutment health and the supporting tissue. An improper design can cause uncontrolled load distribution to the abutment and other supporting tissues.[1] Telescopic crown overdenture is a type of denture that using a double crown, which consists of coping and a removable denture on it. The principle of the telescopic crown system composed of two elements, they are internal crown called the primary crown and the external crown called the female or secondary crown. The using of telescopic denture can provide protection for an abutment, lighten the load received by the abutment and provide a more aesthetic result. Telescopic denture is a modified form of existing conventional denture and overdenture with some advantages, such as increasing retention, rigid vertical support, stability and proprioception.[2,3] In dental bridge, the magnitude and direction of denture movement are more stable so that the occlusion force applied to the periodontal tissues and alveolar bone close to normal. The type of dental bridge which commonly used are adhesive bridge and fixed fixed bridge. Adhesive bridge is a type of bridge which consist of a single pontic and two retainer wings attached to the abutment using cement or resin.

The retention is a micromechanical retention between the enamel surface and the retainer surface. The denture has a very minimal preparation so that it is more conservative. The FFB is dental bridge that has two or more abutments with rigid connectors on both ends of the pontics. This denture provides excellent strength and stability, and also distribute the pressure more evenly to the restoration and providing an excellent splinting effect.[4,5] This paper discusses about the fabrication of telescopic overdenture on the mandible and adhesive bridge and FFB in the maxilla that serves to repair and restore the mastication of the patients.

CASE

A 32-year-old male patient stated chief complaint of difficulty to chew food due to missing some on the posterior area. Patient was in good general

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health and there was no systemic disorder. The intraoral examination revealed missing teeth of 15, 16, 26, 36, 37, 46 and 47 (Fig.1). The position of 17, 27, 38, 48 were mesioversion. Radiograph showed no lesion and the general crown root ratio was 1: 2 (Fig.2). The treatment of this case were adhesive bridge for tooth 25-0-27 and FFB for 14-0-0-17 in the maxilla.

Figure 1 The overview of maxilla and mandible prior to the fabrication of the dentures.

Figure 2 Panoramic view of the patient prior

The telescopic overdenture was made for 35, 38, 45 and 48. In the early stages, first impression was done to fabricate a diagnostic model and the temporary denture. The preparation was performed in boxshaped on the occlusal teeth of 25 and 27 for the adhesive bridge, and the preparation of 14 and 17 were done for the FFB, followed by the final impression and the making of the bite registration for the lab process. The adhesive bridge and FFB were inserted (Fig.3), and the process continued with the preparation of 35, 38, 45 and 48 for the primer coping of the telescopic overdenture. Furthermore, the impression was done with elastomer material for the maxilla and mandible to obtain a working model. Primary crown of the 35, 38, 45 and 48 were made and the cementation performed. The impression was done for the second time in the mandible to obtain a working model for the fabribrication of the secondary crown that will be attached with the metal frame dentures.

Before all the elements were sent to the laboratory for the fabrication of the metal frame, the clinician has to record the interarch relationship by making bit rim for the maxilla and mandible, followed by taking the bite registration. After that, the process continued with try-in of the metal frame, teeth arrangement, and insertion of the denture (Fig.4).

Discussion

The loss of the teeth, especially at the posterior region can cause a disharmony in the oral cavity.

Figure 3A The FFB, **B** adhesive bridge, **C** the FFB and adhesive bridge has inserted

Figure 4 Insertion of **A** primary coping on teeth 45 and 48, **B** primary coping on teeth 35 and 38, **C** telescopic crown overdenture on mandible

The antagonist teeth and adjacent teeth may experience pathological migration resulting in decreased in efficiency of chewing, and disorders of the TMJ. To overcome the possibility of this condition, it requires a prosthesis to restore the normal occlusion. The prostheses used can be a removable prosthesis or a fixed prosthesis.[2]

Adhesive bridge is a bridge that has a pontic and a retainer of thin metal attached to the abutment in proximal and lingual/palatal part by adhesive material and using the acid etching technique. An adhesive bridge that also called with resin bonded fixed prosthesis due to its retention that uses an adhesive material. In this case, adhesive bridge is used to replace the 26 because of the narrowed alveolar ridge and the reduced of mesiodistal distance to the first molar.

The FFB is a fixed denture which uses the rigid connectors on both ends of the pontic. The dentures were attached using resin cement, so it can be removed by the doctor only. Compared with removable denture, fixed denture has several advantages, such as convenient as the original teeth, does not take long for adaptation but requires precision in cleaning. The patient must go to the dentist for the follow-up and for the plaque control about 3-6 months.[4,5] The teeth loss of 36, 37, 46 and 47 were treated with telescopic overdenture. Telesco-

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pic overdenture is a denture composed of two kinds of coping, they are, primary coping that will be attached permanently to the abutment and secondary coping which attached to the denture frame. The advantage of a telescopic crown overdenture is that there is more even distribution of the chewing load which can minimize the bone resorption. It also provides the proprioceptive effect of periodontal tissues of the abutments. Therefore, in this case is used a telescopic prosthesis.[2]

It is concluded that prosthetic rehabilitation especially in the case of loss of posterior teeth is very important because the denture will help patient to maintain the health of the stomatognathic system.

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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.

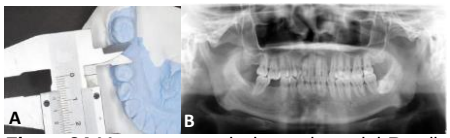

Figure 2A Measurements in the study model, **B** radiographic features

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).

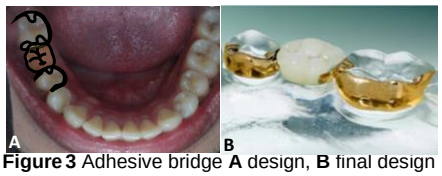

Figure 3 Adhesive bridge **A** design, **B** final design

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).

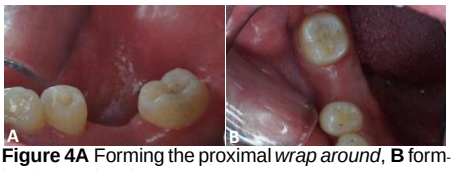

Figure 4A Forming the proximal *wrap around*, **B** forming the occlusal rest

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.

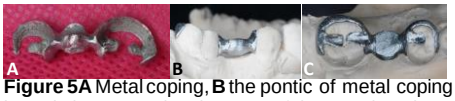

Figure 5A Metal coping, **B** the pontic of metal coping lateral view, **C** occlusal aspect of the metal coping

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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Nasoalveolar molding in early management for newborn with *labiognatopalatoschizis*

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ABSTRACT
A 1-week-old female infant with bilateral cleft lip and palate (CLP) was referred to the Department of Prosthodontic, Hasanuddin University Dental Hospital. The nutrition was managed through a nasogastric tube. The patient was in primary need of appliance that could support the feeding. Intraoral examination revealed bilateral complete CLP deformity diagnosed as *bilateral complete labiognatopalatoschizis.* It was performed fabrication of nasolalveolar molding (NAM) in order to reduce the severity of the initial cleft deformity and to achieve better and more stable results in CLP infants, in particularly advantageous to lengthen the deficient columella prior to the primary surgical repair of the lip and nose. Preliminary impression was done at the first appointment using custom tray and elastomeric material. At 2 weeks after birth, a conventional molding plate was fabricated on the maxillary cast. After the NAM was finished, try in was performed on the patient's mouth and adjustment were done to it edges. It is concluded that NAM allows an overall improvement in functional activity thus increasing infant's weight prior to surgery, also correct the aesthetics of the nasolabial complex in bilateral cleft conditions while minimizing the extent of the surgery and the overall number of surgical procedures.
Keywords: nasolveolar molding, labiognatopalatoschizis, cleft lip, cleft palate

INTRODUCTION

Labiopalatoschisis or cleft lip and palate (CLP), is a craniofacial congenital disorder caused by disorders of facial development in the embryo. Unification failure of processus maxillaris and processus nasalis medialis especially at week 5-7 pregnancy will result in unilateral or bilateral labioschisis. Processus medial nasalis, which is the part that forms the two segments intermaxillaris, if it fails to fuse, there is a gap called palatoschisis. Teratogenic environmental factors and genetics play a role in the formation of CLP. Intrauterine exposure to anticonvulsants can increase the incidence of CLP up to 10 times. Smoking habit during pregnancy can increase the probability. Other teratogens are alcohol and retinoid acid.[1,2]

The CLP is a common birth defect. Both can affect several body systems and functions, including eating and drinking, facial development, teething, ability to speak, and can have social and psychological impacts on children and parents.[3]

Babies born with a cleft palate may have difficulty on food intake, even milk. The gap cannot be closed tightly, given the presence of incomplete palatal structures. Discharge from the nose due to the inability of the palate to separate the nose from the oral cavity, as well as the baby being easily choking when breastfeeding, often occurs in infants with a cleft palate defect.[3,4]

Feeding appliances are often required by CLP patients. Nasoalveolar molding (NAM) is a device for the patients, so this article discusses the use of NAM which creates a seal between the oral and nasal cavities and helps the baby suck milk.

CASE

A 7-day-old infant patient referred to the Hospital of Halimah Dg. Sikati Makassar with complaints of congenital CLP (Fig.1). The patient wants to be immediately treated in order to provide food intake for the baby. Her parents provided informed consent prior to the treatment. Nutrition was managed through a nasogastric tube (NGT). The patient was in primary need of appliance that could support her feeding (Fig.2A).

Figure 1 Patient's extraoral profile

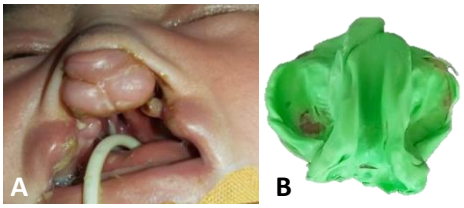

Figure 2A Intraoral examination, **B** preliminary impression

MANAGEMENT

Anamnesis and objective examination are performed to confirm the diagnosis of bilateral complete labiognatopalatoschizis. On first appointment,

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preliminary impression was done with elastomer material and infant acrylic custom tray. Child should be crying while making impression, otherwise it will be known that airway is blocked. After impression was fully set it was carefully removed (Fig.2B) and two casts were made, one for construction of molding plate and the other for measuring the intra alveolar gap.

Next, the mold is formed on working cast. The molding plate is made on a plaster model of clear, hard acrylic material and the edges also cleft area were fabricated with soft denture material (Fig.3). It is tried in the child's mouth and adjusted so that there is no acrylic in the cleft area. It is highly polished and smoothened (Fig.4).

After several adjustment, the feeding plate inserted in patient's mouth and checked for the adaptability by feed the baby with milk (Fig.5). Evaluation was done also, and the parents were taught to remove, clean and insert the appliance.

DISCUSSION

Congenital CLP abnormalities are common. So, treatment of this deformity become a global health problem. Difficulty sucking milk often occurs when feeding or drinking in infants with CLP. In order for the baby to suck well, muscle coordination is needed intraoral, which is difficult for people with CLP.[3]

Figure 3 Design of the obturator

Figure 4 Insertion of the obturator

Figure 5 Feeding test

Coordination of the intraoral muscles is necessary for sucking success, which can be challenging in children with CLP. It is difficult to breastfeed a child with a cleft palate. The infant is unable to produce suction due to the opening in the palate.[4,5] The degree of difficulty, however, will vary depending on the severity of the cleft. The mother will need to make some adjustments in order to breastfeed a child with a cleft palate successfully. The modified football hold (child is normally held at a 45°) is an example of a position that can be used to reduce nasal regurgitation.[6]

Feeding obturator is a passive device designed to provide a normal contour to the cleft alveolus and hard palate. They separate the oral and nasal cavities and in doing so provide a surface to position the nipple during suckling. The combined use of a palatal obturator and lactation advice can improve the time taken to feed, volume of intake, and growth at 4 weeks of age when commenced with newborn infants who have cleft palate or combinbined CLP.[5]

Previous research on NAM has yielded outstandstanding results. The alveolar cleft areas were reduced by more than 1 mm. nonetheless, it is believed that the number of surgeries and hence scarring will be minimized.[4] PNAM can help to reduce the cleft gap more effectively in CLP cases. Long term result of the method needs further investigation.[6]

It is concluded that while limiting the extent of surgery and the overall number of surgical treatments. The PNAM provides for an overall improvement in the aesthetics of the nasolabial complex in both unilateral and bilateral cleft situations.

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Esthetic removable partial denture

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ABSTRACT
Prosthetic rehabilitation of a partially edentulous patient can be established by using wide range of treatment options. Magnetic attachment retained denture has always been considered beneficial for the patient, because it is giving a more esthetic and functional outlook to the denture. The following case report discusses removable partial denture with no clasps showing by using magnetic attachment retained, thus increase esthetics. A 60-year-old male patient came to Department of Prosthodontics, Airlangga University, for his esthetic problems and chewing inability. Intraoral examination revealed teeth 14, 13, 12, 11, 21, 22, 23, 24, 28, and 46 remained at lower jaw. He never had a denture and needed to make a new one. Clinical and radiographic examination along with the preliminary impression were taken. Teeth preparation and impression for magnet keeper, then cementation of magnet keeper on teeth 12 and 24. Functional impression for upper and lower jaw with individual tray. Denture delivery and one week after followed by insertion of magnet EX 600 in the denture. It was concluded that magnetic attachment retained partial denture could enhance the natural looking for the patient because it has no clasps showing.
Keyword: Magnetic retained, removable partial denture, overdenture

INTRODUCTION

The esthetic impact of tooth loss can be highly significant and may be more of a concern to a patient than loss of function. Restoring facial esthetics in a manner that maintains an appropriate appearance can be a challenge and is a major factor in restoration and maintenance decisions made for various prosthetic treatments.[1]

Tooth loss consequences consist of anatomically reduced ridge volume and physical anatomic tools for mastication also the oral capacity for neuromuscular functions to manipulate food. Therefore a denture may help increase their natural feeling of chewing. Conventional removable partial denture (RPD), teeth or implant supported overdentures, fixed partial dentures, and implant supported fixed or partial dentures are the most preffered prosthetic treatment approach.[2] However, the traditional retention systems such as metallic clasps, frequently used in these conventional removable dentures, impose lateral forces on remaining abutments, increase abrasive wear, and cause unaesthetic appearance.[3]

Famous statement of Devan[4] dictum, *It is essential to retain that is present originally in oral cavity than to replace what is lost due to any reason*". Overdentures cover one or more teeth or dental implants, restoring the entire dentition. They help preserve natural teeth or roots that are often indicated for extraction because of periodontal tissue loss. Maintaining these teeth or roots enables a delay in alveolar bone resorption and preserves periodontal proprioception and masticating efficiency.[5] Overdenture is a better option as compared to a removable complete denture prosthesis. Study by Renner *et al*. said that 50% of the roots used as overdenture abutments remained immobile even after 4 years.[6]

Magnetic attachments provide no vertical resiliency while decreasing horizontal stress transmission to abutment.[7] Magnet used in this study is MAGFIT EX. Magfit utilizes a stainless steel casing hermetically sealed by microlaser welding to ensure excellent corrosion resistance. All Magfit magnetic attachments are closed field in order to ensure that the magnetic field leakage at the gingival margin is substantially below the accepted US Safety Standard of 0,02T. The surface of the keeper is coated with Cr-rich layer to protect it from oxidation during the casting process. Magfit DX attachments have ellipsoidal outer lip with an anti-rotation feature to ensure firm fixation in the denture base.[8]

The following case report discusses removable partial denture with no clasps showing by using magnetic attachment retained.

