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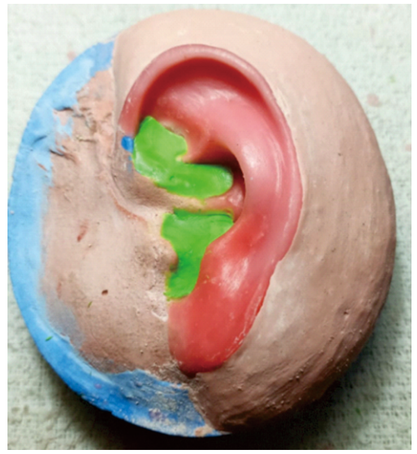

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An overview of type-2 diabetes mellitus: dental implant survival rates

[1]Mefina Kuntjoro, [1]Nike Hendrijantini, [1]Agus Dahlan, [2]Husniya Juwita Farha, [2]Mayang Aziza Hanif Ardianto
[1]Department of Prosthodontics
[2]Undergraduate Student
Faculty of Dental Medicine, Universitas Airlangga
Surabaya, Indonesia.
Corresponding author: **Mefina Kuntjoro**, e-mail: **mefina-k@fkg.unair.ac.id**

ABSTRACT
Dental implants are an alternative treatment to replace missing teeth, as it is one of the oral health problems in the elderly. The success of dental implants is affected by a process known as osseointegration. Systemic condition such as T2DM can interfere with the osseointegration process which can lead to implant failure. As the patient's blood glucose level increases, it will increase the accumulation of AGEs. These AGEs will interfere with the stages of bone-implant contact and also bone growth around the implant. This review article is aimed to review dental implant survival rates in T2DM patients based on HbA1c, ISQ and CBCT examinations. It is concluded that dental implants in T2DM patients after being evaluated for 2 years showed a good result. This result is obtained with the condition that HbA1c control is below 8%. Another solution to support the success of dental implants placement in T2DM patients is the use of delayed insertion technique and modification of the implant surface with HA or SLA is also recommended. Evaluation of implant success can also be done with pre-operative planning, such as evaluation of the bone condition with ISQ and CBCT examinations.
Keywords: dental implant, uncontrolled T2DM, implant survival, CBCT, ISQ

INTRODUCTION

Dental implant treatment is one of the leading alternative treatments in dentistry aimed at edentulous patients with tooth loss. Tooth loss is one of the most common oral health problems experienced by the elderly. Based on data from the Center for Disease Control and Prevention (CDC) that almost 1 in 5 elderly people aged 65 years and over has lost their teeth.[1] According to the American Academy of Implant Dentistry (AAID), each year an additional 500,000 dental implants are placed.

The high procedure for dental implants placement is also inseparable from the factors that influence the success of the placing, namely bone-implant contact (BIC) by a process called osseointegration. After the implant is placed, inflammatory cells and bone cells will move to the surface of the bone-implant. The process of bone regeneration and mineralization or remodeling is continued until complete osseointegration occurs.[2]

Diabetes mellitus is a group of metabolic disorders with the main characteristic of chronic hyperglycemia.[3] According to the International Diabetes Federation (IDF) in 2021, the global prevalence of diabetes mellitus in 2021 is 10.5%, with 90% of all diabetes cases being type-2 DM (T2DM). The diagnostic criteria for DM can be indicated by an HbA1c level 6.5%.[4] Optimal glycemic control in non-pregnant adults is defined as HbA1c <7% (53 mmol/mol) and uncontrolled diabetes HbA1c is 7% (53 mmol/mol).[3]

T2DM patients who get implants must pay attention to their blood glucose control. Uncontrolled high blood glucose can change the quality of the dental-implant osseointegration process. As the patient's blood glucose level increases, it will increase the accumulation of AGEs through the formation of ROS. These AGEs will interfere with the stages of BIC and also bone growth around the implant.[5]

The clinical impact of implant integration can also be assessed by implant stability quotients (ISQ), or implant measurements.[6] ISQ was used as a non-invasive indicator to determine the implant loading time frame and as a prognostic indicator for the likelihood of implant failure using the resonant frequency analysis (RFA) method as a quantitative ISQ parameter.[7] The ISQ is based on the resonant frequency and ranges from 1 (lowest stability) to 100 (highest stability). A higher ISQ value indicates a higher primary.[7] An ISQ value >70 is considered optimal for implant success.[8] Meanwhile according to Sargolzaie*et al.,* the optimum ISQ value as the implant success is >60.[9]

To get a good implant adaptation to support the success of implant placement, the patient's condition before receiving a dental implant must be evaluated, namely those concerning the condition of the alveolar bone and systemic conditions of the patient such as diabetes, osteoporosis, obesity, and the use of drugs. In evaluating the condition of the alveolar bone, it is necessary to consider the distance between the crest of the alveolar bone and the opposing tooth, the mesiodistal distance

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of the bone (in addition to considering the size of the implant diameter, which is 6-8 mm on average), and the fasciolingual width of the bone (generally >6 mm).[10] Evaluation of the condition of the alveolar bone can be analyzed, one of which is by using a cone beam computed tomography (CBCT) examination. This CBCT examination can provide an accurate 3-D picture of the anatomy, quality and volume of alveolar bone. So that the use of CBCT can be used in planning the installation of pre-surgical implants.[11]

There are six factors that can affect the osseointegration of dental implants: the biocompatibility of the implant material; macroscopic and microscopic properties of the implant surface; implant placement status; surgical technique; uninterrupted healing phase; and the prosthetic design continues and the long-term implant loading phase.[12] This article reviews the implant survival rate in T2DM patients based on HbA1c, ISQ examination, and CBCT examination.

LITERATURE STUDIES

A literature review of studies conducted on survival rates in T2DM patients based on HbA1c, ISQ examination, and CBCT examination using the *preferred reporting items for systematic reviews and meta-analyses* (PRISMA) method. A comprehensive literature search was conducted on the Pubmed database (US National Library of Medicine, USA) with studies published in the last 5 years (2017-2022) period. The keywords used were 'DM and dental implant survival', 'uncontrolled T2DM and dental implant survival', 'DM and immediately loaded implant'. Results are limited to studies published in English.

All studies obtained from database searches with the above search criteria were gathered and duplicates were removed. The remaining studies were then filtered by reading "title". Studies that did not match with the inclusion criteria were excluded at this stage. The remaining studies were screened at the final stage by reading the abstract and those that did not match with the inclusion criteria were excluded.

The inclusion criteria consisted of a) articles describing uncontrolled T2DM and dental implant placement, b) types of cohort studies and clinical studies, and c) research conducted in 2017-2022. Exclusion criteria included a) review articles, b) research published other than in English, c) research that did not address survival rates for uncontrolled T2DM and dental implant placement.

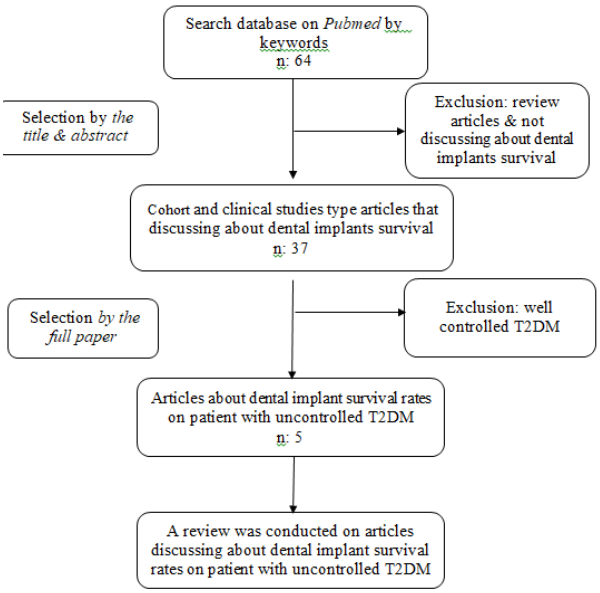

Figure 1 Schematic of the article exclusion process

DISCUSSION

Implants survival rates based on HbA1c

Diabetes mellitus is a systemic disease characterized by impaired insulin secretion which results in a high plasma glucose level in the blood, or commonly referred as hyperglycemia. Hyperglycemia is a result of an accumulation of advanced glycation end products (AGEs) through the formation of ROS, which will affect the quality of the collagen structure as an organic bone matrix. In addition, AGEs reduce the proliferation and function of osteoblasts and increase resorption by osteoclasts. Hyperglycemia can lead to decreased bone formation and poor new bone quality, also affects the reduced bone density around dental implants and reduced osteoconduction at the osseointegration stage.[5,13]

Glycemic control is important for the maintenance and prevention of diabetes complications. The percentage of glycosylated hemoglobin that is HbA1c, is considered the best indicator for measuring glucose levels in the previous six to eight weeks than fasting plasma glucose. According to the criteria, optimal glycemic control in adults is defined as HbA1c <7% (53 mmol/mol) and uncontrolled diabetes HbA1c 7% (53 mmol/mol).[3]

Survival rates in dental implants are defined when the dental implants were able to stay in their sockets and when evaluated for 1 year, the implants did not experience infection, pain, mobility, peri-implant bone loss.[14,15] In patients with uncontrolled T2DM, when evaluated for 2 years after insertion, good results were obtained, and there was