CASE

A 60-year-old male patient came to Department of Prosthodontics, Teaching Hospital of Dental Faculty, Airlangga University for his esthetic problems and chewing inability. Intraoral examination revealed teeth 15, 14, 12, 11, 21, 22, 23, 24, 28 remained at upper jaw. At lower jaw only tooth 46 remained with mobility grade 2 (Fig.1).

Figure 1 Pre operative view: natural remaining teeth

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The clinical and radiographic examination revealed that in the upper arch, the remaining teeth at upper jaw had fractures, caries, and periodontal tissue loss, and tooth 46 had mobility grade 2. With the remaining teeth that cannot be used as abutments for fixed prosthetic treatment, it was decided that overdenture could be the choice of treatment. It was decided to perform a magnet-retained partial overdenture for maxillary arch and bare-root complete overdenture for mandibular arch.

MANAGEMENT

Clinical and radiographic examination along with the preliminary impression using irreversible hydrocolloid (alginate) were taken on the first visit. The next visit was to extract teeth 13, 14, 28 and root canal treatment for teeth 12, 24, 36; composite filling for teeth 22, 23. Teeth color matched with *Vitapan* shade guide.

Impression of study cast of upper arch is taken with *polyvinylsiloxane* (PVS) for preparation of making temporary crown. Teeth 11, 21 being prepped for single crown. After the preparation of the abutments, the impression was made by using a PVS elastomeric impression material (reguler body) with *putty/wash one step impression technique*. Direct temporization made with *Bis-acrylic composite*, then *temporary single crown* inserted (Fig.2).

Figure 2A Preparaton for single crown 11, 21, **B** impression of crown preparation.

Abutment teeth 12, 24, 36 were endodontically treated. The teeth were cut down to gum level (equigingival) and post space preparation for teeth 12, 24 was done up to 2/3rds of the length of the canal with *gates glidden drill* and. In order to prevent the movement of the post in the post space, an antirotational notch was placed. Chamfer margin of 1 mm was made. To support the impression material in the post space, a toothpick was placed in the post space. Lentospiral was used to coat the inner surface of the teeth by PVS light body. A pick up impression was made with putty. Post space preparation was done for teeth 12, 24 and tooth preparation to receive metal coping was done for 36. Impression sent to dental laboratory for fabricating magnet cast keeper and metal coping (Fig.2).

After fabricating the posts, they were tried in the patients mouth and verified for fit. The prepared post space was thoroughly washed with distilled water and dried thoroughly with endodontic aspirator and absorbent paper points. The casting was cemented using *luting glass iononomer cement.*

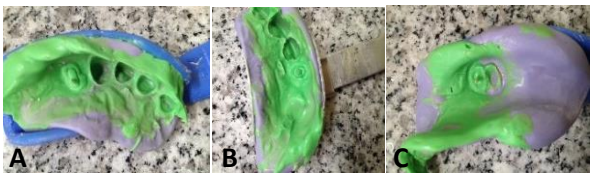

Figure 3A,B Magnet cast keeper abutment impression, **C** impression of lower ridge abutment for metal coping

Denture was then fabricated by conventional material and methods. Preliminary impression of maxillary and mandibular arches were made using impression compound *irreversible hydrocoloid* and cast poured in dental plaster (Fig.3). Acrylic custom tray with wax spacer was fabricated. An additional wax spacer to the dimension of denture magnet, about 3x2 mm was placed over the root face on preliminary cast. Final impression was made while putting magnet on the cast keeper using PVS *medium bodied* consistency. Master cast was poured in type IV dental stone and occlusal rims were made on the denture bases. Jaw relations were recorded and transferred to a semiadjustable articulator for arrangement of artificial teeth. Artificial teeth were mounted and tested in the oral cavity to check occlusion and esthetic results. The dentures were manufactured and installed along with single crown of teeth 11, 21 (Fig.4).

Figure 4A Denture insertion intra oral, **B** patient profile while wearing the new denture

Patient was recalled after 1 day, 3 days, and 7 days for evaluation. On recall it was observed that patient was satisfied with his new dentures and was able to masticate properly.

After 7 days of denture insertion, denture in 12, 24 region was scraped to make space for magnets and a hole made in the buccal flange adjacent to keeper's location. The magnets were positioned on the keepers in the mouth. Resin was added to the scraped area and the mandibular denture was placed over the magnets in mouth under proper occlusion. After the resin was set, denture was removed with the magnets picked up in the mandibular denture. Excess resin was trimmed and denture polished. After polishing, the denture was again placed intra-orally and checked for comfort, occlusion

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and retention. Patient was instructed how to wear and remove the denture, denture maintenance and oral hygiene as well.

DISCUSSION

Tooth loss leads to difficulty in masticatory function and oral capacity for neuromuscular functions to manipulate food also influences facial appearance and psychological condition.[1] Treatment of choice in this particular case was magnet-retained partial overdenture for maxillary arch and bare-root complete overdenture for mandibular arch. Remaining teeth had fine periodontal and gingival attachment so it worth to be maintained.[9] Endodontically treated retained root can support a denture and transmit masticatory pressures to the periodontal ligament receptors. This improves the patient's oral perception, also to prevent bone resorption.[1,10]

Magnets had many advantages, such as ease of placement, automatic reseating, constant retention with many cycles, easy replacement, small size with strong attractive forces, can be placed within prosthesis, dissipate lateral functional forces, less need for parallel abutments, can be used for implant-supported prosthesis, ease of cleaning.[11]

In order to be an abutment for cast keeper, abutments must be prepped almost at the same height as surrounding ridge. Magnetic attachments prevent any lateral forces also it had easy application.[12] It has to be noticed that magnets increase retention of partial or complete dentures and overdentures.[13] it offers adequate retention and decreases the transmission of excessive forces to the remaining teeth.[14,15]

Conventional removable partial denture have led to harm the periodontal tissue, and may contribute to carious lesion formation, also the appearance of clasps may interfere patient smile and resulting in presence of wearing denture.[16] Additionally, the magnetic overdentures are more stable and retentive than conventional partial dentures, and they are easily removed and seated without the patient having to grapple with clasps and complex paths of insertion, thereby improving esthetics, function, and comfort.[17]

Based on denture design of RPD, Shala et al[18] confirmed statistically significant difference (P= 0,008) patient's success of RPDs with attachment compared with RPDs with claps which agree with Owall,[19] that considering patient's satisfaction were better when used combination with fixed partial dentures retained with attachment (93,8%) compared with RPDs retained with claps (58,7%). Similar results reported that the presence of anterior teeth in an RPD could influence patient's satisfaction.[20]

Magnet used in this study is MAGFIT magnetic attachments developed by Aichi Steel Corporation for the Toyota Group, which claimed to have the strongest retention with an ultra-compact size, no corrosion due to Aichi Steel's precision micro-laser welding technology enables a perfect hermetic seal of the stainless steel outer casing which protects the magnet from corrosion in the oral environment, and new magnetic materials technology.[21]

There are few types of magfit; Magfit DX and MAGFIT EX, these are cast coping type magnet. MAGFIT DX series is suitable especially for molars where vertical space is limited. It has a thin disk-type design with improved wear resistance. The ellipsoidal outer lip of the magnetic assembly prevents rotation to ensure firm fixation to the denture base. It is 30% shorter than the EX series but wider in diameter. Durability has been enhanced by increasing the hardness of the magnet casing. MAGFIT EX has a "sandwich type" structure with attractive forces ranging 400-600 gf, which is comparable to the spring method. MAGFIT EX600W is recommended for cases with regular space requirements. MAGFIT EX400W is suitable for cases with minimal space conditions as well as cases requiring lower retention. MAGFIT EX is in rectangular shape, so it is prone to use in long or oval shaped retained root surface.[12] MAGFIT EX600W is chosen for this case because the dimensions (3,8 x 2,8 mm) suitable for root surface of teeth 12, 24.

After magnet insersion, patient was recalled to observe and evaluate denture. Patient was satisfied with appearance of his new dentures and was able to masticate properly. There were no mucosal inflammation. Denture is better in retention and stability. The patient was instructed to control intra oral hygiene by regularly brush abutment teeth with fluoride toothpaste because clean and healthy periodontal is what makes any treatment especially overdenture successful.[12] Denture also had to clean regularly with baby toothbrush that has really soft bristles and liquid soap twice a day. Denture-wearing habit patient must follow is to remove denture at bedtime and put into liquid denture cleanser.[22,23] Almost 40% of patients no longer use their RPD within 5 years because of factors such as sociodemographics, pain, and esthetics. Timely recall and maintenance are required for success.[24] Patients are advised to control every 6 months so prosthodontic treatment can be optimal.[25]

It is concluded that regarding quality of dentu-

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res, patients are generally satisfied more with RPD with attachment based on level of aesthetics, retention, and chewing ability, because they prefer not to show the anterior labial clasps of RPD. Magnet-retained partial overdenture may be preferred in the rehabilitation of partial edentulous patients to the conventional removable dentures, because of their advantages such as better aesthetic, retention, stability, stable occlusion, and chewing function due to the conservation of proprioception feedback. Also, the rate of the residual ridge resorption was decreased because of the transfer of compressive forces into the tensile forces by the periodontal ligament and better stress distribution.

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Effect of *Sargassum Sp* effervescent on surface roughness of acrylic resin

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ABSTRACT
One type of denture cleaning is effervescent tablet. Brown algae effervescent granules (*Sargassum sp*) have been demonstrated as denture cleansers but it has not been proven whether these materials affect the surface roughness of acrylic resins. This research analyzes the effect of effervescent *Sargassum sp* and alkaline peroxide as a soaking agent on the surface roughness of acrylic resin plates. This laboratory experimental study with 27 samples of acrylic resin plates divided into three groups; A was immersed in effervescent granules, B was immersed in alkaline peroxide, and C was immersed in aquadest. Immersion was carried out for 15 minutes per day and lasted for 4 consecutive days; everyday each solution was replaced with a new one. Measurement of surface roughness and hardness of samples using Confocal Laser Scan Microscopy. Wilcoxon's test on the alkaline peroxide group showed a p-value of 0.008 ($p<0.05$) indicating a significant difference in surface roughness values before and after immersion. Paired t-test in the algae and aquadest groups showed $p>0.05$ which means that there is no significant difference in surface roughness values before and after immersion. It was concluded that *Sargassum sp* effervescent granule solution does not affect the surface roughness of the acrylic plate.
Keywords: surface roughness, *Sargassum sp*, effervescent

INTRODUCTION

The most commonly used denture base material is heat cured poly/methyl methacrylate acrylic resin. Acrylic resin is used because this material is non-toxic, non-irritating, insoluble in oral fluids, good esthetics, easy to manipulate, easy to repair and small dimensional changes. In addition to its beneficial properties, acrylic resin has disadvantages, namely the presence of residual monomers, is porous, absorbs water, and is less resistant to abrasion.[1] Water absorption by heat cured acrylic resin (HCAR) occurs by diffusion of water molecules into and spread between acrylic resin macromolecules so that the macromolecules separate. This is what can cause the surface roughness of the acrylic resin material which slowly over a certain period of time can penetrate the PMMA mass and occupy a position between the polymer chains so that the disturbed polymer chains are forced to separate. This absorption affects the physical properties of acrylic resin.[2]

Surface is a boundary that separates a solid object and its surroundings. Surface roughness is the irregularity of the surface texture, which generally includes the irregularities caused by treatment during the production process. The surface roughness of denture plates, especially acrylic plates, needs to be considered. The rough surface of the denture plate facilitates the accumulation of plaque and food debris, thereby increasing the *Candida albicans* colony which can cause *denture stomatitis.*[3]

Acrylic as a denture plate must have a smooth surface and minimum surface roughness because it can affect the health of the oral cavity tissue.[4] Clinically, the denture plate surface roughness threshold value is 0.2 m.[5] Surface roughness occurs on the HCAR plate, due to continuous use of the denture, causing some reactions to the tissue because the mucosa under the denture will remain for a long time. The rough surface of the denture plate makes it easier for plaque and food residue to build up so that it affects the level of oral hygiene of the patient and makes it difficult to maintain oral hygiene due to the continuous accumulation of plaque.[6,7]

Surface roughness in dentures can be a place for colonization of microorganisms that can injure oral tissues. Accumulation of food debris on dentures based on acrylic resin that is not cleaned can cause halitosis and adversely affect the health of oral tissues, it can also increase the number of microorganisms in the oral cavity such as the *C.albicans*.[8,9] *C.albicans* is opportunistic and can become pathogenic if the surrounding environment allows this fungus to multiply so that it can cause disturbance.[10]

Denture cleaning can be done by mechanical using a toothbrush and ultrasonic, and chemical techniques by immersing the denture in a disinfection solution such as alkaline peroxide, alkaline hypochlorite, chlorhexidine, sodium hypochlorite, enzymes and herbs. Chemical cleaning of acrylic resin dentures is more effective than mechanical methods, so cleaning agents that have bactericidal and fungicidal properties are needed, are easy to use,

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and are compatible with all denture materials.[11]

Along with developing of science, the use and utilization of herbal ingredients in Indonesia has progressed very rapidly. Herbal disinfectants are used by the community as an alternative of denture cleansers, in addition to the basic ingredients for denture cleaning in the form of chemicals that are developing in the market. The effectiveness of disinfectants from herbs has been widely studied and proven to prevent the growth of microorganisms found on denture plates.[12]

The government has announced the use of medicines derived from nature or herbs that can be obtained from cocoa pods (*Theobroma cacao l*). Cocoa pods are the largest waste produced by cocoa farmers and cultivators. Cocoa pods contain many bioactive components that can be used as dental therapy ingredients. Cocoa pod extract with a concentration of 0.25% can inhibit the growth of *Streptococcus mutans*, while a concentration of 6.25% can inhibit the growth of *C.albicans*.[13-15]

Utama, et al stated that there was a significant effect between solvent temperatures at 5-10°C, 20-25°C and 25-31°C denture cleanser effervescent granules of cocoa pod extract (*Theobromacacao l*) on the growth of *S.mutans* and *C.albicans*. The most influential temperature in inhibiting the growth of *S.mutans* and *C.albicans* is 20-25°C.[16]

Sargassum sp. brown algae is also one of the herbal ingredients that have antifungal and antibacterial properties so that it can be managed as a denture cleaning agent. In Choudhury's research, it was tested methanol extracts that of the three classes of seaweed, *Chlorophyta* (green algae), *Phaeophyta* (brown algae), *Rhodophyta* (red algae), *Phaeophyta* (brown algae) species had the highest antibacterial activity.[17]

Rosdiana cited by Afdila, shows that *effervescent* is considered more convenient to use as a cleaning agent compared to other preparations because it does not require large containers for storage, are more economical, easier to use, and the size and dosage are accurately measured.[18] *Effervescent* preparations can also be given to elderly people with decreased mobility.[19]

One of the herbal ingredients that has been proven to inhibit the growth of *S.mutans* and *C.albicans* is brown algae. Brown algae containing active compounds including flavonoids, alkaloids, saponins, phenols and triterpenoids have been shown to be able to inhibit the growth of *S.mutans* and *C.albicans* on acrylic plates with a concentration of 2.5% as cited in Utama and Ikhriyani's research on the effectiveness of effervescent granules from algae dechlorophyllization. Chocolate (*Sargassum polycystum*) in inhibiting the growth of *S.mutans* and *C. albicans* on acrylic resin plates.[20] Another herbal ingredient that has been proven is *Sargassum ilicifolium* or brown algae which is one of the genus *Sargassum* which belongs to the class *phaeophyceae*. *S.ilicifolium* contains Mg, Na, Fe, tannin, iodine and phenols have potential as antimicrobial agents. The active compound as antifungal from Sargassum seaweed is tannin.[21] Utama and Tetelepta in 2017, that one species of brown algae, *S. polysyctum* which contains active compounds including flavonoid, alkaloid, saponin, phenol and triterpenoid has been shown to be able to inhibit the growth of *S.mutans* and *C.albicans* on acrylic plates with a concentration of 2.5%.[22]

Effervescent is used as a cleanser, peroxide is provided in powder and tablet form. Materials containing alkaline compounds, detergents, sodium perborate and powder. When this material is mixed with water, the sodium peroxide perborate decomposes releasing oxygen. The cleaning is a result of the oxidizing ability of the peroxide decomposition and of the effervescent reaction to produce oxygen. It can effectively remove organic deposits and kill microorganisms. Alkali peroxide is a safe, effective method of denture cleaning and sterilization, particularly among geriatric patients.[23]

Confocal laser scan microscopy (CLSM) is a 3D surface roughness tester that serves to measure the roughness of a surface with standard or measuring properties of Rα, RZ, Rq, Rmax with an instrument accuracy of 0.02 m. The goal is to assess surface roughness using a laser indicator as a sensor to check the profile of the surface of the test object. This tool produces a graph and values and 3D images that can be viewed from various sides of the surface.[24]

Based on previous research, brown algae effervescent granules effectively inhibit the formation of *S.mutans* and *C.albicans* colonies on acrylic resin plates, this indicates the potential of effervescent granules to be an alternative to dentures. Therefore, the researchers wanted to find out more about the effect of 2.5% brown algae effervescent on the surface roughness of acrylic plate because it has an important role in the use of dentures.

METHODS

The samples of HCAR were 27 plates with a size of 10x65x3.3 mm for 3 treatment groups. Group I, solution of 2.5% sargassum effervescent granule extract, group II alkaline peroxide solution or sodium perborate, and group III aquadest. This acrylic

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resin sample was immersed in 2 mL of solution for each treatment group for 15 minutes/day at 24℃. After 15 minutes, it was removed and then washed with distilled water and dried on tissue paper and stored in a container to measure the surface roughness of the acrylic resin plate. All of the treatment groups were carried out for 4 consecutive days and each solution was replaced with a new solution everyday.

The samples were first measured using a surface roughness tester before immersion to see the roughness value before immersion. After immersion, the final surface roughness is measured using a surface roughness tester by 1) the sample is placed on a flat surface, and the operator placed the stylus at the point that has been made after immersion on the surface of the sample; 2) the tool is activated, the stylus moves along a straight line horizontally 8 mm long and back again; 3) measurements were made three times on each sample, then they were averaged as the final surface roughness value. This research conducted with ethical clearance no.UH 17120404.

RESULT

It was obtained data as shows in Table 1. The comparison between the mean values the results of the comparison of the three roughness groups shows a p-value more than 0.05, which means that there is no significant difference (Table 2).

Table 1 The mean and SD of the calculation of the surface roughness of HCAR for each group before and after immersion

Rudeness	Before	After
Alkaline Peroxide	0.0184±0.0019	0.0403±0.033
Algae	0.0170±0.0025	0.0164±0.022
Aquadest	0.0177±0.0028	0.0174±0.003

Table 2 Comparison of roughness between groups before treatment

	Alkaline peroxide	Algae	Aquadest
Alkaline Peroxide		0.223*	0.507*
Algae			0.569*

** LSD Test*

Table 3 Comparison of roughness between groups after treatment

	Alkaline peroxide	Algae	Aquadest
Alkaline Peroxide		0.000*	0.000*
Algae			0.452*

** Mann Whitney test*

Comparison of the roughness values of the alkaline peroxide, algae and aquadest groups after treatment, obtained from algae with aquadest using the Mann Whitney test, p-value > 0.05 (0.452) which means that there is no significant difference in the roughness value of the algae and aquadest groups. While the comparison of algae and alkaline peroxide and aquadest and alkaline peroxide showed a value of $p < 0.05$ which means that there is a significant difference in the roughness between algae and alkaline peroxide and aquadest and alkaline peroxide (Table 3).

Table 4. The difference in the mean and SD of the calculation of the surface roughness of HCAR before and after immersion

Rudeness	Before	After	p value
Alkaline Peroxide	0.0184 ± 0.0019	0.0403±0.033	0.008*
Algae	0.0170 ± 0.0025	0.0164 ± 0.022	0.285
Aquadest	0.0177 ± 0.0028	0.0174 ± 0.003	0.447

*p-value < 0.05 Wilcoxon & paired t test

The Wilcoxon test in the alkaline peroxide group showed a p-value of 0.008 ($p<0.05$), which means that there was a significant difference in surface roughness values before and after immersion. Algae and aquadest groups were analyzed by paired t-test showing $p>0.05$ (0.285 and 0.447) which means that there is no significant difference in surface roughness values before and after immersion in the algae and aquadest-immersed groups (Table 4 and Fig.1).

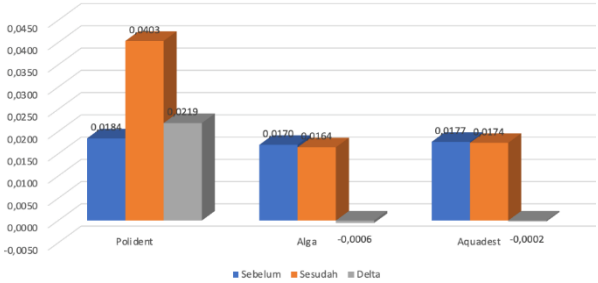

Figure 1 Histogram graph of the mean and SD of surface roughness of HCAR before and after immersion with alkaline peroxide, algae and aquadest.

DISCUSSION

On roughness examination, table 1 shows the average surface roughness value of acrylic resin for each group before and after immersion, indicating a change in the alkaline peroxide, algae, and aquadest groups as the control group. This is because aquadest is pure water with the assumption that it only contains H_2O molecules without the addition of other ionic elements and does not contain active substances that can accelerate the breaking of HCAR polymer chains. Aquadest has a lower effect on the surface roughness of HCAR compared to immersion using alkaline peroxide.[25] Table 2 is a comparison of roughness between groups before treatment, where the table shows an insignificant difference with p-value > 0.05.

Table 3 shows the roughness comparison between groups after treatment (immersion) where it can be seen that the comparison between the al-

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kaline peroxide group and the algae group and the alkaline peroxide group and the aquadest group shows a significant comparison value with p-value <0.05 where the roughness value in the polyden group is higher compared to other groups. This is also confirmed in table 4 which is the result of the comparison of the average surface roughness of acrylic resin before and after leaching (soaking) for each group, where the alkaline peroxide group before and after treatment showed a significant difference with the p-value<0.05 while the algae and aquadest groups did not show a significant difference. These results are in line with research conducted by Puspitasari which states that alkaline peroxide causes an increase in the surface roughness value of acrylic resin compared to 75% celery extract. This is because the chemical reaction of alkaline peroxide which dissolves in water produces sodium perborate and will break down into hydrogen peroxide, where this reaction will produce oxygen bubbles (nascent oxygen) which provide mechanical action to remove the biofilm layer from the acrylic resin surface.[26]

The results of this study are also supported by the statement of Jagger and Harrison cit Malheiros et al which states that oxygen bubbles released during this reaction can cause an increase in surface roughness. The oxidation reaction that releases oxygen causes the release of tertiary amines which further accelerates the oxidation reaction in the double bond of the resin matrix, resulting in physisical changes to the acrylic resin surface such as an increase in surface roughness.[26]

Table 4 also shows a decrease in the value of surface roughness in the acrylic resin group soaked with brown algae. Brown algae is an alternative to natural-based denture cleansers that can inhibit fungal growth. Sargassum sp contains Mg, Na, Fe, tannins, iodine and phenols which have potential as antimicrobial agents. The active compound as antifungal from Sargassum seaweed is tannin. This antifungal and antimicrobial ability has the potential to inhibit the formation of a biofilm layer which is the result of microorganism activity on the surface of the acrylic resin.[3]

It is concluded that the effervescent granule solution of Sargassum sp did not affect the surface roughness of the acrylic plate as well as the aquadest solution. Alkaline peroxide can affect the surface roughness of acrylic plate by increasing the acrylic surface roughness values. Immersion of acrylic resin plate in alkaline peroxide solution can significantly affect the surface roughness compared to acrylic resin plate immersed in Sargassum sp effervescent granule solution or aquadest as a comparison.

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Surgical obturator of upper jaw post hemi-maxillectomy sinonasal cancer

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ABSTRACT
Surgical obturator is a maxillofacial prosthesis used in post-hemimaxillectomy patients to close defects and maintain the integrity of components presents in the oral and nasal cavities due to sinonasal cancer. Maxillary defects in maxillofacial patients will lead to stomatognathic disorders and loss of confidence. Prosthetic rehabilitation is an important procedure in palate reconstruction after sinonasal cancer surgery, include forms of treatment carried out in multidisciplinary cooperation with the ear, nose and throat, surgical oncology, oral surgery, and prosthodontics. This article provides information on post-hemimaxillectomy patient management with a surgical obturator. A 65-year-old female patient came to the prosthodontist of Gusti Hasan Aman Banjarmasin Dental and Oral Hospital, on referral from the Banjarmasin Alert Surgery Special Hospital with a diagnosis of sinonasal cancer with hemimaxillectomy and palate reconstruction. Before the operation, impression is carried out first on the maxillary area using alginate. The obturator shape is created by optimizing the retention of the remaining anatomical structures, creating designs on the model, creating clasp retention using wire 0.8, processing with acrylic, followed by postoperative obturator insertion. It is concluded that surgical obturator can be used as post hemimaxillectomy rehabilitation.
Keywords: hemi-maxillectomy, sinonasal cancer, surgical obturator

INTRODUCTION

Sinonasal cancer or sinonasal malignant tumor is a malignancy that occurs in the area of the nasal cavity and paranasal.[1] The overall incidence of sinonasal cancer in the United States is 0.556 cases per 100,000 inhabitants per year with a male-to-female ratio of 1.8:1. The most common histology is squamous cell carcinoma (51.6%) and adenocarcinoma (12.6%), while the most common primary places are the nasal cavity (43.9%) and maxillary sinuses (35.9%).[2] The incidence of sinonasal carcinoma in Indonesia based on research at the ENT Department of FKUI Cipto Mangunkusumo Hospital found 10-15% sinonasal malignancy from all ENT malignant tumors.[3] According to Barnes, factors that can trigger act as sinonasal cancer are exposure to wood dust, nickel, other metal materials, and smoking.[4] Other studies have also said that smoking and being in an environment with cigarette smoke have been established as risk factors for sinonasal cancer.[5] Symptoms that can be experienced by patients with sinonasal cancer include nasal obstruction, facial pain, persistent rhinorrhea (runny nose), or epistaxis (nosebleeds). The symptoms of sinonasal cancer are not specific, and cannot be distinguished from the symptoms of benign sinonasal diseases, so sometimes the patients have had an advanced state.[6]

The American Joint Committee on Cancer (AJCC) classification is used in Indonesia to determine the stage assessed from tumors, nodules, and metastases (TNM) and is divided into stages I, II, III, IVa, and IVb.[7] Optimal care management is determined through a multidisciplinary approach, which involves ear, nose, and throat specialists, oncology specialists, prosthodontics specialists, oral surgeons, and other professionals.[3] The principle of management of sinonasal carcinoma is surgery in the form of a maxillectomy as the main option followed by radiotherapy and or chemotherapy.[8] Surgery in patients with sinonasal can cause defects in the palate area which will have an impact on the normal functioning of the oral cavity such as speech disorders, mastication, and swallowing so that rehabilitation treatment is needed.[9]

Prosthodontic rehabilitation uses maxillofacial prostheses called surgical obturators as a follow-up to post-surgery.[10] Surgical obturators are prostheses used to close palatal defects after a maxillectomy, restore masticatory function and improve speech.[11] Surgical obturators can be used in patients with intact teeth, total edentulous or partially edentulous.[12,13]

CASE

A 65-year-old female patient came to the Prosthodontics of RSGM Gusti Hasan Aman Banjarmasin, on a referral from an ear, nose, and throat specialist at RSKB Siaga Banjarmasin to make a surgical obturator that will be installed after surge-

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ry. From the anamnesis, it is known that the patient is diagnosed with sinonasal cancer in the palate area and surgery will be performed. An extraoral objective examination shows a convex profile of the patient's face, there is swelling of the maxillary (Fig.1A), while intraorally the teeth left only teeth 23 and 26 (Fig.1B). Based on the panoramic radiographic supporting examination, abnormalities were seen in the maxillary area to the patient's nasal cavity area as well as dental impactions 14 and 28 (Fig.2). The patient must be surgically performed immediately and plan for rehabilitation due to palate defects that will be caused after surgery later.

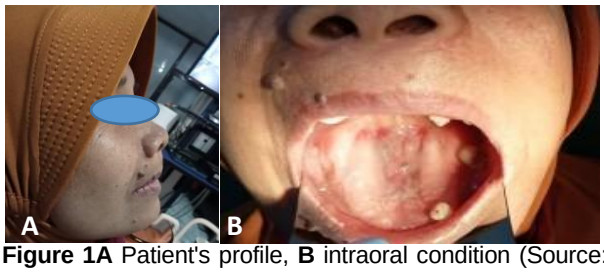

Figure 1A Patient's profile, **B** intraoral condition (Source: own documentation)

Figure 2 Panoramic radiographic (Source: own documentation)

MANAGEMENT

For the rehabilitation of this patient, a plan is made to make a surgical obturator to cover the palate defect due to surgery. Before surgery, impression is done using stock trays with alginate material on the upper jaw and then filled with a type IV stone cast (Fig.3A) as a working model. The impression is done carefully because the condition of the palate area is very soft, using a 50 mL syringe to assist in anatomical printing. Because of the patient's condition that only left teeth 23 and 26, retention was made in the form of adam clasp on tooth 26, and a C clasp on tooth 23 using wrought-wire. Then a night obturator model was made that covered the entire surface of the printed product to the limit of the movable and immobile mucosa. Surgical obturators with nights are sent to the dental lab for acrylic processing (Fig.3B). The obturator is made using acrylic resin material, after the processing is completed, finishing, and polishing (Fig.4).

After surgery, a defect was obtained on the durum palate, the obturator that had been made before installation was soaked first with a 0.2% chlorhexidine gluconate solution. Still, under the influence of general anesthesia, the operating area was cleaned with sterile gauze, and conduct an intraoral examination first. The defect area of the palate has been given sterile gauze with 0.2% chlorhexidine gluconate. Inserter surgical obturator to the patient to see the edge boundary and retention of the obturator. It is necessary to be careful of defects in the maxilla of the former operation (Fig.5A).