Table 1 Results of article characteristics

No	Author, year	Type of Study	No. of patients	No. of implants	Duration of Study	Survival rates (%)	Conclusion
1	Eskow *et al.*, 2017	Cohort study	24	72	2 years	96.7%	It was concluded that the 2-year evaluation of dental implants in patients with uncontrolled diabetes was good
2	Aguilar *et al.*, 2016	Cohort study	85	85	2 years	86.3%	In diabetic patients, implant treatment can be carried out provided that HbA1c control is carried out so that it must always be below 8% or diabetic patients with moderately-glycemic control
3	Juncar *et al.,*2020		4	16	6 months	100%	Implant placement with an immediate filling technique got good results when the patient's HbA1c showed a level of 7.05% (range 6.8-7.3%)
4	Latimer *et al*., 2021	Cohort study	21	21	1 year	100%	HbA1c >7.5% - <10% does not affect dental implant survival during 1 year of placement
5	Friedmann *et al.,* 2021	Pilot study	32	48	1 year	100%	Implants placement used in a minimally invasive approach and prevention of augmentation procedures will result in good implant integration.

was no significant difference with survival rates in patients with controlled T2DM.[16,17] Aguilar et al, also added that when an uncontrolled T2DM patient is to be treated with implants, there is a requirement for installation, namely HbA1c control so that blood glucose is always below 8%.[17] Research conducted by Juncar, et al[18] showed a safe HbA1c level for implant placement was an average of 7.05%.[18] Both studies are based on an immediate-loaded implant placement technique. The results of the research from Aguilar *et al.,* were supported by Latimer *et al.,*[8] which was conducted for 1 year that dental implant survival reached 100% when the glycemic control was between >7.5%-10%. Other research reveals, when implant placement uses a minimally invasive approach and preventive augmentation procedures, it will result in good implant integration so that a high survival rate will be obtained.[19]

Although the survival rates of dental implants in patients with uncontrolled T2DM are notably good, several post-installation complications were found. Such as bone destruction, low BIC value, increased plaque index, probing depth, bleeding on probing (BOP) are also causes of peri-implantitis. The risk of peri-implantitis is due to the increased inflammatory and immune response of the host. Hyperglycemia causes an increase in AGEs, AGEs together with RAGEs will reduce the synthesis of matrix proteins such as collagen and osteocalcin. In addition, the binding of AGEs and RAGEs will increase the production of pro-inflammatory cytokines such as IL-6, IL-1b, and TNF-a so that it will increase inflammation around the installation of dental implants.[20,21]

ISQ examination as a support for the successful of dental implants placement

ISQ values are influenced by many clinical and biological factors, with a possible association of ISQ with bone quality at the implant site.[7] In a study in rats with alloxan-induced diabetes, severe diabetes can cause ultrastructural changes in bone formation. In this study, non-insulin-treated and implanted diabetic rats exhibited a loose bone matrix with loose aspect, irregular arrangement, thin trabeculae, empty spaces and large amounts of proteoglycans.[22] In a recent observational study, Alshahrani et al showed that cortical bone loss (CBL) levels in patients with uncontrolled T2DM were significantly higher than in pre-diabetic, controlled diabetic, and non-diabetic patients. In a clinical study also reported that cortical bone thickness showed a positive correlation with local ISQ values, and cortical bone loss caused a decrease in implant stability resulting in a decrease in ISQ values.[23] Based on the above study, patients with uncontrolled T2DM may be able to show a decrease in ISQ values resulting in lower implant stability.

CBCT examination as a support for the successful of dental implants placement

In support of a successful implant, CBCT examination has the advantage in which when used during diagnostic planning as well as pre- and post-operatively, CBCT produces detailed 3D volumetric images, with low exposure doses of around 10-1000 Sv, fast exposure time, lighter equipment. and small, and ease of use may be the main contributors to its growing success.[11]

Failure and complications of implant placement can be caused by poor bone quality, inadequate bone volume, errors in pre-operative planning, and errors in viewing the anatomical structure of the bone. In pre-operative planning, it is necessary to assess bone quality which consists of bone density and thickness. In addition, bone density measurements were also carried out to see how much

free space was available for dental implants. Meanwhile, post-operative CBCT is also used to evaluate bone formation including the height and width of the bone around the implant.[24]

Research by Pramanik and Firman[24] determined that the minimum mesiodistal, buccolingual distance is 8 mm while the minimum distance from the alveolar crest to the superior border of the mandibular canal or the inferior floor of the sinus is 10 mm. The value of bone density that is safe for dental implants is in the range of 400-800 HU.

Implant surface modification and implant placement techniques as a solution to increase survival rates in T2DM patients

In a study of rats with streptozotocin-induced diabetes, modification on the implant surface with hydroxyapatite (HA) and sandblasted and acid-etched (SLA) may provide the potential to enhance implant osseointegration. Histomorphometric results showed the highest BIC value were in implant surface modified with HA group, the highest new bone formation value in implant surface modified with SLA group, and increased osseointegration in both groups HA and SLA.[8,25] Therefore, implant surface modification with HA and SLA can be suggested in T2DM patients to enhance new bone formation and osseointegration.

There are 3 methods of implant placement, namely 1) implant that is inserted directly after tooth extraction (immediate insertion), 2) implants that are inserted 6-8 weeks after tooth extraction, and 3) implants that are inserted 4-6 months after tooth extraction (delayed insertion). A study found that patients with moderately T2DM who had implants implanted immediately after tooth extraction experience failure. Although immediate implant placement has the advantage of shortening treatment time and minimizing invasive procedures in patients, when applied to T2DM patients, there were higher failure survival rates than those with delayed implant placement. This is due to the bone graft given when the implant is inserted immediately after tooth extraction prevents BIC from occurring so that the osseointegration was not optimal.[26] Thus patients with T2DM can be advised to use the delayed insertion technique. Research conducted by Aguilar et al, showed that when an uncontrolled T2DM patient is to be treated with implants, there is a requirement for installation, namely HbA1c control so that blood glucose is always below 8%.[17] Juncar, et al[18] also added a safe HbA1c level for implant placement was an average of 7.05%.

It is concluded that the placement of dental implants in T2DM patients after being evaluated for a short period of 2 years showed a good result. High survival rates were obtained with the condition that HbA1c control is carried out so that it is always below 8%. In the evaluation of implant placement, control HbA1c > 10% caused complications such as decreased rate of new bone formation, bone density, and high risk of peri-implantitis. In addition, HbA1c control must be below 8%. Our solution to support the successful installation of dental implants in T2DM patients are the use of a delayed insertion technique compared to immediate insertion, and modification of the implant surface using HA or SLA is also recommended. Evaluation of implant success can also be done with pre-operative planning, such as evaluation of the bone condition with ISQ and CBCT examinations. So, further research is needed on the survival rates of T2DM patients in terms of various aspects such as insertion technique, CBCT examination, ISQ stability level.

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Tooth-supported overdenture vs stud retained overdenture: a case report

Hazira M. Yusof
Universiti Sains Islam
Malaysia
Corresponding author: **Hazira M Yusof**, e-mail: **hazirayusof@yahoo.com**

ABSTRACT
Overdenture can preserve alveolar bone while providing support and stability to the prosthesis. This case report describes a treatment of a tooth-supported partial overdenture for the upper and lower stud retained overdenture. This method provides an alternative solution to the conventional partial denture and implant retained overdenture. This treatment is a simple and cost-effective, which provides the patient with a highly retentive, stable denture with improved masticatory performance.
Keywords: overdenture, tooth-supported overdenture, stud-retained overdenture
This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

Residual ridge resorption is a continuous process that occurs throughout life. Severely resorbed ridge is classified as a technically difficult case due to the limited structural availability that is integral for the support, stability and retention of a denture. According to the Glossary of Prosthodontic Terms an overdenture can be defined as any removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, dental implant.[1] An implant overdenture provides an excellent retention to the denture as proposed by the McGill consensus. However, in consideration of the economy, the cost of an implant overdenture can be enormous.

Tooth-supported overdenture offers an alternative option to an implant where the supporting structure were derived from a precision attachment. There are 5 different types of attachment available in the market such as stud, extracoronal attachment, intracoronal attachment, bar, and auxillary group.[2] This case report describes a treatment where the patient was prescribed with an upper tooth supported overdenture and lower stud-retained overdenture.

CASE

A 67-year-old female came to the clinic with a complaint of a loose upper and lower denture. Intraorally patient presented with discolored and severely attrited upper anterior teeth underneath a partial overdenture opposed to a complete denture with a worn-down stud attachment on teeth 33 and 43 (Fig.1A). The upper anterior teeth are carious due to long-standing tooth-supported overdenture, however, there are no history of pain, no tender to palpation and all upper anterior teeth are vital. The lower residual ridge was severely resorbed with recession occur on tooth 33 and 43 although there was no mobility detected. Medically, patient had no relevant history that can affect her visits and treatment. Radiographic examination of the upper anterior teeth showed no periapical lesion and no pulp involvement. Lower radiographic examination (Fig.1B) showed root canal treated teeth of 33 and 43 with crown to root ratio of 1:1, however, the was a small void between the posts and gutta percha. Further examination on both teeth 33 and 43 showed no signs and symptoms of pain.

Based on the intraoral and radiographic findings, the treatment options given to the patient for the upper arch were; extraction of all upper anterior teeth followed by a conventional partial denture or constructing a new tooth-supported overdenture. For the lower arch, the plan was to redo the stud attachment followed by tooth supported overdenture. After deliberation of the advantages and disadvantages of the treatment, the patient then decided to retain her upper anterior teeth so the treatment chosen for the upper arch was tooth-supported overdenture.

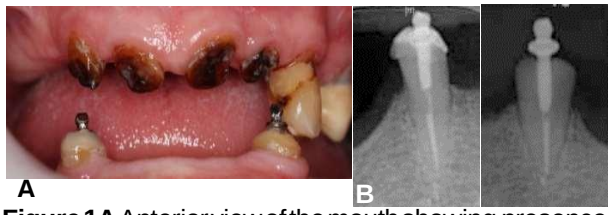

Figure 1A Anterior view of the mouth showing presence of carious anterior teeth and worn down lower studs on teeth 33 and 43; **B** Radiograph showing lower anterior teeth of 33 and 43.