After 1x24 hours of surgery, the first control is carried out to find out whether the surgical obturator is still retentive or not, whether there are no injuries to the wings of the surgical obturator, and whether defects in the palate are still well closed. Cleaning of obturators and soft tissues of the oral cavity using sterile gauze with 0.2% chlorhexidine gluconate material. The patient is asked to perform repeated swallowing movements so that the patient can adapt to the obturator. The second control was carried out 3 days after the first control (Fig. 5B), there was food debris attached around the wing of the surgical obturator, and the defect in the palate was still well closed even though from the patient's description there was fluid entering the nasal cavity and the fluid came out of the nose. In the second control, the swelling on the face has begun to decrease. The third control was carried out 3 days after the second control, there was still food debris attached around the wing of the surgical obturator, and the patient had not dared to clean the surgical obturator himself (Fig.6) and was subsequently evaluated after one month; the results of the examination showed that the patient could swallow food well, and could also speak well compared to when not wearing an obturator. After checking the obturator and there are no problems, the patient is

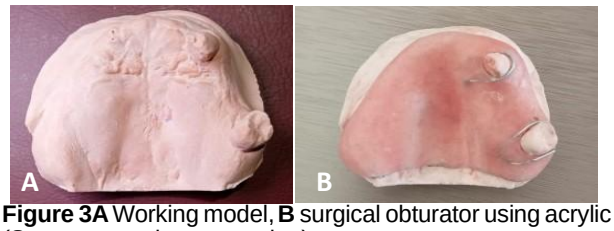

Figure 3A Working model, **B** surgical obturator using acrylic (Source: own documentation)

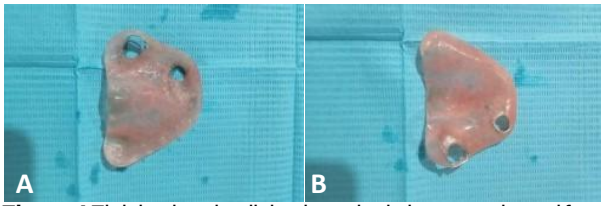

Figure 4 Finished and polished surgical obturator viewed from the outer and inner surfaces (Source: own documentation)

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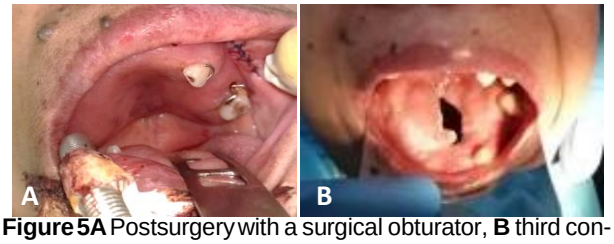

Figure 5A Postsurgery with a surgical obturator, **B** third control (Source: own documentation)

Figure 6 Fourth control (Source: own documentation)

taught to install and remove the obturator and teaches how to clean the obturator and the soft tissues of the oral cavity.

DISCUSSION

Defects of the maxillary are caused by surgical treatment of benign or malignant neoplasms, congenital malformations, and trauma. The size and location of the defect affect the degree of damage and difficulty in prosthetic rehabilitation. Lack of support, retention, and stability are common problems of prosthodontic treatment for patients who have undergone a maxillectomy.[12]

Maxillectomy is an action in the maxilla that causes defects in the face and oral cavity in the form of damage and deformation to the face and oral function. Maxillary reconstruction is the rehabilitation of the treatment of maxillary defects after a surgical procedure involving the loss of part or all of the maxilla.[14] Prosthodontic rehabilitation of acquired defects on the upper jaw can be organized into three stages of treatment. For each step, a different type of obturator is made.[15] In this case, the post-maxillectomy defect is closed with a surgical obturator made of acrylic resin to prevent the entry of food into the respiratory tract.[16] The main purpose of surgical obturator is to maintain the remaining teeth and tissues and to provide comfort, function, and aesthetic to patient.[17]

This type of tool is made from molds obtained before the day of operation and inserted at the end of the maxillary resection action. The many benefits of using a surgical obturator include providing a stable matrix for surgical packing, being able to form a barrier between the oral cavity and the wound during initial healing, and allowing the patient to speak and swallow more effectively.[18] The main difficulties that occur after resection may have a psychological impact on the patient that can be reduced by the presence of a surgical obturator. For this case, a surgical obturator is immediately made before surgery and inserted on the day of surgery immediately after maxillary resection. No teeth were added and retention was obtained from the remaining teeth.[15]

In surgical obturators, education to maintain oral hygiene is very important to support the healing process and postoperative tissue regeneration and avoid local infections that can hinder the healing process. Ultimately the prosthesis for maxillofacial defects has a significant impact on the patient's quality of life when returning to the social environment.[19] The quality of life of patients with maxillary defects can obviously be improved by the provision of well-designed obturators. Prosthetic obturators can restore mastication, ingestion, aesthetics in particular the middle of the face, resonance, and speech. Patients with maxillofacial defects undergoing rehabilitation can continue their social habits as usual.[20]

It is concluded that surgery in sinonasal cancer involving the maxillary area and nasal cavity often causes defects in the area that disruption of the normal functioning of the patient's oral cavity such as chewing, swallowing, and talking so that rehabilitation is needed for the patient's condition. A surgical obturator as a post-hemimaxillectomy rehabilitation treatment has been shown to close defects in the maxilla and restore speech function, chewing, and swallowing in patients.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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The surgical and definitive obturator after hemimaxillectomy of the palate

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ABSTRACT
To describe the use of surgical obturators and definitive obturators in post-hemimaxillectomy. Palatal tumour patients who have undergone hemimaxillectomy surgical came to the Department of Prosthodontics for the examination. Clinical examination revealed a large lesion on the left palate and involved his teeth. Two types of obturators were made, they were surgical and definitive obturators. Obturator has been used for four months and was helpful in restoring swallowing, mastication, speech, and aesthetic functions. It is concluded that the use of an obturator can help patients in swallowing, masticating, and speaking, as well as helping to restore aesthetic function.
Keywords: definitive obturator, hemimaxillectomy, palatal tumor, surgical obturator.

INTRODUCTION

One of the cancer treatments in the oral cavity is a surgical process to remove lesions in the tissue. This removal is performed partially or completely on a jaw.[1] The surgery can involve both soft and hard tissue.[2] Removal of this tissue will result in a defect that will affect the integrity of the oral cavity. In addition, these defects can also affect aesthetic and another function.[1] Aesthetic disorders can significantly affect the patient's psychological and social condition.[3] Various functions that experience these disorders can be treated with obturators. An obturator is a device that can help to support soft tissue after surgery. In addition, the obturator can improve the patient's psychological condition, which can make the patient more confident. The obturator also has artificial teeth that can replace the function of teeth that have been lost due to removal of tumor lesions. These functions include speech, mastication, aesthetic, and psychological functions.[1]

The obturator is created to maintain the lining between the nasopharynx and oropharynx. This is done so that the food eaten does not enter the respiratory tract. In addition, the use of an obturator in this condition can also provide sufficient pressure in the oral cavity to facilitate swallowing.[3] The use of surgical obturators is divided into some types based on the time of use, namely immediate, delayed, interim, and definitive. An immediate surgical obturarator is placed immediately after surgery or removal of a tumor mass. Delayed surgical obturators are placed 7-10 days after surgery. Interim surgical obturator is placed 4-6 weeks after surgery. Definitive surgical obturators are placed 4-6 months after surgery.[4] In this case report, we will discuss the two types of obturators, they are immediate surgical obturators and definitive surgical obturators.

CASE

A 53-year-old female patient came to the Dental Hospital of Hasanuddin University upon a referral from an ENT specialist. The patient was planned to undergo surgical removal of the left upper jaw due to the presence of a tumor. The patient needed a surgical obturator prosthesis after removal of the tumor for her oral cavity. On clinical examination, there was enlargement with hard palpation of the left hard palate with involvement of teeth 21 to 27. In addition, there were caries in 18, 12, 38, 37 and root remnants in 17, 16, 26, 27, and 36 (Fig.1). The patient will undergo hemimaxillectomy surgery in the area. On the panoramic radiograph, a radiopaque mass extends over the right hard palate (Fig.2).

Figure 1 Intra oral photography.

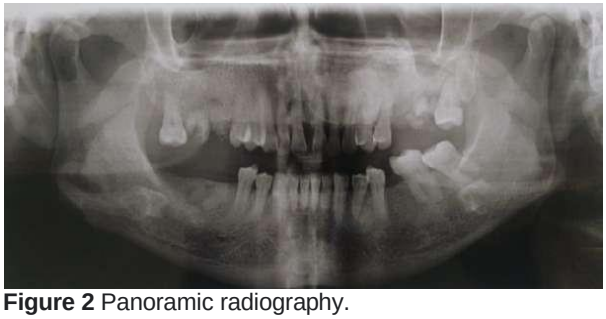

Figure 2 Panoramic radiography.

MANAGEMENT

At the first visit, clinical photographs of the oral cavity were taken. Then an initial impression was

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also performed using irreversible hydrocolloid material to obtain a diagnostic model for the maxilla and mandible. After a multidisciplinary discussion was conducted with the ENT specialist to determine the extent of the maxillary retrieval plan. The results of the discussion were then simulated on the study model (Fig.3).

Figure 3 Diagnostic model and simulation of the maxillectomy

Figure 4 The surgical obturator.

Figure 5 Surgical obturator insertion immediately after hemimaxillectomy.

After being simulated in the diagnostic model, a surgical obturator was created for the patient. The surgical obturator was made of heat cured acrylic, accompanied by artificial teeth and clasps. All of the abutment teeth were gripped with the half Jackson type (Fig.4). The clasps were placed on 18, 15, 11, and 28. At the time of insertion, the clasp adaptation of each tooth was checked, as well as the position of the obturator base in contact with the tissue (Fig.5).

After the surgical obturator was inserted, immediately after the surgery was completed, the patient was instructed to come for a follow-up the next day. At this first control, the patient showed vital signs within normal limits. General condition improved. Blood pressure was 120/80 mmHg. The patient was able to sit and walk. In addition, the patient was able to drink with the obturator attached to the jaw. Obturator was in a good condition; retention, stabilization, and occlusion were also good (Fig.6). The patient did not complain of any disturbances when using the obturator. The patient was then instructed to use the obturator throughout the day, and to remove it at bedtime at night. The obturator also needs to be cleaned by brushing under running water.

Figure 6 The first follow-up, 24 hours after surgery.

Figure 7 Seven days after insertion.

Figure 8 Three months after insertion.

Control was carried out again on the 7th post-insertion day. The patient's clinical condition was getting better. The patient did not complain of interterference with the use of the obturator. The patient was able to eat and talk well. The obturator was in a good condition (Fig.7), but it was necessary to reduce the buccal flange to adjust the healing of the soft tissue around the defect. The patient was then instructed to keep cleaning his obturator, and to keep using the obturator for the times described in the first control.

Subsequent control was performed 3 months after insertion. On clinical examination, the visible tissue healing is getting better. There was still hyperemia in the palatal mucosa (Fig.8). The patient has become more comfortable in using the obturator for eating and talking activities. However, a buccal flange still compressed the mucosal area. So, the buccal flange was reduced to adjust to the healing mucosal tissue. Patients were still instructed to use their obturator at predetermined times and to clean the obturator as explained in the previous controls. The patient was then referred to oral surgeon for removal of the remaining roots 17 and 16

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in preparation for a definitive obturator.

Subsequent controls were performed 4 months after insertion. At this meeting, the post-extraction sockets 17 and 16 were examined, as well as the surgical healing area that was in contact with the obturator (Fig.9). Then anatomical impression was carried out for the making of an individual impression tray (IIT), border molding and physiological impression were performed (Fig.10).

Figure 9 Anatomical impression, 4 months after surgery.

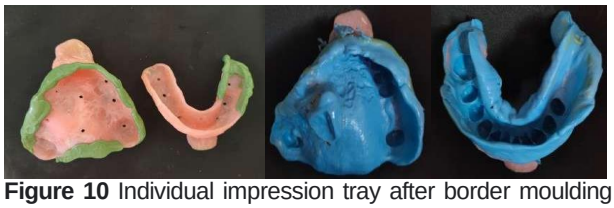

Figure 10 Individual impression tray after border moulding and secondary impression.

Figure 11 Metal frames try-in.

At the next meeting, a metal frame try-in was performed for a definitive obturator in the maxilla and a removable partial denture for the mandible (Figure 11). The obturator used is a hollow bulb type obturator. One week later, a dental try-in was performed, then at the next meeting a definitive obturator was inserted (Figure 12). Then, definitive obturator control was performed 1 week after insertion.

DISCUSSION

Rehabilitative treatment such as obturators in post-maxillary surgery patients is a challenge for dentists. The determination of the choice of its use must be based on clinical examination, as well as further examination such as radiographs.[5] In addition, it is necessary to build a discussion with oral surgeons, in order to achieve the best treatment results. The making of this obturator requires the formation of a boundary between the nasal cavity and the oral cavity. This device must be able to assist in improving oral functions, especially mastication.[6,7] Loss of some tissue can change the function of surrounding structures, such as speech, breathing, swallowing, and aesthetic disturbances.[8]

The obturator used by the patient must close the surgical defect. This is done for the purpose of mastication and to protect the area of the defect that is undergoing healing, so that it can assist in the healing process. Obturators can also be used to reduce postoperative bleeding, as well as to reconstruct the contours of the palatal area of the defect. This prosthesis also improves speech function, aesthetics, swallowing, and the patient's psychological condition, by increasing their self-confidences.

Obturators have various types based on their shape or use. In a case report made by Vivek et al in 2017, an obturator with a thermoplastic material was used. The patient is a 73-year-old woman who recently underwent a maxillectomy due to necrotizing ulcerative gingivitis.[9] In 2019, Uma Maheswari also made an obturator for her 64-year-old male patient. The patient had recently undergone maxillectomy surgery. The obturator made is a hollow antral bulb type.[10] This type is similar to the type of obturator used in this case report. Hollow or empty space formed in the obturator in this type is considered to reduce weight and increase the retention of the obturator.[11]

The choice of the type of obturator can be made based on its stability.[12] Hoshiai uses a movable obturator which consists of a ball attachment on the metal base and a socket on the obturator which acts as a stress reliever. A palatal obturator made of acrylic was made by Eucheol for a patient who recently underwent tumor resection in the area of the nasal cavity involving the hard and soft palate.[13] According to Lee et al,[14] this type of obturator can help shape the underlying soft tissue. In a case report made by Mamoru,[15] a female patient with diagnosis of squamous cell carcinoma of the maxillary sinus can be rehabilitated with a movable obturator. This patient had recently undergone maxillectomy surgery, and the use of this type of obturator was considered to provide good stability.[15] According to Mohit et al, in order to obtain better retention, and to provide ease of evaluation, the use

Figure 12 Definitive obturator insertion.

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of a better obturator was used connected with headgear and face bow as one alternative that can be done.[16]

It is concluded that the use of an obturator can assist patient in swallowing, mastication, and speaking, as well as helping restore aesthetic function.

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Precision attachment with intraradicular post in bilateral free end edentulous

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ABSTRACT
Loss of the molar on both sides can interfere with the important process of mastication and affect the shape of the face, that is greatly interferes mastication process. Therefore, dentures must be replaced immediately. A 63-years-old female complained about her dentures because they feel loose and uncomfortable. The patient lost teeth 16-11, 21-27, 34, 35, 46, and 47. The jaw lost its occlusal support. Loss of the posterior teeth on both sides of the mandible condition; the teeth with a strong grip are the indication to make a removable denture with precision attachments. The treatment is a removable denture with an upper and lower metal frame with a retention ball attachment. First, fiber posts were installed on teeth 45, which have been endodontically treated. Then, teeth 34, 35, 44, and 45 were prepared, and a crown was made with a ball attachment handle as male part on the posterior part of the porcelain fused to metal. It is concluded that the patient is satisfied with her new denture, feels more comfortable chewing, and the appearance was much better than before.
Keywords: edentulous, occlusal stop, precision attachment, intraradicular post

INTRODUCTION

Dentures must distribute occlusion pressure evenly on all mucosa and teeth to reduce movement when the denture is functioning properly, the condition is called cross arch stability. The use of metal frames as major and minor connectors can minimize the movement of the denture because of its rigid nature so as to create cross arch stability.[1] Precision attachment is a special type of direct retainer used in the manufacture of removable partial dentures (RPD).[2]

The advantages of precision attachment partial dentures over conventional metal frame RPD are aesthetic because they do not have wire retention components and are not susceptible to caries.[1] Precision attachments provide better vertical support, better tissue stimulation and lower stress distribution to abutments than conventional denture.[3] This paper is aimed to describe a case of bilateral free end edentulous that is rehabilitated with precision attachment and intraradicular post.