MANAGEMENT

This treatment was chosen due the severely attrited upper anterior teeth and considering the success of previous stud attachment on the lower overdenture. Removal of caries was done and all affected dentine were removed. Patients' upper anterior teeth were then contoured leaving only 2 mm of coronal height as the abutment for the upper

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partial denture (Fig.2A). The initial treatment procedure for the construction of denture was parallel to the construction of a conventional denture. However, during the bite registration visit upon confirmation of the occlusal vertical dimension (OVD), the height of occlusal rim was measured to ensure inter-arch distance. This is to assess whether the height of the OVD was able to accommodate both the height of the upper abutment teeth and lower stud attachments without encroaching patients' freeway space area.

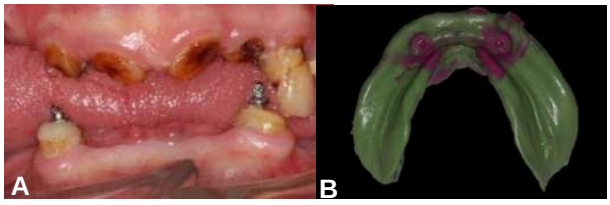

Figure 2A Stabilization of caries and upper abutment teeth preparation; **B** impression of the canal for the construction of stud attachment

After the confirmation of the availability of inter-arch space, stud attachments on teeth 33 and 43 were removed under rubber dam isolation and the abutments were contoured leaving only 2 mm of coronal height intraorally. The abutment was prepared with a chamfer margin at 0.5 mm all around with dome- shape preparation. Impression of the canal was taken for the construction of stud attachments (Fig.2B) and the stud attachments were cemented using Panavia.

Figure 3 Stud attachment on teeth 33 and 43

All treatment stages were done in the same manner as the conventional denture, however, during the try-in stage it is crucial to assess the occlusal vertical dimension (OVD) to ensure adequate interocclusal space for the tooth overdenture and stud attachment. After assessment of space, old studs on teeth 33 and 43 were removed. Preparation of chamfer margin was done at the equigingival level and an impression was taken using light and medium bodied silicone (Fig.2B) for the construction of new studs (Fig.3). After cementation of stud, try-in partial and complete denture was done to assess the aesthetic while ensuring the OVD is correct by phonation assessment.

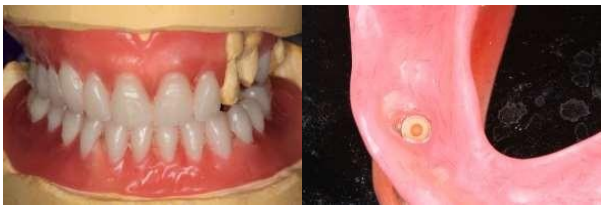

Figure 4 Try-in of tooth-supported overdenture vs stud-retained full denture

Upon confirmation on the try-in stage, new impression of the lower arch was taken. The new impression will be used in-lab pick-up technique. After the denture was processed, laboratory will use the new impression for housing pick-up using auto-polymerizing acrylic resin. During final visit the processed denture was tried and the any necessary occlusal adjustment was performed (Fig.4). During the delivery visit, the occlusion was checked along with the stability and retention of the final prosthesis. Patient was issued with the definitive denture (Fig.5) and OH instructions alongside maintenance information regarding her new denture.

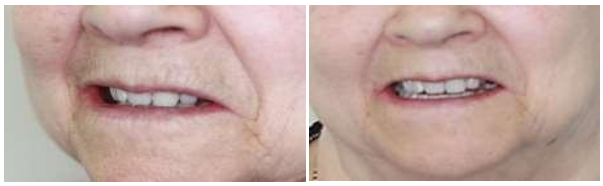

Figure 5 Stud housing and rubber after acrylic resin pick-up

Discussion

Tooth-supported overdenture offers the advantages of proprioception from the periodontal ligaments, preservation of alveolar bone and enhanced support, stability and retention to the denture and increase the masticatory performance.[3,4] In cases where patient is partially dentate the overdenture offers a slower transition pace to edentulism, better denture adaptation and acceptance to denture which helps with the psychological factors in the long run.[5]

The confirmation of the OVD in this patient is one of the crucial steps in the treatment planning. This is because the added vertical height of the anterior teeth abutments and stud attachment in comparison to a conventional denture inter-arch requirement. The minimum requirement of 2 mm of acrylic resin above the attachment to acquire the optimum acrylic strength should also be considered. The technique that can be used to determine the adequacy of inter-arch space can be achieved is by using diagnostic models and fabrication of temporary prosthesis on a mounted semi adjustable articulator.[6]

There are a few disadvantages of tooth-supported overdenture and as seen in this patient. The use of overdenture increases caries risk underneath the denture especially in the elderly patients. Overdenture requires meticulous OH technique to reduce caries risk and periodontal diseases. A thorough oral and denture hygiene education with regular follow-up visit is imperative in this type of the treatment.

There are two techniques that can be used for stud housing pick-up; chair side and laboratory, which were described in this case report. For a chair side technique pick-up, a space was created and the housing was placed on the stud while autopolymerizing acrylic resin was loaded in the space created. The denture was then positioned in the mouth waiting for the acrylic resin to set in a closed mouth technique. This technique has the benefit of reduced impression required for the denture construction in comparison to laboratory pick up. However, extra precaution needs to be taken to avoid displacement of acrylic resin in an undercut that can caused a locked-in denture.

The rubber ring located in the housing will requires replacement after rigorous denture use due to wear although this is a simple procedure that can be done in a short visit.

It is concluded that patient was satisfied with the denture and its well-functioning properties. The stability and retention of the denture was greatly improved. This finding confirmed that overdenture is a simple and cost-effective treatment which can be an alternative to implant retained denture while providing better retention than conventional denture.

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Masticatory muscle activity in complete denture wearers: a surface electromyographic analysis

[1]Nazia Rasheed, [2]Suja Joseph, [2]Aby Mathew T, [3]Veena Paul, [2]Shibi Mathew, [2]Joshy Abraham
[1]Former Postgraduate student, Pushpagiri College of Dental Sciences
[2]Pushpagiri College of Dental Sciences
[3]Annoor Dental College
Thiruvalla, Kerala, India
Corresponding author: **Nazia Rasheed**, e-mail: **Naziarasheed202@gmail.com**

ABSTRACT
The investigation of the adaptation process to a new denture is relevant to understand the control of muscles. Surface electromyography provide reproducible data of masticatory muscle function and helps to assess the performance of dentures. This longitudinal study simultaneously evaluated electric potential in masseter and anterior temporalis during clenching at maximum intercuspation position and mastication at 2 months after denture insertion and one year later was done in complete denture patients. The surface electrodes were placed in anterior temporalis and masseter region of 22 patients during maximum voluntary clenching and chewing. Statistical analysis was performed by paired t-test. A significant increase in electrical activity was found during clenching and chewing after one year compared to two months. The overall mean EMG value of masseter was significantly higher during chewing at 2 months ($p<0.001$) and 1 year ($p<0.001$). A negative correlation was found with respect to age and EMG value of masseter. It is concluded that the electrical activity presented statistically significant difference after one year indicating improved functional quality. A good rehabilitation improves the efficiency of muscles. Monitoring the effect of rehabilitation on stomatognathic system help to preventively warn about dysfunctions and treatment modifications needed.
Key words: complete denture, masseter, surface electromyography

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INTRODUCTION

Rehabilitation of lost teeth with conventional complete denture (CD) are still widely performed in general clinical settings owing to economic conditions and non-invasiveness of procedure. Mastication is a highly coordinated neuromuscular function involving fast effective movements of the jaw and continuous modulation of force. In edentulous subjects, sensory feedback is altered. Pattern of chewing function is different in CD wearers as compared to dentate individuals. One of the best proven methods to evaluate masticatory muscle activity is surface electromyography.[1] To provide further insight into the adaptation to new CD in edentulous subjects, a longitudinal study was done for the evaluation of jaw muscles activity by EMG. SEMG measurements can provide objective, documentable, valid, reproducible data on functional condition of masticatory muscles[2]; SEMG of both static (clenching) and dynamic (chewing) procedures are taken into account due to it being combination of masticatory efficiency.

This study attempts to determine the difference in masticatory muscle activity during clenching and mastication in CD wearers.

METHODS

Research question is there any change in muscle activity of masseter and temporalis muscle at 2 months and one year of removable CD use during clenching and mastication. The null hypothesis stated that there is no significant difference between masseter and anterior temporalis activity during clenching and mastication at 2 months and after one year of denture wearing.

The sample size of this longitudinal study was calculated as 22 with a confidence interval of 95%, power of study as 80% based on values from previous literature.[3,4] All patients were above 40 years of age who visited Department of Prosthodontics for conventional CDs and met the inclusion criteria were selected. Twenty-two volunteers were chosen upon the criteria that their dentures had satisfactory interocclusal and maxillomandibular relationship. All participants reported an adequate masticatory efficiency and were satisfied with their dentures. The oral mucosa was free of irritation and clinical signs of inflammation. None of the subjects ever had a history of mandibular dysfunction or any disease that might affect muscles of the masticatory system and have class 1 maxillomandibular arch relation. The dentures fabricated with same heat cure acrylic resin and denture teeth by compression moulding technique. The patients were ready to cooperate with study.

A written informed consent was obtained from research participants. The investigation was approved by the Institutional Ethics Committee (PCDS/IEC/K11/11/15).

The exclusion criteria were patients with neurologic disease, lack of motor coordination, with uncontrolled jerky movements; patients with para-

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functional habits such as clenching, bruxism, tongue thrust etc; presence of mucosal irritation or inflammation; history of diseases of muscles of mastication; patients with other systemic conditions affecting cooperation for lengthy appointments; and patients wearing pace makers, implantable defibrillators.

Patients at 2 months after insertion are named as group 1, consist of group 1A namely muscle activity of group 1 during clenching, and group 1B namely muscle activity of group 1 during chewing; patients at 1 year after insertion were named as group 2, consist of 2A namely muscle activity of group 2 during clenching, and group B namely muscle activity of group 2 during chewing; RT is right temporalis, LT is left temporalis, RM is right masseter, and LM is left masseter.

There two study variables: EMG amplitude (microvolt) of right and left masseter and anterior temporalis during clenching and chewing at 2 months, and EMG amplitude (microvolt) of right and left masseter and anterior temporalis during clenching and chewing at one year.

This study was performed at Pushpagiri College of Dental Sciences, Thiruvalla and EMG studies were done at Department of Neurology, Pushpagiri Medical College, Thiruvalla.

Electromyography evaluation

Surface EMGs were performed using Nihon Kohden Neuropack EMG machine,[5] made in Japan 2006, MEB-9400) with quantitative EMG software (QP-946BK). The low noise amplifier speeds up examination and gives values easily and quickly. Reports were generated in Microsoft excel. MUP wave forms were automatically detected and measurement results were displayed. EMG signals were recorded at a filter setting of 20 Hz for the low filter and 10 kHz for the high filter and amplified.

EMG was recorded after the complete absence of any discomfort, when the patients were presumed to be adapted to their dentures, after 2-months. During all recording, the patients were seated with their head unsupported with Frankfort horizontal plane parallel to floor and were asked to maintain a naturally erect position to avoid the postural effect on the recorded muscle activities. Thus seating position for each patient was standardised.

Application of surface EMG electrodes requires proper skin preparation beforehand. In order to obtain a good quality EMG signal, the skin's impedance must be considerably reduced. For this purpose, the dead cells on the skin e.g. hair must be completely removed from the location where the EMG electrodes are to be placed.

The site of electrode placement was rubbed with abrasive gel and cleansed with a cotton pellet moistened with alcohol (Avagard antiseptic solution) before electrode placement to remove excess oil that reduces skin electrical resistance. This enhanced contact with the electrodes helped to obtain signals of good quality. The patient was asked to hold the jaws tightly closed to palpate the muscles for proper placement.

Care was taken that for each individual the electrode placement was as far as possible identical at the two sessions. The disposable surface electrodes were positioned on muscle bellies parallel to muscle fibres with adhesive tape. The electrodes were circular with a diameter of 1 cm. The centre-to centre interelectrode distance was 2 cm. Prior to test resting values were collected for a period of 10 seconds.[6]

Location and orientation of the electrode

Two detecting surfaces (or EMG electrodes) were placed on the skin in bipolar configuration.[8,9] Muscle function test was used to position the electrodes over the evaluated muscles.[10]

EMG recording of the muscles

For masseter, the electrodes were placed parallel to the muscle fibres, with the electrode at the intersection between the tragus-labial commissure and the exocanthion-gonion lines, perpendicular to the skin surface, according to the technique described in literature.[11] The electrode was placed in the centre of the masseter muscle, at an equidistant point from the upper and lower insertions, main-taining the teeth in occlusal contact

In the case of the anterior temporalis muscle, during mandibular movement, the anterior border was located and the electrode was placed perpendicular to the sagittal plane 1.5-2.0 cm over the zygomatic arch immediately behind the frontal process of the zygomatic bone.[11]

EMG evaluation during clenching-mastication

For clenching, each patient was instructed to clench their teeth for 3 seconds to measure the muscle activity. Next the patient was asked to relax the muscles, slightly separating the teeth for another three seconds. All the recordings were repeated 3-three times.[12] The machine automatically displayed the mean activity of muscle. The recordings were made at 2-months and 1-year of denture use.

The masseteric and anterior temporal myoelectric activities of left and right sides were recorded by

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means of bipolar electrodes. The recording electrodes were approximately 20 mm apart. The patient was grounded by grounding electrode by fixing the third electrode on the forehead.

In mastication, on a command signal the subject placed the gum into the mouth. The subject closed the teeth into occlusion keeping the test food between the tongue and started unilateral chewing when the signal was given. The test food was chewed side for 15-seconds while the EMG was recorded.[13] Chewing movements were tested three times. This phase is one sequence. Participants were asked not to move their heads during the recordings, two sessions were held for each individual. The first session was held to familiarize subjects with the experimental protocol. Only data from the second session were analyzed.[6]

Test specimen

Test specimen was one piece of spearmint flavoured sugarless gum. On a command signal the subject placed the gum into the mouth and chewed deliberately on the right side for 15 sec. The patient was asked to chew the chewing gum first on the preferred side, which was always the right side. Unless stated to the contrary, the observations made apply to chewing on the side of preference.[13]

After using the denture for a period of 1-year, masticatory function was evaluated by recording the EMG activity for masseter and anterior temporalis muscles during clenching and mastication.

Statistical analysis

Data was collected and entered in MS Excel sheet. The descriptive and analytical statistics were computed with the statistical package of social sciences (SPSS) v.22 software. Percentages, mean and standard deviation were computed. Analytical statistics of the EMG recordings was performed by paired-*t* test. Normality was checked for the data. The significance was set at $p<0.05$.

Table 1 Age distribution of the study group

	Frequency	Percent
55-60	6	27.2
60-65	8	36.36
65-70	6	27.2
Above 70	2	9
Total	22	100

Table 2 Gender of study group

Gender	Frequency	Percent
Male	11	50
Female	11	50
Total	22	100

RESULTS

The mean age of samples were 62.13 years with SD of 4.34 (Table 1). Gender distribution was maintained equally in the study (Table 2).

This study showed a significant difference in EMG values between the two time periods with higher mean scores of EMG activity at 1-year. The results suggest that there is a significant increase in EMG potential. The null hypothesis was rejected and the alternate hypothesis stated was that there is a difference in EMG amplitude at 1-year compared to 2 months of denture use.

The mean EMG value of RM is found to be significantly higher than LM during clenching at 2 months ($p<0.001$) and 1-year ($p<0.001$). In the same way it was observed for temporalis muscle also where in the mean EMG-value of RT is found to be significantly higher than LT during clenching at 2 months ($p<0.001$) and 1 year ($p<0.001$) (Table 3 & Fig.5). During clenching, significantly higher mean EMG values are recorded at 1-year for RM ($p<0.001$) and LM ($p<0.001$) as well as RT ($p< 0.001$) and LT muscles ($p<0.001$) (Table 3 & Fig.5).

The overall mean EMG value of masseter is found to be significantly higher than temporalis during clenching at 2-months ($p=0.005$) and 1-year ($p=0.045$) (Table 4).

During clenching, the overall mean EMG value of masseter ($p<0.001$) and temporalis ($p<0.001$) muscles are found to be significantly higher at one year than that recorded at 2 months (Table 4,10).

During chewing, the mean EMG value of RM is found to be significantly higher than LM at 2 months ($p<0.001$) and 1 year ($p<0.001$) (table 8). The mean of EMG value of RT is found to be significantly higher than LT 2 months ($p<0.001$) and 1 year ($p<0.001$) (Table 5).

At 1-year also, the mean of EMG-value of RM ($p<0.001$) and RT ($p<0.001$) are observed to be higher than LM and LT muscles, respectively (Table 5).

The overall mean EMG value of masseter is found to be significantly higher than temporalis during chewing at 2-months ($p=0.001$) and 1-year ($p=<0.001$) (Table 6,9).

During chewing, the overall mean EMG values are found to be statistically higher at 1-year as compared to 2-months for both masseter ($p<0.001$) and temporalis ($p<0.001$) muscles (Table 6 & Fig.6,7).

Comparing tables 4 and 6, it is found that clenching values are higher than chewing values.

A negative correlation was found with respect to age and masseter EMG value. As age increases, during clenching and chewing, the mean EMG values of masseter decreased at 2 months and one year, but the results are not statistically significant (Table 7).

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Table 3 Mean, standard deviation of each muscle during clenching at each recording time.

Muscle	**2 Month**	**1 Year**	*p* value
Masseter			
RM	419.40±37.10	434.54±32.71	<0.001
LM	407.86±37.95	428.72±37.04	<0.001
p value	<0.001	<0.001	
Temporalis			
RT	399.40±31.87	408.95±30.38	<0.001
LT	393.09±37.38	404.13±33.12	<0.001
p value	<0.001	<0.001	

Table 4 Overall mean, standard deviation of each muscle during clenching at each recording time

Muscle	**2 Month**	**1 Year**	*p* value
Masseter	827.27±74.69	863.27±69.62	<0.001
Temporalis	813.09±63.24	792.50±65.95	<0.001
p value	0.005	0.045	

Table 5 Mean, standard deviation of each muscle during chewing at each recording time.