CASE

A 63-years-old female came to Department of Prosthodontic *Universitas Gadjah Mada* complained about her denture were no longer comfortable to use and felt painful when she used to eat, the lower jaw had many missing teeth so that the patient has difficulty chewing food. Case history revealed that she uses the denture for 2 years and now some of other teeth is missing so the old denture is not retentive anymore (Fig.1).

The right second premolar has been performed root canal treatment before. So, a fiber post must be attached to the tooth to increase retention and strength to the tooth (Fig.2). Then, teeth 34,35,44, 45 were crown-preparation for precision attachment (Fig.3).

MANAGEMENT

Double impression technique was made with light body of polyvinyl siloxane. The models were sent to the dental laboratory to make metal coping for teeth 34, 35, 45, and 46.

Figure 1 Profile of the patient.

Figure 2 intra oral.

Figure 3 Crown preparation

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Fig 4. Dental impression, **Figure 5** Work model impression

Next step is try in the precision attachment, the metal frame for the upper and lower jaw and check the inclination of the anterior teeth.
Because the pasient lost all of the anterior teeht, we have to measure the porportion of the teeth and the face with MMR (mandibula maxila relationship) first. This step is important because patient feel that the older denture inclination is incorrect and make her difficult to close the lips.
Try in metal coping into the teeth and check the retention was done to evaluate the retention, stabilization and occlusion as well as space between of metal coping and antagonist teeth. The second impression is carried out with the metal coping placed in the teeth. And then send it back to laboratorium for make a metal frame denture.

Figure 6 Try in metal coping and MMR

Figure 7 Try in presicion attachment denture

Check the retention, stabilisation, occlusion, aesthetics of the teeth and phonetics. Retention, the denture does not come off when installed. Stabilization, the denture remains stable when functional movements are carried out. Occlusion, the overall arrangement of the teeth must be harmonious during occlusion. Aesthetics, the color of porcelain fused to metal teeth have same color withn the remain teeth. Phonetics, pronounce the letters p, b, t, s, d, f, V clearly and without interference.
After that, we cemented the precision attachment denture to the abutment teeth with luting cement (GIC type 1). Then educate the patient about her denture such as :
How to use and to how to remove denture
How to maintain dentures. There are two ways. Mechanical way: gently brushed under running water and Chemical method: with denture cleanser.
Remove the dentures at bedtime and cleaning them before they are stored in a clean place (no need to soak in water when storing).

DISCUSSION

In this case, the Direct retainer used is a precision attachment in 34,35,44,45 teeth. The type of precision is an extracoral type because it can avoid excessive tooth preparation.
The type of hook that we use in this case is a ball-type extracoronal. The type of attachment requires consideration of several basic principles, such as crown-root ratio, the type of coping, the available vertical space, the number of abutments, the amount of bone support available, the location of abutment teeth, the cost and long-term care.[4] The RPD with an extraoronal ball link can be done without having to reduce many teeth so as to reduce the possibility of teeth becoming non-vital. Otherwise, it can provide good retention and aesthetics.[5-7]
It is concluded that precision attachment RPD can be used to improve retention, stabilization and aesthetics. This type of denture can also be used in some conditions where there are non-parallel abutment teeth and bilateral free end case.

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Precision attachments for partial edentulous rehabilitation

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ABSTRACT
A 48-year-old female patient was referred to the Department of Prosthodontic, Hasanuddin University Dental Hospital, Makassar with complaints of difficulty chewing food due to partial tooth loss. The patient had used a denture on the lower jaw but it was loose so she wanted to make a denture on both jaws without using wires so as not to disturb the aesthetics. Intra-oral examination, the upper jaw was left with nine teeth with gingival recession and the lower jaw was totally edentulous. A hybrid denture that could support the patient's aesthetics and a conventional complete denture in the lower jaw were fabricated. Initially, a preliminary mold and study model were made, then temporary vertical dimensions were determined followed by recording the relationship of the maxilla and mandible using the two dots method, and mounted on an articulator. Preprosthetic treatment included scaling, endodontic treatment. Preparation of teeth 13, 14, 24, and 25 for porcelain-fused to metal. It is concluded that precision attachment in dentistry is the functional mechanical part of a removable partial denture. The use of precision-attached dentures has simplified and strengthened the retention, function and aesthetic aspects when compared to conventional removable partial dentures.
Keywords: maxillary partial denture, extracoronal precision attachment, patient comfort

INTRODUCTION

Free-end removable partial denture is a common case. Rehabilitation of such cases is a challenge because they are contraindicated for fixed dentures. The fabrication of a RPD requires a retainer, which is a clasp for immediate retention. The presence of a clasp may not meet aesthetic requirements, especially if it is located in the anterior region.[1,2]

Precision attachments are sometimes referred to as the link between fixed and RPD because they combine features that are common to both types of construction. Attachments are defined as *mechanical devices for fixation, retention, and stabilization of prostheses*. Precision attachments are two pre-fabricated metal components made to form an articulated joint. The first component or matrix is a metal rest-sit or keyway, which is positioned within the normal clinical contour of the cast restoration placed on the attachment or the second componente the patrix, which is attached to the RPD.[3]

Due to their versatility, precision attachments have many advantages. Despite this, these attachments were generally neglected in the past, due to their high cost and lack of understanding of their application. As society has become more aware over the past decade, a dental surgeon who is familiar with precision attachments will be able to expand his or her treatment options.[4]

A precision attachment appliance in a hybrid denture has a similar basis to a clasp, with the components of occlusal rest, bracing arm, and retentive arm, which are small interlocking devices to connect the denture to the abutment teeth providing retention, stability, comfort, and improved aesthetics, as well as the biomechanical benefit of having the ability to distribute load on the abutment teeth to maintain healthy periodontal tissue.[5]

Hybrid prostheses may be indicated when the denture is still unable to replace all damaged tissue so as to restore the patient's aesthetics. A hybrid prosthesis is a denture that has fixed parts and some removable parts using precision hook retention. The advantages of using a hybrid prosthesis can be made limited to the space of the denture, there is no need for a hook arm on the labial or buccal part of the tooth, it can last a long time with good oral hygiene.[6]

Indications for hybrid prostheses with precision hooks, including aesthetics, pressure redistribution, minimization of trauma to soft tissues, control of chewing load and rotational forces, misaligned abutment teeth, future treatment efforts, retention.[6] Contraindications for hybrid prostheses with precision hooks are clinical short crowns. Teeth have high enough crowns because precision hooked components can effectively compensate for the leverage exerted on the crown.[7]

This article discusses the fabrication of a precision hooked metal framework or hybrid denture.

CASE

A 48-year-old female patient was referred to the Department of Prosthodontics, Hasanuddin University Dental Hospital, Makassar with complaints of having difficulty chewing food due to partial loss of

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teeth in the upper jaw and all teeth in the lower jaw. The patient had used a denture on the lower jaw but the denture felt loose. The patient wanted to have dentures made on both jaws without using wires so as not to disturb the aesthetics (Fig.1).

Extraoral examination showed no loss of facial height. Temporomandibular joint movement was normal. Intra-oral examination showed a partially edentulous upper jaw where there were nine remaining teeth with gingival recession and a totally edentulous lower jaw (Fig.2).

The treatment plan was a partial denture with an attached metal framework or hybrid denture that could support the patient's aesthetic and a conventional complete denture on the mandible.

Figure 1. Patient's profil

Figure 2 Intra oral photography

MANAGEMENT

After the examination, a preliminary cast of the maxilla and mandible was made with irreversible hydrocolloid; then cast with dental stone to obtain a plaster model. Determination of the tentative vertical dimension followed by a record of the maxillomandibular relationship was then mounted on an articulator.

Preprosthetic treatment was performed including periodontal treatment namely scaling in upper jaw, endodontic treatment of teeth 13, 14, 24, and 25. Then, preparation of those teeth for the manufacture of PFM split crowns. Impression of abutments was performed using a two-step technique with polyvinyl siloxane (PVS) and the mold is poured with dental stone and processed in the laboratory. Next, try on metal and female coping, molding and tooth color selection (Fig.3). Try-in split crown and metal frame (Fig.4).

Individual tray was made for the lower jaw, border molding was performed, and secondary molding was performed using polyvinyl siloxane.

Figure 3 Try-in copping metal and the female

Figure 4 Try-in split crown and metal frame

Beading and boxing were performed to make casts that had been secondary molded and processed in the laboratory. The two-point method was used to determine the maxillomandibular relation and vertical dimension measurements. Arrangement of artificial teeth and try-in in the mouth, followed by acrylic packing and finishing, followed by denture insertion (Fig.5).

The first control was carried out on 24 hours post insertion. The second control was carried out three days after the first control (Fig.6).

Figure 5 Insertion the denture

Figure 14 Follow up stage

DISCUSSION

Tooth loss is a serious problem often cause problems with mastication, phonetics and aesthetic. Use of RPD to replace missing teeth is often lacking satisfy the patient from the functional and esthetics.[1,2,5] In the case of free-ended dentures, which the manufacture of fixed dentures is contraindications, another option is to combine types of RPD in combine with precision attachment.[8]

In general, a precision link can be classified as intracoronal or extracoronal attachment. The intracoronal attachment is hooks that lie within the contour of the crown of the tooth, while the extracoro-

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nal type can be all or part of the hook that is outside the crown. The reason for using extracoronal type is good dental crown too small to accommodate all attachment parts or tooth pulp is too large so that it can be disturbed by the connection that all lies in the crown.[9]

According to Preiskel, precision relationships are classified into four main groups, namely 1) relation intracoronal. This type of link is usually used to connect the units of the denture fixed, holding restoration with removable denture free-tipped with distal extension; 2) hook extracoronal. This attachment provides stability and retention for RPD with extension distal.[5] Different types of extracoronal hooks (extracoronal attachments), including Conex attachment, Scott attachment, Dalbo extra coronal attachments, and the checka attachment system.[10]

Differences in extracoronal precision attachment only lies in the material and size and the position of the arm for retention; 3) stud hook. This type of hook is usually in the forms of a ball and socket, mainly used to provide overdenture stabilization and denture retention. One advantage of the stud hook is that it makes it easy oral cleansing and maintaining crown root ratio; and 4) hook bar. Originally used for splinting a group of teeth, but when it is often used for retention and stabilization overdenture.[10]

It is concluded that precision attachments are difficult to master in terms of technical ability. In order to treat a case of precision attachment, a complete understanding of the biomechanics of maxillomandibular function, different attachments, and material science expertise is required. Precision attachments successfully serve the functions of retention, stress distribution, and esthetics if the case is planned on strong biological and technical grounds, and the dentist and patient provide sufficient care during the maintenance phase.

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A customized sinistra ocular prosthesis for a geriatric patient

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ABSTRACT
Geriatric patients have limitations such as lack of communication, finance, and limited visit time. Therefore, fabricated ocular prosthesis is preferred. On the other hand, fabricated ocular prosthesis have disadvantage of not being able to fit completely in the eye socket. To overcome this problem, the patients need an appropriate prosthesis to increase their quality of life. A 75-year-old male patient, came to RSGM UGM Prof. Soedomo, using fabricated ocular prosthesis, complained that his ocular prosthesis loose and there was discoloration. Clinical examination, there were no abnormalities in the eye socket. The treatment plan was making customized ocular prosthesis using acrylic resin. The treatment procedure comprises impressing the eye by using individual tray; making the model of wax sclera followed by trying on the wax sclera pattern to the patient eye socket and continuing the acrylic resin process of sclera followed by trying to the eye socket, and then determining the location and iris diameter to draw the iris and pupil. The final process is by inserting the ocular prosthesis to the patient eye socket. One week after insertion, the patient felt comfortable and had no complaints. Ocular prosthesis helps to improve the patient's quality of life.
Keywords: customized ocular prosthesis, rehabilitation, geriatric

INTRODUCTION

The eyes are very important organs for seeing and facial expressions.[1] The eye consists of several parts, such as the sclera, pupil, iris, limbus, collarate, and eye muscles[2]. The loss of eyeballs may lead to problems in function, psychology, and aesthetics. Loss or absence of the eyeballs can be caused by a congenital abnormality or trauma that requires surgical intervention.[3] Replacement of the missing eyeballs may be necessary to improve physical and psychological healing for the patient and to increase social acceptance.[1]

Rehabilitation due to loss of an eyeball can be divided into two types, namely orbital implants and ocular prosthesis.[2] Ocular prosthesis was divided into two categories, namely fabricated and customized ocular prosthesis. The advantage of fabricated ocular prosthesis is that they are minimally manufactured because they do not require any manufacturing steps in the laboratory.[2] Fabricated eye prosthesis come in three sizes and three iris colours. The disadvantage of this eye prosthesis is discomfort and infection due to the difference in size between the eyeball and its socket, which results in a water sac that becomes a breeding ground for bacteria. Other disadvantage is that the mismatched iris colour causes aesthetic problems.[2]

The purpose of this article is to describe the rehabilitation treatment with a customized ocular prosthesis.

CASE

A 75-year-old male patient came to RSGM UGM Prof. Soedomo using a fabricated ocular prosthesis. The patient's history was a traffic accident 30 years ago. The patient had to undergo enucleation surgery. The patient complained that his prosthesis was loose and had become discoloured.

On objective examination, the eye socket was normal, there was no irritation, and there was no infection. The eyelid muscles were still in good condition, so the patient could open and close the eyelid. The eye socket was deep enough to allow for retention of the eye prosthesis (Fig.1A). The first visit was for anamnesis, objective examination, and to take a photo of the patient's profile. The diagnosis was of loss of the left bulbus oculi due to trauma. The treatment plan was to make a customized ocular prosthesis with acrylic resin.

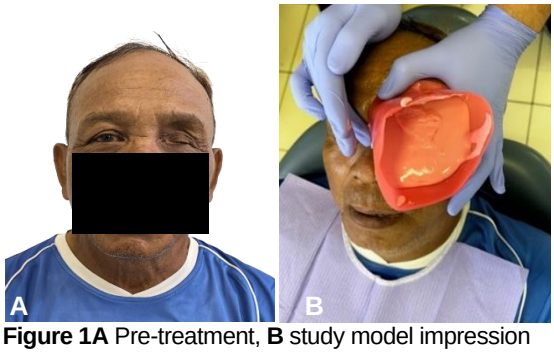

Figure 1A Pre-treatment, **B** study model impression

MANAGEMENT

For individual tray fabrication, the patient was asked to close his eyes. Afterwards an irreversible hydrocolloid impression material was poured around the eye (Fig.1B). Then the cast was filled with dental stones (Fig.2A). The hardened stone was used as a working model to make individual trays using a self-curing acrylic resin.

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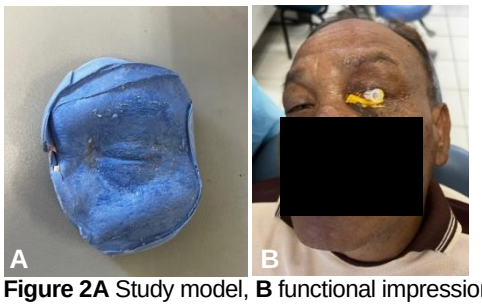

Figure 2A Study model, **B** functional impression

The impression procedure

A light body polyvinyl siloxane impression material was injected into the eye socket, to which an individual tray was attached. The patient was instructed to move his eye to the right and then to the left, then up and down, and finally, in a circular motion to obtain a functional impression of the defect (Fig.2B). After the material was set, the impression was removed from the socket and it was examined for completeness or any voids (Fig.3A). Boxing of the impression was done, and was poured in three parts to get a split cast by using type III dental stone (Fig.3B).