Muscle	**2 M**	**1 Year**	*p* value
Masseter			
RM	348.95±35.51	366.86±32.59	<0.001
LM	332.18±30.30	357.81±26.22	<0.001
p value	<0.001	<0.001	
Temporalis			
RT	286.36±31.51	310.40±32.59	<0.001
LT	276.59±31.87	301.90±32.96	<0.001
p value	<0.001	<0.001	

Table 6 Overall mean, standard deviation of each muscle during chewing at each recording time

Muscle	**2 Month**	**1 Year**	*p* value
Masseter	681.13±64.23	724.68±57.44	<0.001
Temporalis	562.95±62.96	612.31±65.16	<0.001
p value	0.001	0.000	

Table 7 Correlation between age and masseter EMG amplitude

Correlation	**r value**	*p* value
Age and masseter clenching –1 year	-.240	0.28
2 months	-.200	0.37
Age and masseter chewing – 1 year	-.089	0.69
2 months	-.187	0.40

Table 8 Simplified table showing Mean EMG activity of RM and LM during chewing at 2 months

Muscle	EMG value	P value
Right Masseter	348.95±35.51	<0.01
Left Masseter	332.18±30.30	

Table 9 Mean EMG activity of masseter and temporalis during chewing at 2-months

Muscle		P value
Masseter	681.13±64.23	0.001
Temporalis	562.96±62.97	

The comparison of EMG values obtained during clenching is presented in table 3 and Fig.3,4,5.

The comparison of EMG values obtained during chewing is presented in table 5 and Fig.6,7.

Table 10 Mean EMG activity of masseter and temporalis during clenching at 2 months and 1 year

Muscles	2 months	One year	Overall
Masseter	8237.27±74.67	863.273±69.62	1690.54±143.46
Temporalis	792.50±68.95	813.09±63.24	1605.59±131.97
P value	0.005	0.045	0.016

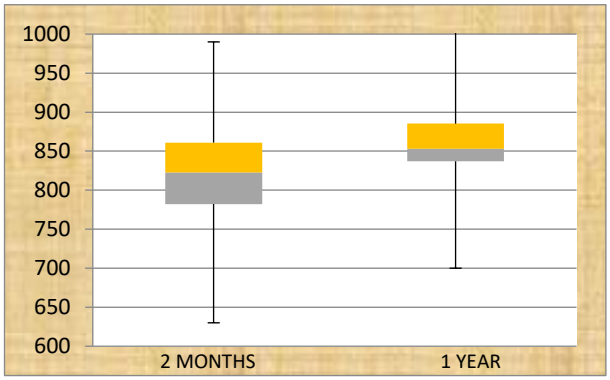

Figure 3 The graph of masseter mean of EMG during clenching

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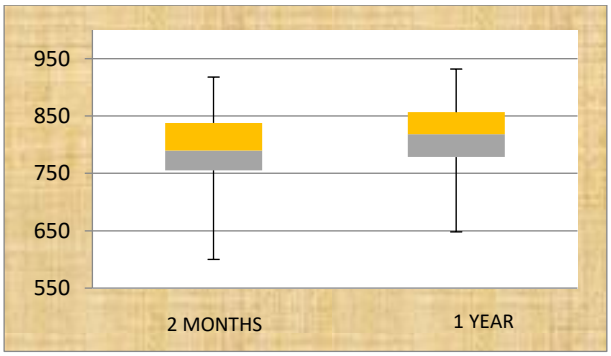

Figure 4 Graph of temporalis mean EMG during clenching

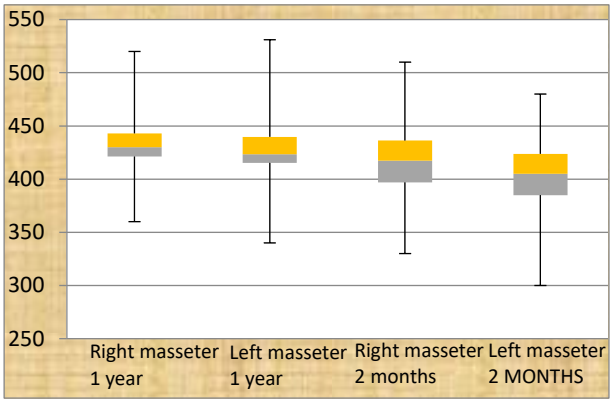

Figure 5 The graph mean of EMG of right and left masseter during clenching

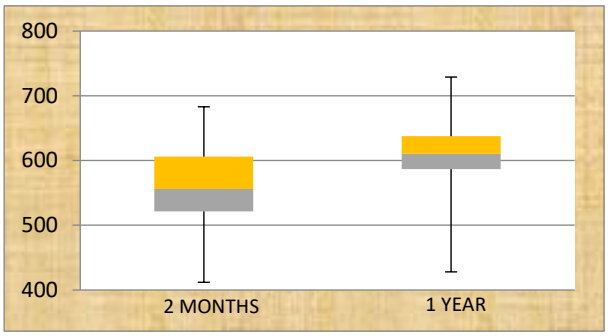

Figure 6 The graph of EMG values of temporalis during chewing

DISCUSSION

Twenty-two subjects were studied aged 58-72 years (mean 62.13 years, SD 4.34) who had all undergone total rehabilitation by means of conventional CD prostheses. The aim of this study was to evaluate through EMG the muscular behaviour after CD insertion between the paired masticatory muscles at 2 months and one year of denture use.

The sEMG has long been the "gold standard" for monitoring muscle activity of masticatory muscle at rest and in function. This pain free examination, allows the study of the muscular activity, enabling the capture of action potentials generated during the muscular contraction, which can be analyzed considering the parameters of length and amplitude.[12] The theory behind these electrodes is that they form a chemical equilibrium between the detecting surface and the skin of the body through electrolytic conduction, so that current can flow into the electrode. These electrodes are simple and very easy to implement. The conductive properties of the whole nerve and muscle allow measurement of electrical activity with extra-cellular (surface) electrodes. These electrodes do not penetrate the cell membrane, but detect potential differences external to the muscle fibre and distant from the potential source. So, they do not interfere with natural function. EMG techniques permit more precise assessment of muscle functions than that was previously possible by clinical observation.[4]

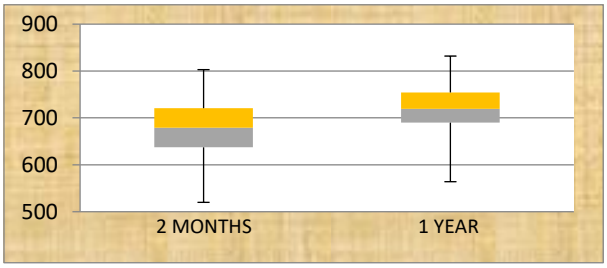

Figure 7 The graph of EMG values of masseter during chewing

As the muscle contraction increases, the muscle gives a higher EMG-values and works better. There is an increase in the EMG values if the retention is better, if the prosthesis functions better or also if the muscle works better. Hence, better readings are obtained. Analysis of masseter and temporalis muscles permit determining muscle activity during function. The present sEMG analysis of both static (clenching) and dynamic (chewing) procedures were taken into account due to it being the combination of the masticatory efficiency.

The reasons for evaluating the two muscles, masseter and temporalis, only are firstly as these are one of the two muscles of mastication, and as these are the muscles which are not deep and can be palpated and so their function can be recorded by the surface EMG.[14] Measurements were done at 2 months which is considered as the minimum adaptation period. Marcelo et al[12] suggested that a period longer than five months of wearing the new dentures is required for adaptation and the acquisition of functional capacity.

Clenching

The clench test is able to record the patient's ability to clench and recruit the masticatory muscles (temporalis anterior and masseter muscle groups are recorded). Higher sustained amplitude readings are a good indicator that the muscles are able to function. During clenching, recruitment of motor

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units increases so as to allow maximum biting force to be developed. It seems clear that the better the masticatory system works, the greater the force it will be able to develop comfortably, and that requires perfect motor co-ordination and the absence of any discomfort in teeth or TMJ that would inhibit the application of force. Thus, the potential recorded during clenching is a measure of the quality of the masticatory system.

It is known that there is a linear relationship between the strength of a muscle and the amplitude of EMG. The mean values obtained during clenching were comparable to that reported in literature.[14] (masseter 430.60 and temporalis 426.80)
There is an evidence-based studies reporting that maximal bite force and the electrical muscle activity during maximal bite in the intercuspal position are significantly weaker in patients with functional disorders of the masticatory system.[15] A reduction in sEMG amplitude during a functional clench test is a clear indication of a physiologic impairment. In our study during clenching, in masseter muscle after one year EMG amplitude increased with respect to 2 months (p<0.001) (table 3,4). According to some authors, less myoelectric activity indicates atrophy.[11] This was not found in any samples of this research. For this reason, the effects of dental prosthesis can be considered as beneficial. Therefore, the rehabilitation with CDs may be considered as beneficial to patients allowing aesthetical, functional and physiologic improvements with relatively low cost.

Chewing

Mastication is controlled neurologically. According to literature,[16] alterations in occlusal relation due to residual ridge resorption and CD seating would affect the EMG activity of masticatory muscles. However, there are few EMG studies on the effects of tooth loss and CD use.
In this study sugarless chewing gum was used as the test material for chewing. The right side was chosen at random. To standardize the test-material it was used chewing gum as it has uniform properties that provide an ideal test bolus for our study. As salivary stimulation can influence masticatory-function it was used a commercially available sugarless chewing gum. Many authors have used chewing gum in their studies.[17-19]

Masseter muscle

The masseter is the most active muscle during the chewing process.[20,21,54,61] This activity was noticed in this study also at 2-months and one-year after prosthetic rehabilitation. Therefore, the difference between right and left masseter muscles were recorded. Literature review shows that this difference may be found in most cases since patients usually prefer one side rather than the other during chewing, independently of age, gender or food type, even after myofunctional therapy.[20,21] Significantly higher values were observed for masseter than temporalis during clenching at both sessions which mean that masseter is more active in clench.

In clenching, the comparative means electrical activity values of the masseter muscle during the tooth clenching test at two months (RT side 419.40 ±37.10, LT side 407.86±37.95) are comparable to that reported in literature.[4]
The comparative means electrical activity values of the masseter muscles and the anterior temporal muscles during the tooth clenching test, after two months of having the new dentures put in place (Table 3). These findings are in keeping with the fact that the masseter muscle is more active in raising the mandible, especially during masticatory function.[12] According to literature, the mean electrical activities recorded at the surface of the muscles increases with the force of muscular contraction.[12,8]

During chewing, EMG amplitude from the muscle of right side was significantly higher than the left side at 2 months (p<0.001) (Table 2) which is in accordance with previous literature.[22] At 1-year also EMG amplitude from the muscle of right side was significantly higher than the left side during chewing (p<0.001) (Table 2). Comparisons are not available in the literature for 1-year for similar ridge conditions.

Temporalis muscle

The overall mean EMG value of masseter is found to be significantly higher than temporalis during clenching at 2 months (p=0.005) and 1-year (p=0.045). The temporalis muscle activity was significantly lower than the masseter activity when the subjects clenched with a CD (Table 4). Similar data were found in literatur.[16,23] Our results support the findings in the literature that during voluntary dental clenching, the myoelectric activity of the temporal muscle does not exceed the activation of the masseter muscle.[12]
During clenching electrical activity of the temporal muscle was lower than that of the masseter muscle at 2 months of having the new CDs put in place. Similar data were found in literature.[16,23]
During clenching, at one year also electrical activity of the temporal muscle was lower than that of

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the masseter muscle. Comparisons are not available in the literature.

The maximum tooth clenching recordings revealed an increase in the mean electrical activity value of the anterior temporal muscles at 1-year compared to 2-months ($p<0.001$) (Table 5). Also, high SD were observed in the initial data for temporalis during clenching. After one year of denture use SD values decreased in similarity with some authors.[21]

Chewing

EMG activity of temporalis muscle in the side of chewing was higher than the other side at 2 months and 1-year ($p<0.001$) similar to that obtained in few studies.[21] The mean EMG values of temporalis during chewing at 2 months are comparable to that reported in literature.[24]

The overall results agree with some authors who reported that the chewing efficiency showed marked increased by time in favour to the conventional acrylic because improving the denture adaptation which may be due to the neuromuscular control, which is gradually and slowly generated by time, i.e. the longer the period of denture wearing, the better the neuromuscular control gained.[9,24] Clinically, the use of the new CD should allow, functional benefit of the masticatory system.[21] Thus, the results of the present study indicate that masseter contributes to most of isometric force during maximum clenching and temporalis is the postural muscle controlling mandibular movements in excursive function. So, their electrical activity helps in assessing physiologic process of mastication adaptation.

Age

The results demonstrate that EMG activity of masseter muscles during clenching negatively correlates with age. Elderly patients exhibited significantly lower EMG voltage.[25] In our study it was observed that EMG activity was less in older patients (above 70 years old) similar to studies reported.[6] This is mainly due to a late and progressive weakening of masticatory muscle that takes place with ageing. Ageing seems to modify the neuromascular controls involved in mastication. This point is in accordance with the fact that masticatory performances decrease with age as other motion activities.[4] Some age-related changes such as deterioration in the fast and slow fibres in striated muscle result in impaired muscle force.[26]

Limitations of the study

Future research is needed to better characterrize the complex process of mastication and how this function is influenced by food properties. Observing a larger sample size with more homogenous groups and use of free mastication while subjects are processing different foods in a random manner will likely help to detect additional meaningful differences on the outcomes of various prosthodontic treatments. Adaptations of neuromascular system may take an extended time and may be a determinant factor in influencing the EMG activity and this aspect can change the results.

Further investigations are needed to explore the relationship between occlusal features and muscular activity Moreover prolonged use of devices in the oral cavity can cause changes in muscle activivity. Longitudinal studies are to be done to appraise the long-lasting effects and modifications in neuromuscular control induced by prosthetic rehabilitation. It would be convenient to perform EMG studies in a larger number of patients who initiate the use of a new CDs, even carry it out routinely, to implement measures that contribute to a better adaptation to dentures.

Within the limitations of this study, it was possible to conclude that the new prosthesis has positive effect on subject's muscular activity. Understanding the functional behaviour of masticatory muscles of CD wearers are important in the prognosis of treatment.

Jaw muscles are versatile entities with dynamic nature. By EMG, we can see muscular changes in patients with prosthetic rehabilitation; therefore, it can be stated that good-rehabilitation interferes on muscle harmony thus improving the efficiency of muscles.

Electrodiagnostic resources are still far from a concrete professional reality due to the lack of knowledge about the technique along with high-cost equipment. It is essential to explain to CD users, the importance of attending periodical visits in order to evaluate their dentures and oral conditions.

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Custom ocular prosthesis with modification in impression and iris button for rehabilitation of post-enucleation eye defect: a case report

[1]Kriswandy Putra, [2]Putri Welda Utami Ritonga, [3]Haslinda Z. Tamin
[1]Postgraduate Program in Prosthodontics
[2]Departement Prosthodontics,
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia
Corresponding author: **Kriswandy Putra**, e-mail: **drg.kriswandy@yahoo.com**

ABSTRACT
Loss of eye have physiologic and social impact on patients, especially in pediatric patients. To overcome this problem ocular prosthesis can be made similar with the color, shape, size and movement of the patient's eye, so the ocular prosthesis can look like natural eye. The various methods, techniques and concepts documented in this case report with modifications to the physiologic impression and making of iris buttons aim to get the better movement of the prosthesis and 3D profile of the iris. A 6-years-old female patient came to the USU Dental Hospital to fabricate a new eye prosthesis. The patient had a medical history of retinoblastoma at the age of 2 years and had enucleation surgery. The eye is rehabilitated with fabrication of a custom ocular prosthesis with modifications on physiologic impression and iris button making. Modifications to physiologic impression and modifications to the fabrication of iris buttons will provide movement, shape and 3D effects of iris that are better than stock eye prosthesis. It is concluded that custom ocular prosthesis with modification on physiologic impression provide a better and more natural movement. While modification on making iris button using customized iris button cuvette will facilitate the process of making iris button.
Keywords: custom ocular prosthesis, physiologic impression, iris button

This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

Eyes are one of the important organs in the human body. Other than its primary function on vision, a complete eye contributes to aesthetic face and facial expression. Loss of eye will impact patient physiologic and social life, especially in pediatric patients.

Eye loss can be caused by congenital anomalies, trauma, or tumors.[1] There are 3 types of surgery on eye ball consisting of evisceration is the removal of the contents of the eyeball by leaving the sclera, Tenon's capsule, conjunctiva, extraocular muscles, while the cornea is sometimes maintained with the condition of the nerve fibers intact; enucleation is a surgical process in which the entire eyeball is removed after severing the muscles and the optic nerve, while exenteration is the removal of the contents of the orbit, including the eyelids and surrounding tissue.[1-3]

In the case of eye defects, the rehabilitations can be divided into 2 types, orbital implants and ocular prostheses.[4] Ocular prostheses can be divided into 2 types, stock eyes and custom ocular prosthesis.[5] Stock eye is a popular rehabilitation method in the past and are still used up to now,[6] because the minimal manufacturing time until it does not require any manufacturing steps in the laboraratory and consists of various types of iris sizes and colors. The disadvantages are discomfort and infection due to the difference in size between the eye socket and the stock eye, causing water pockets to become a breeding ground for bacteria, unmatched iris color also causes aesthetic problems in stock eyes. Stock eyes have a thin shape and are made of acrylic material, indicated for the rehabilitation of post-evisceration eye defects.[6]

Custom ocular prosthesis can be indicated to rehabilitate eye socket after evisceration and enucleation, whereas custom ocular prosthesis is contraindicated in patients who are allergic to acrylic materials and in eye sockets that lack retention. Custom ocular prosthesis has various advantages such as the color of the ocular prosthesis iris and sclera can be adjusted to the color of the eye that is still present. The prosthesis can be adjusted to the condition of the patient's eye socket and the movement of the custom prosthesis will be better than the stock eyes. Meanwhile, the disadvantage of a custom ocular prosthesis is that it takes a long time for the manufacturing process in the laboratory.[6]

The manufacture of custom ocular prosthesis has evolved in manufacturing techniques and materials from time to time. Ocular prosthesis can use materials made of glass or poly methyl methacrylate (PMMA) acrylic resin. At this time glass material is not an option for making eye prostheses because these materials break easily and their surface changes due to contact with orbital fluid and can only survive 18-24 months.[4] Based on previous experience the use of glass material also cannot cor-

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rect the loss of orbital volume or the atrophic condition that occurs, has a rather sharp edge and is less comfortable to use.[6] The first custom made ocular prosthesis made of acrylic material was made in 1943 by the dentists of the United States Army. This material has advantages such as not easy to break and easy to produce. Although the intaglio surface of this prosthesis fits into the eye socket, not the entire surface of the prosthesis is polished, so it can cause irritation to the socket if it is loose.[4]

This paper is aimed to explain the process of making a custom ocular prosthesis with modifications in physiologic impression and the manufacture of the iris button.

CASE

A 6-years-old female patient, came to the Universitas Sumatera Utara Dental Hospital with a chief complaint of loose and deformed old artificial eye that she wanted to make a new and better artificial eye. The patient had a medical history of retinoblastoma at the age of 2 years and had undergone enucleation surgery at that time. The patient has also worn stock eyes after 2 months post-surgery to date (Fig.1A,B,C).