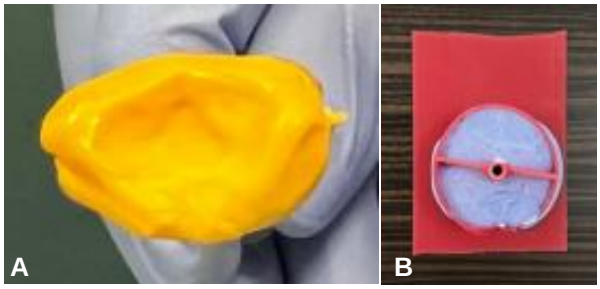

Figure 3A Functional impression, B work model

The wax sclera try-in

A wax pattern was fabricated by allowing molten modelling wax to flow into the mold (Fig.4A). Afterwards, the wax pattern was tried in the patient's eye socket, and the patient was asked to move his eye to the left and right to check for comfort, stability, and retention (Fig.4B). Furthermore, the sclera colour was recorded using photography of the patient's real eye. The smoothed sclera wax pattern and sclera colour notes were sent to the laboratory for packing.

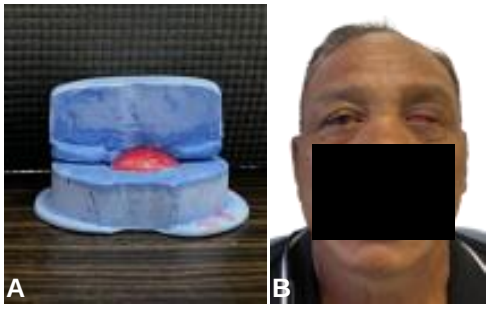

Figure 4A Wax pattern sclera, B wax sclera try-in

The acrylic sclera try-in and determine position of the iris

The patient was instructed to look straight and keep all their facial muscles relaxed. The acrylic sclera was tried in the patient's eye socket, and the patient was asked to move his eye to the left and right to check for comfort, stability, and retention. Afterwards, the iris and the pupil were designed based on the other eye using a pencil. The iris diameters usually range from 10 mm, 10.5 mm, 11 mm, 11.5 mm, and 12 mm.[2] The iris diameter was designed by direct measurement using a sliding caliper (Fig.5A). Then the acrylic sclera was sent to the laboratory for iris colouring.

Figure 5A Acrylic sclera try-in, **B** insertion

Insertion

The prosthesis was inserted into the eye socket, and it was evaluated for aesthetics and patient comfort. The patient was educated to insert and remove the prosthesis (Fig.5B).

DISCUSSION

Ocular defects constitute an important maxillofacial deficiency which requires prosthetic replacement.[3] A few methods have been used, such as stock ocular prosthesis, modifying stock ocular prosthesis, and customized ocular prosthesis.[4]

A stock ocular prosthesis has disadvantages such as a cavity gap, which can lead to an accumulation of tears and mucous secretion, creating heaviness in the cavity and resulting in the dislodgement of the prosthesis from the cavity. Moreover, the aesthetics are also compromised, as the shades of the sclera and the iris do not exactly match those of the contralateral eye.[4] Whereas the customized ocular prosthesis has advantage in resemblance of size and colour of the contralateral eye. This can help to maintain pressure balance around the eye socket, thus reduce the incidence of the conjunctival abrasion and ulceration. The customized ocular prosthesis provides more aesthetic results because the iris and the sclera are custom fabricated and painted.

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The iris painting is one of the important steps in the fabrication of a custom-made ocular prosthesis. This technique is complex, it increases the treatment time, and it requires artistic skills, which are necessary in the iris painting. Moreover, the age, systemic conditions and financial constraints may limit their use.

It is concluded that the key of effectively rehabilitating geriatric patients with ocular defects is giving professional treatment with attentive and sensitive care. The use of customized ocular prosthethesis can provide a good aesthetic result in the rehabilitation of geriatric patients. Additionally, it can help them reintegrate into society by enhancing their psychological well-being.

In addition to helping a minimal intervention geriatric strategy in the rehabilitation of geriatric patients, the adoption of a customized stock ocular prosthesis can provide an acceptable aesthetic outcome.

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Use of finite element analysis in pain perception on flat ridges with various occlusal schemes in complete dentures

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ABSTRACT
Edentulism is an oral health problem that affects the quality of life because of the loss of equilibrium in the stomatognathic system with impaired mastication. This problem can be more deteriorating in the condition of flat ridges, which increases the stress distribution in the mucosa under masticatory load. Stress distributions that exceed the pressure-pain threshold will result in poor masticatory performance, making it critical to choose the ideal occlusal scheme for such ridge conditions. However, the measurement of stress distribution in the mucosa with various occlusal schemes is challenging for *in vivo* and *in vitro* testing because of the inability to represent the complex stomatognathic system. *In silico* testing using finite element analysis (FEA) can be the solution since the modeling simulation is acquired from CT-scan or digital designs and feasible experimental treatments. This paper discusses the use of FEA in the measurement of stress distribution in the mucosa, particularly the flat ridges to different occlusal schemes in complete dentures, and its association with pain. It is concluded that advantages of FEA in obtaining accurate modeling and testing flexibility allow the measurement of stress distribution and its association with pain on flat ridges with different occlusal schemes in complete dentures.
Keywords: edentulism, flat ridge, pressure-pain threshold, stress distribution, finite element analysis

INTRODUCTION

Edentulism is an edentulous state without natural teeth,[1,2] which if it occurs as a whole it will be called as full edentulism, the condition without any natural teeth.[2] Edentulism is seen as an irreversible condition and as a final condition of the course of oral health disease, which shows changes in physical and health conditions ranging from biomechanical, phonetic, to aesthetic appearance disorders that affect quality of life.[2,3]

Edentulism is considered as one of the most severe oral cavity problems, especially for the elderly, which impacts quality of life and makes this condition part of a public health problem and affects primary health services.[4–7] The Basic Health Research or Riskesdas in 2018 published by the Ministry of Health of the Republic of Indonesia shows that the proportion of patients who lose their teeth and become edentulous increases with age.[5] Although in developed countries the number of edentulous sufferers is decreasing every year, the opposite is happening in developing countries.[2,8] This is because socioeconomic factors, educational background, and government policies cause most patients to feel that tooth extraction and denture insertion is a more favorable treatment option when compared to the treatments to salvage the tooth that are more complicated and higher costs.[3,8–11]

Complete denture treatment not only serves to replace the missing tooth, but also includes the supporting tissues that were lost when the tooth was extracted, in order to restore the harmonious function of the stomatognathic system. The impact of tooth loss in terms of biomechanical aspects has its own problems because the loss of supporting tissue in the form of the periodontal ligament has an impact on changes in sensory and mechanical functions that cannot be replaced by the edentulous ridge.[3] These differences will affect the patient's ability to use dentures because of the need for adaptation to mastication.[3]

The edentulous ridges that serve as support for the denture base have a much smaller surface area than the periodontal ligament in healthy teeth, moreover, the tolerance threshold and adaptation of the mucosa to accept masticatory loads are not as good as that of the periodontal ligament.[3] Additionally, the movement of the denture during functional or parafunctional movements, can cause pain or even the residual ridge to receive a load that can be destructive.[3] This condition causes the patient to limit the masticatory load by choosing foods that do not require too much mastication effort so as not to exceed the tolerance of the mucosa under the denture.[3]

This will be worsen if the area of the edentulous mucosa gets smaller due to continuous resorption, as is the case with flat ridges.[12] This smaller area of the edentulous mucosa will be even more significantly different compared to the area of the periodontal ligament in completely dentate patients, and as the result, the masticatory load in flat ridge patients will be distributed over a much smaller area.[3] This matter can cause pain as a form of mu-

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cosal response when receiving excessive pressure,[13] which can be managed by reducing the load that will be received by the ridge and reducing resistance during movement.[14] One way to achieve that is by choosing a particular occlusion scheme such as lingualized or monoplane, although there are concerns that these occlusion schemes also affect the esthetics and the masticatory performance.[14]

Given that the goal of prosthodontic treatment is not only to focus on replacing the lost structure, the denture must also be able to chew foods.[15] The patient's ability to chew can be expressed in an assessment of masticatory performance, which is measured conventionally using the sieving technique,[15,16] color-changeable chewing gum,[17] or odor intensity test.[18] However, the assessments focused on how effective the patient's ability to chew without any further assessment of why some types of food could not be crushed properly, which could be because the patient was trying to limit mastication idue to exceeding the mucosal pain threshold.[3]

Assessment of the biomechanical response of the mucosa when the denture functions result in a complex structural response, so to be able to study how the biomechanical behavior occurs, a complex stomatognathic system simulation is also needed.[19] The rapid development of digital technology allows for alternative tests other than *in vivo* and *in vitro*, simulation modeling can be carried out accurately and complex biomechanical behavior can be carried out repeatedly without any destructive process, in the form of *in silico* testing, by finite element analysis (FEA).[19–21] The use of the FEA test, especially in dentistry related to the biomechanical response of the mucosa in dentures, has been widely used since 2000, and is growing rapidly.[22]

This paper aims to discuss the use of FEA in measuring the stress distribution in the mucosa, especially the flat ridges associated with pain in complete dentures with various occlusal schemes.

LITERATURE STUDIES

Stomatognathic system

The stomatognathic system or masticatory system is a combination of joint and oral structures that are involved and work together in carrying out the functions of speech, mastication, and swallowing.[1] Speech or phonetic function in edentulous patients will affect the patient's ability to communicate which ultimately plays a role in limitations in socializing and low self-confidence.[6,7,11,23]

Swallowing function is also impaired in edentulous patients where the swallowing process is carried out by moving the tongue forward between the maxillary and mandibular ridges to create a closed space. The time required for swallowing increases in edentulous patients or in patients with unstable dentures, and this increases the risk of aspiration into the laryngeal cavity.[24,25]

In terms of mastication, the edentulous state causes the digestive process that occurs in the mouth to be disturbed, which results in the improper absorption of nutrients.[7,23,26] The edentulous patients often prefer soft foods, they usually avoid vegetables or fruits that tend to be harder, which also plays a role in increasing the risk of obesity, digestive disorders, risk of heart disease, and diabetes.[23,26]

Masticatory components

Masticatory components consist of teeth and their supporting structures, temporomandibular joints (TMJ), muscles of mastication, innervation, tongue, cheeks, and lips.[1] The masticatory function of edentulous patients is disrupted due to the missing masticatory components, which is trying to be replaced by making dentures. When a tooth is extracted, the tooth and some of its supporting structures are lost (periodontal ligament and resorption of alveolar bone), so the denture will gain support from the underlying mucosa and residual alveolar bone.[3]

Biomechanical of residual ridge support

The periodontal ligament in fully dentate patients serves as support and positional adjustment for the teeth and is also responsible for sensory perception under load, which cooperates with receptors from other components of mastication to regulate mandibular movement.[3] Loss of the periodontal ligament makes a difference in support in fully dentate patients and fully edentulous patients, which will depend on mucosal support.[3]

Mucosal elasticity causes denture instability during functional and parafunctional movements, with mastication and swallowing being the most common activities that tend to occur in a vertical direction.[3] However, movement in the lateral or oblique direction has the most damaging effect because it causes displacement of the denture so that the masticatory load is distributed unevenly over the entire supporting tissue, with the area receiving greater stress than the other areas.[3,27]

Large loads that occur continuously can cause damage to the mucosa and underlying alveolar bone, so denture base needs to be made as wide as possible and in close contact with the mucosa so that the masticatory load is distributed evenly.[3]

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Flat ridges

The support of the edentulous ridge will decrease when it gets smaller due to the resorption process that occurs progressively.[12] After one year of tooth extraction, the height of the ridge decreased by 2-3 mm in the maxilla while in the mandible there was a reduction of up to 4-5 mm.[12] However, this bone remodeling process will continue but to a lesser extent, in the mandible the reduction is about 0.1-0.2 mm per year, whereas in the maxilla it is four times less.[12] A number of studies also show that increasing age has a negative correlation with the height of the alveolar ridge.[10,28,29] this is thought to be due to the greater level of bone resorption so that it cannot be balanced by the level of bone formation.[30,31]

The consequences of ridge resorption that occur in fully edentulous patients result in reduced depth and width of the vestibule and sulcus, muscle attachment closer to the crest of the ridge, loss of vertical dimension, reduced lower facial proportions, anterior rotation of the mandible, and visual appearance to prognathic looking profile.[10,12] This condition will lead to a decrease in the area of the ridge, based on the Cawood and Howell classification regarding changes in the shape of the ridge in edentulous patients, the flat ridge condition is included in classification V with inadequate height and width of the edentulous ridge to support the prosthesis.[32]

The area of the edentulous mucosa in the maxilla ranges 42.12-46.54 cm^2 on average and 23.34-28.43 cm^2 in the mandible,[33] but due to continuous resorption, this area can be reduced to 22.96 cm^2 in the maxilla and 12.25 cm^2 in the mandible.[3] When compared to the area of the periodontal ligament in complete dentition, which is 45 cm^2 in each jaw, hence the masticatory load in completely edentulous patients will be distributed over a much smaller area.[3]

Mucosal response

The oral mucosa has sufficient physiological and mechanical capacity to not deform under stress,[34] this is because of epithelium and underlying collagen fibers.[35,36] However, when subjected to excessive pressure, injuries can occur to both soft and hard tissues, pain or discomfort, and even further bone resorption, which will affect masticatory performance when wearing dentures.[13,31,37–40]

The pressure-pain threshold (PPT) is the maximum pressure that the mucosa can accept before feeling pain.[41] This value is higher from anterior to posterior with PPT in maxillary edentulous higher than in mandible.[42] The reduced area of the edentulous mucosa will cause the masticatory load to be distributed to a smaller area and decrease the PPT value, as the result, pain will appear more easily when receiving pressure.

Occlusal schemes

The reduced area of the denture support mucosa on the flat ridge requires management by reducing the load that will be received by the ridge and reducing the resistance during movement in order to prevent pain from occurring.[14] One of the efforts that can be done is to arrange the artificial teeth in certain occlusal schemes other than bilateral balanced occlusion, in example lingualized or monoplane occlusion.[14,43]

The bilateral balanced occlusion uses anatomical elements to provide a more natural appearance and good masticatory efficiency. The lingualized occlusion uses anatomical elements in the maxilla and non-anatomical elements in the mandible so that the appearance still looks natural in the premolar area. The monoplane occlusion uses non-anatomical elements as a whole so that lateral movement reduces stress on the mucosa.[14]

The difference in shape of these elements helps in reducing the load that will be transmitted to the ridge and also minimizes resistance during movement, but the impact is reduced masticatory efficiency, less aesthetic appearance, and modifications to the elements that need to be made.[14,44,45] This will be more clearly seen if the chosen occlusal scheme is a monoplane with all non-anatomical elements.