On clinical examination of the intraocular tissue (Fig.1D), the eye sockets were in good condition and the depth of the eye sockets was shallow in the inferior palpebral area but quite deep in the superior palpebral area.

MANAGEMENT

Anatomical impressions were performed using an impression tray made of visible light cure (VLC) which was connected to the syringe (Fig.2A) by first testing the tray into the eye socket to see excessive

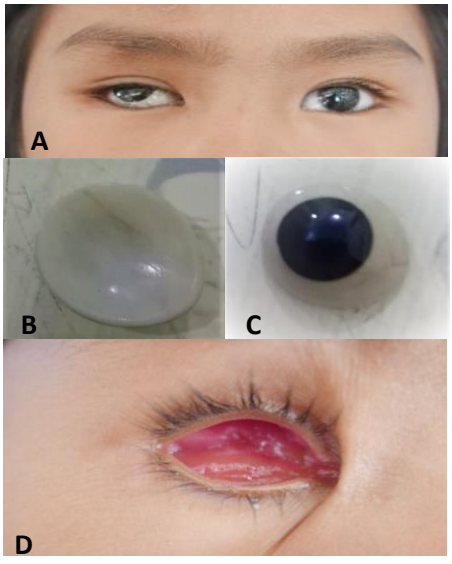

Figure 1A The patient uses old stock eyes, **B** old stock eyes intaglio surface, **C** old stock eyes facial surface, **D** intra-ocular examination of the right eye.

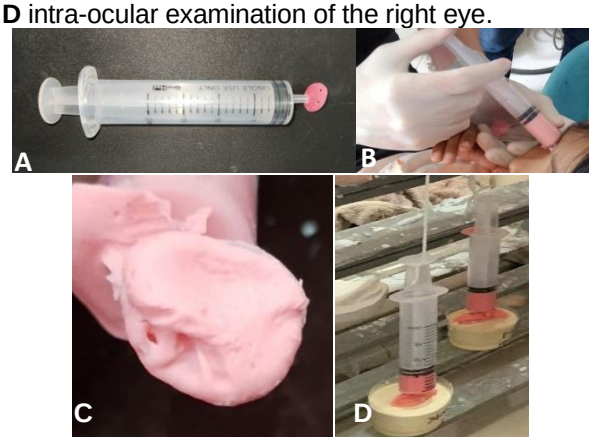

Figure 2A VLC impression tray connected to a disposable syringe, **B** anatomical impression with irreversible hydrocolloid impression material, **C** intaglio surface of anatomical Impression, **D** anatomical impression

Figure 3A Anatomical wax pattern making, **B** try in anatomical sclera wax pattern into the patient's eye socket

expansion. Anatomical impressions of eye sockets were performed using irreversible hydrocolloid (alginate) material with normal setting time. First, stir the alginate in a rubber bowl with the ratio of powder and water according to the manufacturer's directions, after stirring insert the alginate into a syringe with a VLC impression tray attached to the syringe. Then the tray is placed into the socket and the alginate is injected into the eye socket. The position of the patient sitting in an upright position, the patient was instructed to move the eyeball to the right, left, up and down without moving the head to record the proper depth and width of the socket (Fig.2B). After the material hardens, the tray is removed and the remaining print material is cleaned from the socket.

The anatomical imprinted intaglio surface (Fig. 2C) was implanted in a small plastic cup containing half of the dental stone to anterior posterior border of the impression and allowed to harden (Fig.2D).

Making anatomical slera wax patterns; first the surface of the mold is coated with petroleum jelly then liquid wax is poured into the mold, let the wax harden after that the wax pattern is adjusted to the shape of the patient's natural eye convexity with the highest part of the convexity located in the pupillary area. Trial the anatomical sclera wax pattern on the patient's eye socket until the eyeball shape is most suitable for the natural eye. After everything

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is matched, surface of the wax pattern is smoothed (Fig.3A). After that, try in the patient's eye socket to see if it matches the real eye (Fig.3B).

Making physiologic impression tray mold using polyvinyl siloxane (putty and light body). First, the anatomical sclera wax pattern was implanted from the intaglio to the periphery on the base of the cuvette using putty material and then allow it to harden, then apply vaseline to the putty surface to prevent the putty and the antagonist light body merging. Cover the surface of the cuvette with plastic separator then place the antagonist cuvette. The antagonist cuvette is then filled with putty material then closed and pressed, after the putty material hardens open the cuvette, remove the plastic separator and inject the light body on the antagonist surface then the cuvette is closed and pressed again to get details of the wax pattern. After the printed material hardens, open the cuvette and remove the wax pattern (Fig.4A).

After obtaining a mold from putty material, it will be continued with the manufacture of physiologic impression tray using a self-polymerized acrylic resin with a ratio of powder and liquid according to the manufacturer's instructions, the acrylic is stirred in a rubber bowl and allowed to reach the dough stage then the acrylic is inserted into the mold and pressed on cuvette to remove excess acrylic. After the acrylic material hardens, open the cuvette and trim the physiologic tray (Fig.4B).

Physiologic impression was carried out using polyvinyl siloxane (light body) material. First, adhesive tray material was applied to the intaglio and peripheral surfaces of the physiologic impression tray, then the light body impression material was injected into the eye socket using a mixing tip and a dispensing gun. Insert the physiologic tray into the eye socket then the patient was instructed to

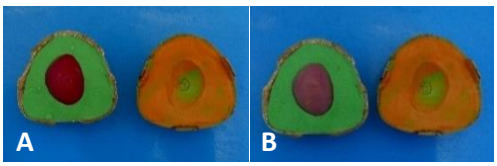

Figure 4A Immersion of anatomical sclera wax pattern in cuvette, **B** physiologic tray from self-polymerized acrylic

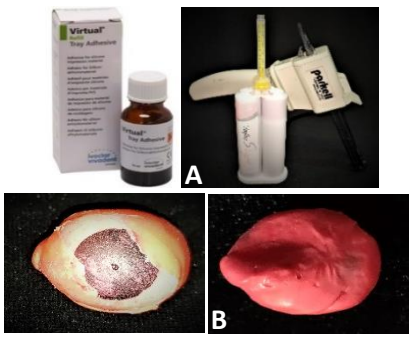

Figure 5A Tray adhesive material, PVS light body and, **B** the result of physiologic impression.

close his eyes and move his eyes up, down, left and right, this aims to record all movements that may occur when the prosthesis is used. After the impression material hardens remove the physiologic tray from the socket. Smooth out the impression result by removing excess material (Fig.5).

In making mold for physiologic sclera, embedded physiologic impression tray intaglio surface into the base of cuvette using a type IV dental stone; where the embedded portion of the tray is the intaglio portion of the impression tray. After the dental stone has hardened, apply vaseline to the entire surface of the dental stone and physiologic tray then unite the antagonist cuvette and fill it with the type IV dental stone, then close the cuvette and the dental stone will harden. After hardening, open the cuvette and remove the physiologic impression tray to obtain a mold from the physiologic sclera (Fig.6A).

Physiologic sclera is made by using wax with pouring liquid wax into the mold. First heat the wax until it melts then pour the molten wax on the facial mold and let it harden. After hardening, proceed with pouring the molten wax on the intaglio mold where after the molten wax is poured, immediately close the cuvette and press the cuvette until the wax hardens. Open the cuvette and remove the physiologic sclera wax pattern and trim away excess wax.

Try in physiologic sclera wax, determine the location, size and color of the iris. Try-in physiologic sclera wax pattern is performed on the patient's eye socket to see if the sclera convexity is in similar with contralateral eye, then check the movement of the physiologic sclera wax pattern (Fig.6B). Determination the location and size of the iris is using the interpupillary distance (IPD) ruler (Fig.6C).

Determine the size of the iris, in this patient the iris size is 11 mm, so an iris disc made of plastic material with a diameter of 10.5 mm was used to compensate for the enlargement effect due to the convexity of the sclera and iris button. Then the pupil disc was placed with previously determined

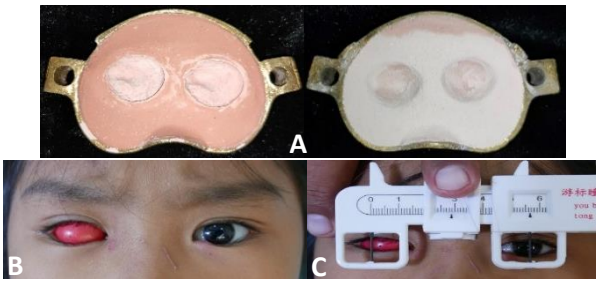

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Figure 7A Iris and pupil disc that have been fused, **B** making iris pattern with light cure resin composite, **C** the coloring process and the finished iris.

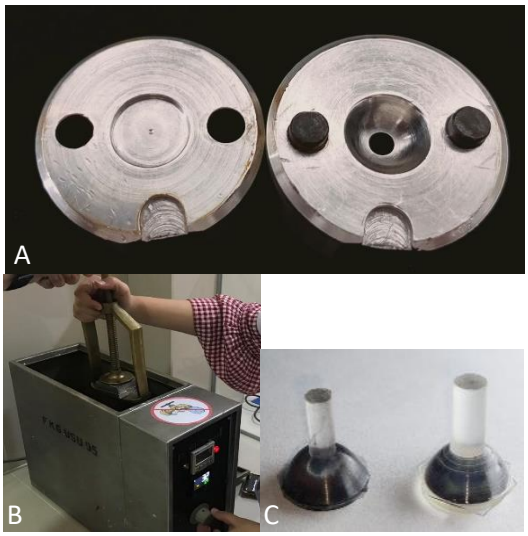

Figure 8A Customized iris button cuvette, **B** waterbath, **C** finished iris button

midpoint in the iris disc (Fig.7A). Making iris pattern is done by using light cure resin composite to get a better 3-D effect. After the iris pattern is finished, it is followed by coloring the iris using acrylic paint with the color that matched with patient contralateral eye. Where in this case acrylic paint is used with a mixture of burnt umber and black colors in a ratio (1:1/2) (Fig.7B); when finished, the paint is allowed to dry for 24 hours (Fig.7C).