Masticatory performance

Efforts were made from obtaining the widest possible base, close adapting dentures with mucosa, to selecting an occlusal scheme as prosthodontic efforts to obtain dentures that restore the balance of the stomatognathic system. The denture produced is intended to function in mastication, and this can be assessed by testing masticatory performance.[15] Masticatory performance is carried out to measure how small food particles are produced using standardized test conditions.[1]

The conventional technique that is often used is the comminution method which uses the test food which is crushed by mastication, and the resulting particles are then filtered using a sieving technique,[15] or the use of fuchsine beads and spectrophotometry, or silicone cubes with multiple sieves.[16] In addition, there is also a mixing ability method that uses a special test food in the form of chewing gum with two colors, the patient is asked to chew and ob-

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serve the color change in the gum,[17] or with an aroma sensor that uses chewing gum with a special aroma that will be measured after the completion of mastication using an odor sensor.[18]

Finite element analysis (FEA)

The FEA is a numerical method to get a solution to a problem accurately with modelling simulations for later analysis.[20,21] This method was originally developed and used in engineering to be a solution to complex physics and engineering problems, due to a series of very complicated steps. The development of FEA allows modelling construction to be carried out quickly and effectively, thus playing an important role in the engineering field.[22]

The use of FEA in the medical field has become a testing tool that has developed significantly, especially the use of biomechanical analysis on living things, because it is non-invasive and easy to repeat without the need for duplication.[46] Furthermore, the modelling and treatment can be freely defined as desired, various elements can also be combined, the test process is run in one program, and the resulting model also has identical conditions to the original.[20]

Developments in the field of radiography such as CT and MRI have made FEA popular in dentistry, because it can accurately model bone geometry, in terms of quality, quantity, and shape.[46,47] The use of FEA in dentistry, for example the assessment in implants.[47-49] obturator,[50] restoration,[51] periodontal ligament,[52,53] and trauma and fracture.[54,55]

DISCUSSION

Resorption that occurs at the edentulous ridge is a consequence of tooth extraction and long-term use of dentures.[31,56] A systematic review conducted by Pham *et al*[56] in a number of studies that measured the rate of resorption in the posterior mandible of patients wearing complete dentures, it was found that the average resorption in the posterior mandible ranged 0.01-2.4 mm per year. This figure has a very large variation and is different from that stated by Laing and Zarb[12] stated that this resorption ranged 0.1-0.2 mm per year. This difference is thought to be due to the factor of occlusal scheme used, of which only seven studies used the bilateral balanced occlusion.

A study by Alsaggaf and Fenlon[40] even found that patients who wore dentures for more than 5 years experienced significant ridge resorption when compared to the group that did not use dentures. This is contrary to what is stated in Wolf's Law, that the edentulous crest will atrophy if it is not used.[57] The author believes that there are other factors that play a role so that resorption in denture wearers is more significant, one of which is the possibility that the load distributed by the denture is uneven so that it exceeds the tolerance threshold of the underlying mucosa.

The mandibular rim gets its blood supply from the periosteal plexus vessels which are susceptible to disruption when exposed to pressure, which can trigger pain and discomfort. If this pressure continues, inflammatory cells will be involved which causes a hydrostatic pressure that exceeds the capillary pressure. Additionally, the supply of nutrients will be inhibited and result in further progressive resorption.[34]

The same thing was also expressed by Joanne *et al*[36] in their experimental study, that when receiving pressure, the connective tissue under the epithelium will experience changes first with collagen sloughing, which has an impact on reducing tissue resilience and lowering the PPT value.

Kondo *et al*[31] and Tanaka *et al,*[58] in their study of the biomechanical response of the mucosa under dentures, concluded that pain can occur when the mucosa under the denture receives an unbalanced load that exceeds the mucosal threshold, which if it continues will be followed by a resorption process.

The concept of occlusion is still an interesting discussion regarding prosthodontic efforts to produce stable dentures. Bhambhani *et al*[59] in their systematic review stated that in the BBO, the deflective contact of the anatomical elements can cause the denture to become unstable. The same thing was also stated in a randomized clinical trial study conducted by Shirani *et al,*[60] patients with BBO dentures tend to avoid some foods that cause discomfort due to frequent denture instability, although in the assessment of mastication efficiency there was no difference compared to other occlusal schemes.

The selection of the lingualized occlusion is also a consideration, especially in inadequate ridge conditions such as flat ridge, with consideration of reducing interferences during lateral movement with a better aesthetic appearance than the monoplane occlusion which is said to be an occlusal scheme that does not provide special benefits.[45,59] Although according to an in vitro study conducted by Madalli *et al,*[61] monoplane occlusion shows the smallest pressure distribution when compared to other occlusal schemes.

A randomized clinical trial study by Sutton *et al*[62] concluded that the lingualized occlusion was significantly superior in reducing mucosal pain when compared to the monoplane occlusion, whereas

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when compared with the BBO, the results were not significantly different.

Studies related to the comparison of various occlusal schemes in denture wearers in several studies,[45,60,62] were carried out based on mastication efficiency or masticatory performance which were assessed subjectively by patients when using dentures and without using standardized test foods. In addition, the patient's inability to destroy food due to the patient's low resistance,[17] this can be expected due to the load being received that exceeds the mucosal tolerance threshold, which cannot be detected by assessing the masticatory performance. Other studies conducted by *in vitro,*[61,63,64] were carried out directly on dentures, but the modeling of the edentulous ridges could not represent the complex original condition, so it was not adequate to study the stress distribution in the oral cavity structure.

In addition to *in vivo* and *in vitro*, assessment of dentures and how the biomechanical response of the underlying mucosa *in silico* using FEA has been carried out since 2000.[27,65–71] The simulation modeling can be obtained from scanning or digital designing (

Figure 1) then the testing will be run in a specific program such as ANSYS. The results and measurements can be observed in the form of stress distribution on the edentulous mucosa under the denture which shown in distinctive colors (

Figure 2).

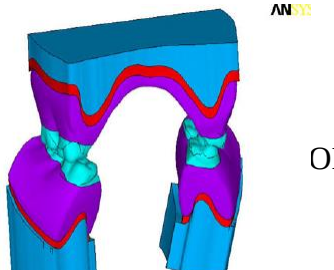

Figure 1 Simulation modeling.[66]

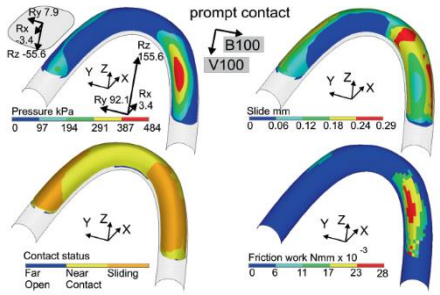

Figure 2 Stress distribution observation.[27]

Takayama *et al*[65] conducted a FEA study on mandibular dentures using anatomical factors with a load of 1 kgf (9.8 N) directed at the anterior, posterior, and balancing facets to observe the displacement of the denture. Displacement was observed to be greatest with the load directed at the balancing facet, indicating that there was premature contact occurring on the non-working side. Disadvantages in this study were the modeling was carried out by simplification of the digitally designed for both the denture and the gingival mucosa, and the given load did not represent the average masticatory load of denture wearers (50-100 N).[71,72]

Chowdhary et al[73] assessed the pattern of stress distribution with FEA on the mucosa under the denture base using 33º, 20º, and 0º factors. The cross section of the denture is made in graphic form and normal bone contours are obtained from CT results, with a load of 50 N. The result is that the 33º factor shows the greatest stress, followed by 20º and 0º. The drawback in this study is the use of 2D FEA testing so that the resulting stress distribution is only assessed at a certain point which does not necessarily receive the greatest load when functioning.

Barão *et al* [67] compared the stress distribution with FEA in the use of conventional dentures with implant-supported overdentures with various types of attachments with a load applied of 100 N to the incisal surfaces. As a result, the implant-supported overdenture received a greater load than conventional dentures. The drawback of this study is that the modeling design was made with simplification of the design and only focused on the anterior area.

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Sadr et al[68] compared the stress distribution with FEA on mandibular denture with flat ridge with and without soft-liner with a load of 50-80 N. The results showed that the use of soft-liner showed an increase in stress of 18.5-30% compared to that without soft-liner. The idea of adding soft-liner on the intaglio surface of the denture apparently did not provide cushioning effect as expected to reduce the stress received by the underlying mucosa.

Mankani *et al* [66] compared how the shape of the posterior elements with inclinations of 0º, 20º, and 33º produced different stress distributions in the tissues under complete dentures when subjected to a masticatory load of 100N in the vertical direction. The results show that the inclination of 20º and 33º produces a higher stress distribution value than 0º, while between 20º and 33º there is no significant difference. This is estimated because different inclinations will cause changes in the direcrection of the load and the greater the inclination, the wider the contact area with the antagonist will decrease. However, this study does not include the oblique load direction variable as a representation of lateral movement, even though this movement is the most susceptible to causing disturbances to denture retention and stabilization.

Żmudzki et al[71] conducted a FEA study on the stress distribution of dentures with knife edges with a load of 100 N applied in the vertical and oblique directions. The results obtained show that the load distribution when receiving a vertical load reaches 252 kPa with a slight shift, but when receiving an oblique load this figure reaches up to 3 MPa with a shift of 1 mm. The authors compared these results with the assumption of an average PPT of 630 kPa (300-1500 kPa), thus exceeding the pain threshold fivefold, and suggested reducing the occlusal load to 30 N alone, which is insufficient for chewing food with a large size. The drawback in this study is no further information regarding relief on knife edge alveolar ridge, which is commonly made before fabricating the denture base.

Żmudzki et al[27] conducted a FEA study on stress distribution in mandibular dentures with convex ridges with a load of 100 N in the vertical and oblique directions with direct contact and delayed contact on the non-working side. As a result, the direction of the oblique load provides greater stress distribution and greater displacement, especially on the nonworking side with delayed contact. Disadvantages of this study are the delayed contact on the non-working side usually occur on unbalanced occlusion, which is avoided in complete denture and no other occlusal scheme was included in the study.

It is concluded that the management of edentulous cases, especially the flat ridge condition, requires a deeper understanding of how the occlusal scheme can play a role in maximizing the patient's masticatory performance while maintaining the condition of the mucosa of the ridge and the underlying alveolar bone from pain and further resorption. The use of FEA can help describing how the stress distribution received by the mucosa under the denture base is more accurate to carry out further analysis related to pain and the possible risk of resorption that can occur, especially if the modeling simulation can be carried out under conditions that are as similar as possible to the original condition. It is suggested that a number of studies related to the use of FEA in assessing the stress distribution in the mucosa under dentures have focused more on normal ridge conditions and bilateral balanced occlusion, so that more studies are needed regarding flat ridge conditions with various occlusal concepts, so that it can be applied in a theoretical and clinical scopes.

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The use of hydroflouric acid as a surface treatment material on bond strength in cohesive fractures of fused to metal porcelain restoration

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ABSTRACT
Porcelain fused to metal (PFM) restoration is one of the most common restorations for fixed dentures because of its high strength, durability, biocompatibility, and satisfactory esthetics. The brittle nature of ceramic makes it easily fractured. Porcelain fracture is the second largest failure after caries. Repairing porcelain directly using composite resin becomes an option because it is cost-effective and easy to apply. The repair process requires chemical and mechanical bonding to create a strong resin bond. Hydrofluoric (HF) acid can be used as a surface treatment material to achieve good bonding. Concentration and etching time affect the bond strength. However, HF becomes harmful when in contact with soft tissues. Strict protocols in its application are observed and prolonged use in the mouth is avoided. This article reviews the effect of HF as a surface treatment material on bonding strength between porcelain and composite resin. Knowing the HF bonding strength changes to time and concentration as a surface treatment material for direct repair. It is concluded that minimizing the contact of HF on soft tissues, applying HF in the mouth for a short time without reducing its function to achieve good bonding strength.
Keywords: porcelain fused to metal, surface treatment, hydrofluoric acid

INTRODUCTION

Porcelain-fused-to-metal (PFM) restoration is a metal-porcelain restoration consists of a metal substructure that supports mechanically and chemically bonded porcelain veneers. Burning technique is carried out to obtain chemical components in the bond.[1,2] The type of metal material that mostly used is Ni-Cr,[1] while the most commonly used type of porcelain is feldsphatic.[1,2] The combination of these materials in PFM restorations is the most common. It is a popular choice for crown and bridge restorations with a 10-year success rate of about 95%.[2] PFM restoration has also been used extensively for about 50 years to produce improvements in function, esthetics and longevity.[3] In the literature reported survival rates of 98% after 5 years, 97% after 10 years, and 85% after 15 years on intraoral use.[4] However, there are drawbacks to PFM restorations due to the brittle nature of porcelain which causes failure of PFM restorations.

Failure of PFM restoration generally occurs in porcelain for about 2.3-8% and is the second largest cause of failure after caries.[5,6] This condition is a dental emergency, especially when it is located in anterior region.[4] Clinically failure starting from porcelain fracture caused by improper coping design, poor preparation, technician error, contamination, physical trauma, or premature occlusion.[3,7,8] In addition, factors such as impact, fatigue, occlusal load and mismatch between the physical properties of metal and porcelain can produce fractures of porcelain which are often cohesive.[7,8] The majority of 65% failures are in the anterior region. Other failures occurred in the labial for about 6%, 27% buccal, 5% incisal, and 8% in the occlusal region. This fracture generally occurs in the maxilla (75%), predominantly occurs in the labial surface.[7]

Friedman classifies PFM restoration fractures into three types, namely static fracture, fracture occurs in porcelain but the restoration remains intact; cohesive fracture, failure occurs in body porcelain; adhesive fracture, failure occurs at the bonding surface between porcelain and metal so that metal becomes visible. While Haelton et al specifically described the fracture of PFM restorations as follows; simple fracture, occurs only in porcelain; mixed fracture, occurs in metal and porcelain; complex fracture, where the metal area is widely exposed.[5,8]

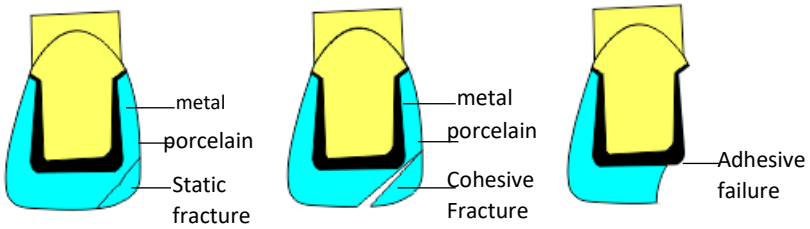

Figure 1 Pictorial representation of Friedman's classification for porcelain fractures; **A** static fracture, **B** cohesive fracture, **C** adhesive fracture.[8]

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A fracture of the porcelain layer or cohesive fracture does not necessarily mean that the PFM restoration has failed. However, it becomes a problem when it occurs on the front teeth for aesthetic reasons.[6] In certain situations, replacing the PFM restoration in the clinic is not a solution to dealing with the fracture problem. Not only a matter of time and cost, the risk of damage to the abutment when removed can occur. Repairing porcelain fracture intraorally is another treatment which is easier and cheaper.[8] Several porcelain repair techniques in PFM fractures have been introduced, including direct and indirect repair.[9,10]

LITERATURE STUDIES

Porcelain repair technique

Porcelain repair technique is divided into 2 types, namely direct and indirect. Indirect repair is carried out in the laboratory using porcelain without or removing the restoration first. Meanwhile, direct repair is a technique that is carried out directly in the mouth on damaged restoration by applying composite resin.[5,6,9-11] According to Robert, porcelain repair technique is divided into 3, namely rebonding porcelain fracture to fix restoration; making porcelain veneer to reattach them to the porcelain fracture; using composite resin to repair porcelain fracture.[5,7,12]

The advantage of the indirect technique is more aesthetic because it is made through laboratory procedure using porcelain material. Disadvantages of indirect technique require additional time and cost. Fracture of the abutment and porcelain veneer can occur when removal of a PFM restoration is required.[5] Some of the advantages of the direct technique include shorter time required, lower cost and easy to application. While the disadvantages are lower strength, quality of use and lack of aesthetics.[11,13]

The direct repair procedure using composite resin is carried out in several stage, including the beginning with an examination of the fracture portion of the PFM restoration. Isolation of the fracture part using a rubber dam. Form a bevel on the porcelain lain fracture suffix using a low-speed green stone bur. Apply HF acid to the porcelain surface, rinse with water and dry. Application of silane material on porcelain surfaces. The bonding material was applied to the porcelain fracture surface and then light cured. The application of the composite resin restorative material using incremental technique and light cured with each layer. Finishing and polishing using a disc bur with conventional method.[12] The success of porcelain repair by direct technique is clinically determined by the intact bond between ceramic and composite resin. This complete bond is achieved by chemical and mechanical bond. Chemical bonding is obtained from the application of silane on the porcelain surface, while mechanical bonding is obtained from the surface treatment performed on the porcelain surface.[6,7,9,14]

Surface treatment

Clinical application of the adhesive method on porcelain requires surface treatment to optimize the adhesion of the composite resin to the porcelain.[15] Surface treatment on porcelain is performed to produce mechanical retention which can increase the bond strength of porcelain repair from the roughened porcelain surface.[4,16] This surface roughness results in a micromechanical bond between the porcelain and the repair material obtained from the surface treatment. This makes surface treatment procedures important in determining the success of intraoral repair.[17] Several surface treatment methods that have been carried out include a) diamond bur. Surface treatment with a diamond bur creates an irregular sharp surface and micro-cracks in the ceramic causing stress concentration and subsequent fracture.[18] Roughing with a diamond bur must be carried out using a high speed to avoid the production of cracks. Cracks in the ceramic margins result from low-speed vibration of the handpiece. The roughening of the diamond bur should be combined with other surface treatment methods to achieve higher adhesion values.[18-20] Pameijer et al and Kussano et al have reported that the surface roughness of porcelain with diamond bur alone results in lower adhesion value than the other surface treatment method.[20]

b) air abrasion. Surface treatment with the use of abrasive particles driven by compressed air or other gases is an air abrasion or sandblasting process.[1] The particles that are commonly used are aluminium oxide and silica coated. Sandblasting is carried out with a high-speed flow of pure aluminium oxide particles (30-250 μm) transmitted through air pressure (2-3 bar or 30-42 psi) for approximately 15 seconds.[19,20] For cleaning, roughening, enlarlarging and activating the surface by sandblasting with 50 μm aluminium oxide particles at 2-3 bar air pressure. The main drawback of this air abrasion is the potential to damage the intended surface, thereby affecting the long-term use of the restoration. When the aluminium oxide particles hit the material with high energy, they produce small surface defects. This is because the porcelain material is fragile, so that cracks usually start from this surfa-

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ce defect. The condition occurs even in the strongest ceramic materials such as zirconia and alumina and becomes particularly problematic in weaker porcelains.[17]

c) laser. Recently, the newest technique for surface treatment is using laser as an alternative to acid etching and air abrasion to get the surface roughness of porcelain. Lasers can be CO2, erbium: yttrium-aluminum-garnet (Er:YAG) and neodymium:yttrium-aluminum-garnet (Nd:YAG), which are used to enhance micromechanical bonding. The porcelain surface is melted by an Nd:YAG laser then solidifies and finally the surface is blistered. In contrast to the CO_2 laser, which produces conchoidal tears on the porcelain surface which helps mechanical retention.[4] Sarac et al concluded that the Er:YAG laser as a surface abrasive did not produce the desired porcelain resin bond although CO_2 and Nd:YAG lasers showed better results, but the effect is lower when compared to HF etching.[21] Surface treatment with this method is still considered because of the heat generated.[4]

d) acid etching. Acid etching provides a clean surface by increasing the capacity for micromechanical retention and, as a consequence, increasing potential bond strength.[22] Acid etching on dental ceramics was first suggested by Simonsen et al in 1983. Since then, several types of acid, such as orthophosphoric (OP), sulfuric, nitric, ammonium hydrogen difluoride, acidulate phosphate fluoride (APF) and HF acid are recommended as surface treatment materials for ceramic restoration. The most commonly used acid etching is HF acid.[14] Acid of HF is an inorganic acid capable of etching the surface of glass.[23] HF acid reacts with silicon oxide (SiO_2) in the glass phase of ceramics, resulting in surface microporosity, which allows the formation of mechanical interlocks with the composite resin.[20,22]

HF acid is considered a relatively weak acid from a chemical point of view because of its low tendency to dissociate into H+ and F- ions. This does not mean that HF is harmless. Quite the opposite; HF has the ability to easily penetrate skin tissue (often without causing external burns) due to its low dissociation potential. These conditions can cause extensive internal tissue damage, as well as alter blood calcium levels (due to CaF_2 formation), which can lead to cardiac arrhythmias.[23] The use of HF during intra-oral repair procedures, exposes the patient to a high risk of acid damage, in particular, soft tissue. Thus, specific protocols should be followed including isolation of the rubber dam, careful use of a triple air water syringe, removal of excess acid and use of a high-volume aspirator to maximize preventive measures.[22]

HF acid with a concentration of 4-10% is the type commonly used in etching porcelain veneers and intraoral repair of porcelain fractures. HF acid can be safely used in dental procedures within this concentration range, including intraoral repairs, with caution and reasonable care when used.[23] Recommended HF etching time is in the range of 20 seconds to 20 minutes, depending on acid concentration and type ceramics.[20,22] Kimmich recommends etching HF acid with a concentration of 2.5–10% for 60 seconds for clinical surface preparation of porcelain cohesive fractures.[4] Concentration of etching on feldsphatic ceramic is usually recommended for the preparation of surface treatment using acid. HF 9-10% for 60 seconds.[24] For example, some of the HF-containing porcelain repair materials available in the market are Ultradent® Porcelain Repair Kit (Ultradent, Utah, USA) and Ceram-Etch (Gresco Products Inc Stafford, Texas, USA).[22]

Surface treatment using HF acid to obtain adequate adhesion between feldsphatic ceramic materials and composite resin is acceptable. Etching of feldsphatic ceramics also has the potential to significantly increase the bond strength of composite resin. Generally, porcelain consists of a glass matrix phase and a crystalline phase.[23] HF acid as an acid that selectively dissolves the glass matrix in porcelain so as to increase the porosity of the surface, it is high energy, microretentive and provides a large surface area for the bonding of composite resin.[25] In principle, these conditions are the same as enamel surface after etching with phosphoric acid.[23] The hydroxyl groups are also exposed after etching using HF which are important for chemical bonding through the solute-pairs present in the silane.[25]

The success of adhesion between porcelain and composite resin is determined by the concentration of HF acid and etching time. The formation of a special "honeycomb" pattern was seen microscopically by SEM on the porcelain surface which was etched using HF acid. The pattern was formed at 4% HF acid concentration for 5 minutes and 9-10% HF acid concentration for 90 seconds, creating a high-energy, retentive and hydrophilic surface. In addition, the adjustment of HF acid concencentration and time also depends on the type of porcelain. The use of high concentrations of HF acid over a long period of time can weaken the bond between porcelain and composite resin.[23]

The use of composite resin to repair fractures in

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Table 1 Comparison of various surface roughening methods on ceramics.[4]

Type of Ceramic	Diamond Burs	HF Acid Etching	Sand blasting	Tribochemical Silica Coating	Lasers	Recommended Method
Feldsphatic Porcelain e.g. IPS Classic (Ivoclar Vivadent, Inc., Amherst, New York), VITA Mark II (Vident, Brea, California)	Effective	Most effective	Effective	Long term low Stability	Low bond strength	HF Acid Etching
Lithium Disilicate based Ceramic e.g. IPS e.max Press, Ivoclar Vivadent, Inc., Amherst, New York	Effective	Most effective [56]	Reduces bond Strength	n/a	Low bond strength	HF Acid Etching
Leucite-Reinforced Glass Ceramic e.g. IPS Empress, Ivoclar Vivadent, Inc., Amherst, New York	Effective	Low bond strength [57]	Effective	Effective	Low bond strength	Sand blasting with alumina particles
Glass-infiltrated Aluminium oxide Ceramic e.g. In-Ceram Alumina; Vita Zahnfabrik, Bad Säckingen, Germany	Ineffective	Ineffective	Effective	Most effective [58, 59]	Low bond strength	Tribochemical Silica Coating
Densely Sintered Aluminium Oxide Ceramic e.g. Procera All-Ceram, Nobel Biocare,USA, Inc., Yorba Linda, California	Ineffective	Ineffective		Most effective [58, 59]	Low bond strength	Tribochemical Silica Coating
Zirconia based Ceramics e.g. In-Ceram Zirconia (Vita Zahnfabrik, Bad Säckingen, Germany), Cercon (Dentsply, York, PA, USA), Lava (3M ESPE, St.Paul, Minnesota)	Ineffective	Ineffective [59]	Effective	Most effective [58, 60]	Low bond strength	Tribochemical Silica Coating

porcelain has been introduced in various methods.[7] Micromechanical retention of composite resin can be obtained from all surface treatment methods performed on porcelain surface.[9,17] However, etching porcelain using HF acid is a commonly used procedure. The use of HF acid to achieve a clean microretention surface before bonding or repairing porcelain can be produced. This is because the acid can dissolve the glass matrix on the porcelain, thereby creating a mechanically retentive surface.[7] Several selections of surface treatment methods on porcelain surfaces that provide effective results can be seen in table 1.

Silane coupling agent application

The application of silane coupling agents serves as a chemical surface preparation for porcelain attachment. The use of silane can increase the adhesive strength of the repair porcelain, because the silica content in porcelain causes the silane coupling agent to be an important factor in achieving the bonding of the composite resin to the porcelain.[2,3,6,9] Silane coupling agent forms a chemical covalent bond between the silica on the porcecelain surface and the composite resin. This bond will increase the micromechanical interlock.[3]

Silane as a class of organic molecules containing one or more silicon atoms. 3-methacryloxypropyltrimethoxysilane is a silane used in dentistry for the intraoral repair and treatment of ceramic restoration prior to cementing.[23] Silanes are activated by acids to form silanol group which react with hydroxyl group (OH) on the surface of the substrate by a condensation reaction (Si-OH + HO substrate => Si-O substrate) when applied to a treated surface, for example on a porcelain surface. The reaction between the organo-functional groups of silanes (with C-C bonds), and the functional groups of resin monomers containing C-C bonds is induced by reactive free radicals generated by photoactivation of initiator components in the resin matrix. As a result, the silane coupling agent connects the composite resin to the porcelain surface.[6,19,26]

Porcelain surface which is treated with HF acid and silane of failure type is a cohesive type of porcelain. Likewise, in the research conducted by Khoroushi et al. It has been reported that the observed failure in the repair of the composite resin on the porcelain is the cohesive form in the porcelain.[3] This means that the bond strength between the composite resin and the porcelain formed in the repair porcelain has good adhesive strength. The combination of silane-bonding should theoretically provide stability and longevity in the repair of porcelain fracture.[3] Therefore, silane is necessary to increase the bond strength between composite resin and porcelain.

DISCUSSION

Failure of PFM restorations can cause aesthetic and functional disturbances that will be felt by patient.[4,18] Indirect porcelain repair by replacing PFM restorations is the best option to correct these disorders, but it is a matter of time, the cost and risk of damage to the abutment can cause more complex problems when the treatment is an option.[4]

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The selection of direct repair is the treatment of choice to minimize the risks that occur when indirect repair is carried out. However, direct repair also has its own challenges in achieving maximum retention of the mechanical bonding system between the porcelain and composite resin surfaces. Mechanical bonding is obtained by surface treatment performed on the porcelain surface. Surface treatment using HF acid is a method that has been developed for a long time.[17]

The HF acid as a surface treatment material also has drawbacks. This material becomes dangerous when in contact with soft tissues. So, its use in the mouth for as short time as possible is a consideration to minimize the possibility of contact with the tissue, without compromising its function in achieving mechanical adhesion strength. The minimum bond strength that must be achieved by the porcelain ripper material is 8-9 MPa.[15] In vitro studies on the use of HF acid as a surface treatment material in the surface roughening of porcelain to produce maximum bond strength between resin and porcelain have been carried out, such as the effect of HF acid concentration and etching time on the increase in bond strength between porcelain and composite resin.[7]

The effect of time and concentration on increasing bond strength can be seen in the results of the study of Moura et al, there was a difference in the effect of time (60 seconds and 120 seconds) on the concentration of HF acid (5% and 10%) on the bond strength of feldsphatic ceramics. The results of the highest shear bond strength test were obtained at a concentration of 10% HF acid for 60 seconds (15.35±3.2 MPa), and the lowest with a concentration of 5% HF acid for 120 seconds (9.41± 2.8 MPa). The results of this study showed that there was an effect of bond strength on the concentration and time of application of HF acid.[24] Similar to the study conducted by Venturini et al., the effect of HF acid concentration on resin bonding to feldsphatic ceramics at different HF concentrations (1%, 3%, 5% and 10%) for 60 seconds. The highest bond strength results were obtained at HF 10% (15.7±2.8 MPa), 5% (14.9±2 MPa), 1% (14.5±3 MPa) and 3% (14.2±3.3 MPa). However, the highest value was at 10% HF acid concentration.[27]

A large concentration of HF acid or a long etching time on porcelain ceramics can result in "over-etching" and significantly weaken the porcelain surface.[23] This is supported by the research of Güler et al. Porcelain after increasing the time from 120 seconds (14.84 MPa) to 180 seconds (12.01 MPa) at 9.6% HF acid concentration.[7] Similar to the results of the study conducted by Moura et al, there was a decrease in bond strength after the addition of time carried out at 5% and 10% HF acid concentrations. The decrease in bond strength occurred at both HF acid concentrations when the time of 60 seconds was increased to 120 seconds.[25]

Over-etching on the etched porcelain surface is clearly visible as "white residue". This appearance is a combination of porcelain salts and porcelain flakes. Sometimes, due to the large amount of residue deposits, it can be very broad covering the porcelain surface, this is related to the concentration of HF acid, time and type of porcelain. The condition cannot be removed by air/water spray and wiping with acetone-soaked cotton. Cleaning can be done by placing it in ethanol followed by ultrasonication. It takes 15 minutes of ultrasonication to release the white residue.[23]

Chemical bonding is required to increase the bond strength between the porcelain and the composite resin. The use of silane coupling agents is very important to obtain increasing of bond strength. Khouroushi compared the bonding strength of composite resin to porcelain feldsphatic using silane or not after surface treatment using HF 9.6% for 3 minutes. The highest bond strength results were obtained in the sample that was given silane 20.47 MPa and in the sample that was not given silane 12.89 MPa. This proves that there is a significant increase in the bond strength between porcelain and composite resin. This is caused by the micromechanical interlocs on the surface of the etched porcelain forming a chemical covalent bond between the silica and the resin, which increases the bond strength.[3,17]

It is concluded that the use of HF acid as a surface treatment material in increasing the bond strength of porcelain and composites is an option that can be considered because the material is quite easy to obtain in the market, more economical, and easy to apply. However, this does not mean that this material is harmless, the use of a rubber dam in its application is necessary to avoid contact between HF acid and oral tissue. The right time and concentration of HF acid to obtain maximum bond strength between porcelain and composite is also a concern. The time and concentration of HF acid that are not possible cannot meet the needs of the bond strength value to be achieved in porcelain repair, which is around 8-9 MPa. Likewise, conditions where time and excessive concentration of HF acid will reduce the bond strength of porcelain and composites.

The selection of the right time and concentra-

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tion in the application of HF acid as a surface treatment material for direct repair of porcelain is needed to ensure that the bond between porcelain and composite resin becomes stronger and more durable. The application of HF acid in the mouth for too long is feared to be a risk of contacting the surrounding tissue. Therefore, the application within a short time without reducing the bond strength is absolutely necessary. The use of silane is necessary when etching porcelain using HF acid, which significantly contributes to increase bond strength between porcelain and composite. Further research is needed on the effect of time and concentration of HF acid as a surface treatment material on porcelain repair to obtain the maximum increase in bond strength between porcelain and composite resin. So that the minimum application time is obtained with the right concentration of HF acid.

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