After the paint is dry, it was continued with making the iris button using a customized iris button mold cuvette (Fig.8A). Iris buttons will be made using heat cured acrylic resin with clear color and processed using a water bath (Fig.8B). After the boiling process is completed, the iris button was ready (Fig.8C).

Insertion of the iris button on the physiologic sclera. After the iris button has been produced, it will be continued by making a hole for the iris button in the physiologic sclera wax pattern. Where the position and diameter of the hole has been determined at the time of try-in physiologic sclera wax pattern. After the hole is made, the iris button can be incorporated into a physiologic sclera wax pattern. After the iris button is installed, the sclera wax

Figure 6A Physiologic sclera mold, **B** try in physiologic sclera wax pattern, **C** using the IPD ruler to determine the location and size of the iris

pattern will be tried in again to the patient to see if the iris button position is correct or if it needs to be readjusted.

Definitive sclera preparation was performed by immersing the physiologic sclera wax pattern into a cuvette with the iris button attached to the sclera wax pattern. Immersion in the cuvette was carried out using type IV dental stone. After hardening the cuvette was opened and dewaxed the cuvette. The cuvette is allowed to dry and then apply cold mold seal (CMS) on both surfaces of the dental stone except for the iris button do not apply CMS. Stir the heat cured PMMA with the ratio of powder and liquid according to the manufacturer's recommendations and the pre-determined color. Mixing is done using a rubber bowl; after that, allow the acrylic to reach the dough stage, then put the resin into the cuvette and press to remove excess acrylic resin. Boiling is done using a water bath at 80^{o}C and a time of 1 hour 30 minutes. After the boiling process is complete, let the cuvette cool then open the cuvette and remove the eye prosthesis, grind the prosthesis from the remaining acrylic and polish the facial to the peripheral edges.

Definitive sclera try-in to see if the convexity is appropriate and make adjustments until the sclera is similar to the original eye. If there is an adjustment to the sclera convexity, the antagonist cuvette must be replanted to correct the changes that have been made. Reduction of the facial surface to the periphery of about 1.5-2 mm to obtain space for the clear acrylic resin (Fig.9).

Coating of clear acrylic on the facial surface. Place the reduced facial sclera back into the cuvette, then stir in the heat cured PMMA with powder-to-liquid ratio as recommended by the manufacturer. Mixing is done using a rubber bowl, after stirring, allow the acrylic to reach the dough stage, then put the resin into the cuvette and press to remove excess acrylic resin.

Boiling was carried out using a water bath at a temperature of 80^{o}C and a time of 1 hour 30 minutes. After the boiling process is complete, let the cuvette cool then open the cuvette and remove the eye prosthesis, grind the prosthesis from the remaining acrylic and polish the facial to the peripheral edges (Fig.10A).

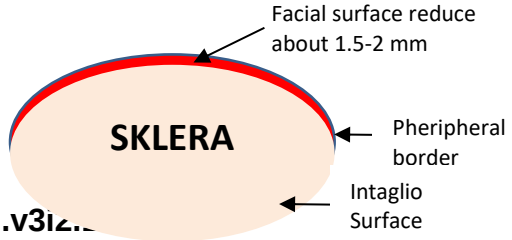

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Figure 9 Overview of reduced facial portion of the sclera

Figure 10A Completed eye prostheses, **B** patient wearing right ocular prosthesis

The finished prosthesis is inserted with attention to esthetic appearance, comfort and function (Fig.10B). The patient is given instructions on how to put on and remove the prosthesis, as well as how to treat it at home. The prosthesis should be inserted with clean hands, removed at wax and immersed in an antibacterial solution. Controls were carried out on days 1, 3, 7 post-inserting.

DISCUSSION

Eye loss can be caused by congenital anomalies, trauma, or tumors. There are 3 types of surgery on eye ball consisting of evisceration, enucleation and exenteration.[1,4] Ocular prostheses aims to restore the patient's facial appearance to look normal, so it can give patient more self confidence in social life.

Ocular prostheses are recommended to be made 6-8 weeks after evisceration or enucleation and after healing of the socket.[4] Ocular prostheses are divided into stock eye prostheses, custom ocular prostheses and ocular implants.[1] Stock eye prostheses come in standard size, contour, shape and colour.

Custom ocular prosthesis can produce movement, orientation, color, iris and sclera contour, pupil and iris size, a more real and symmetrical appearance on the patient's face.[7]

By making a custom ocular prosthesis with modifications to physiologic impression using anatomical sclera made of PMMA acrylic material as an impression tray, with light body Impression materials and Impression techniques with eyes closed and eye socket muscle activation, it is hoped that it will give better results in custom movements.

Meanwhile, modifications to the iris button making by sculpting the iris pattern are expected to give iris a more lively and real impression on the iris from the custom ocular prosthesis produced.

The use of the customized iris button mold itself can simplify the process of making the iris button that will be used.

Process of making a custom ocular prosthesis is very sensitive technique but can produce a better ocular prosthesis compared to the use of stock eyes. With the advantages obtained in this custom ocular prosthesis, it is hoped that it can improve the quality of life of these patients, especially in terms of psychological and social aspects of the patient.

However, this custom ocular prosthesis also requires treatment if it has been used for a long time. the surface becomes rough which can lead to accumulation of debris. Efforts to overcome this can be done by cleaning the ocular prosthesis regularly and if scratches and deposits form, polishing is done again. This is done every 6 months at a time to evaluate and readjust the patient's ophthalmic prosthesis.

It is concluded that custom ocular prosthesis fabrication with modifications to physiologic impressions and iris button fabrication can be an option to rehabilitate post-enucleated eye defects. This physiologic impression modification can record the details of the eye socket intaglio so that the eye prosthesis can have better and natural movement.

While modifications to the iris button manufacturing technique are expected to provide a better 3-D effect on the resulting iris, and using a customized iris button cuvette can simplify the process of making iris buttons so that maximum results are obtained. This method produces a more natural ocular prostheses compared to stock eye and patient feels more satisfied, improving the patient's confidence.

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Silicone auricular prosthetics with adhesive retention: a case report

[1]Nasruddin, [2]Rustan Ambo Asse, [3]Eri Hendra Jubhari
[1]Prosthodontic Specialist Dental Education Student, Faculty of Dentistry, Hasanuddin University, Makassar
[2]Prosthodontics specialist, Abdul Rivai Hospital, Berau, East Kalimantan,
[3]Department of Prosthodontics, Faculty of Dentistry, Hasanuddin University, Makassar
Indonesia
Corresponding author: **Nasruddin**, e-mail: **naslutim@gmail.com**; **Eri Hendra Jubhari**, e-mail: **erihjubhari@gmail.com**

ABSTRACT
A-18-years-old male came to the Dental and Oral Hospital of Hasanuddin University with a complaint of losing his left ear due to a traffic accident several years ago and often feeling pain in his ear especially when blown by strong winds. The patient wants to make an auricular prosthesis so that his self-esteem returns to normal. The extraoral examination showed convex profile, oval-shaped face, symmetrical eyes, nose and lips, submandibular lymph nodes exhibit without complaints. The right and left ears are not symmetrical. Manufacture of silicone auricular prosthesis with adhesive retention. Anatomical impressions of the patient's and his siblings' ears were performed as a guide for duplication of the patient's left ear using an irreversible hydrocolloid impression material. The wax pattern of the ear prosthesis that had been made on the die was paired with the patient to check the size accuracy and left and right symmetry. Then proceed with the process of acrylic packing and coloring. After the laboratory process was completed, insertion is carried out. Signs of successful treatment: silicone ear prosthesis with adhesive retention has restored the patient appearance and self-esteem.

Keywords: auricular prosthesis, silicone, adhesive, self-esteem
This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

Ear defects can occur secondarily to congenital malformations, trauma or tumour surgery. The absence of an ear is a considerable aesthetic problem that may affect the patient's psychology and social behaviour.[1] Correction of ear defects can be accomplished surgically, prosthetically or through a combination of these approaches; the choice of treatment depends on the site, size, age and aetiology of the defect as well as the patient's desires.[1,2]

Reconstructive surgery is limited by the age and medical conditions of the patient, insufficient residual tissue, vascular compromise due to radiation and the patient's preferences.[3,4] Further, after a surgical procedure, the reconstructed ear may not resemble the normal one.[5] On the other side, prosthetic treatment can produce an anatomically accurate and aesthetic device.[4,6] Before introduction of osseointegration, auricular prostheses were retained by adhesives or a connection to eyeglasses.[4,6,7]

The aim of maxillofacial rehabilitation should provide a suitable prosthesis for patients with facial defects so that they are rehabilitated back to the society to face and accept the challenges of life.[8,9] It encourages the best possible quality of life and upholds their self-image during their traumatic psychological adjustment.[10] Among the large number of materials that have been tried out in the history of anaplastology, for example, porcelain, natural rubber, gelatin and latex, two have established them-selves: methacrylates and silicones.[10-12] Retention and stability are major concerns regarding comfortable use of a facial prosthesis. Medical adhesives, anatomical undercuts and mechanical devices like spectacles, hair bands, magnets and implants have been used to retain prosthesis. Since the introduction of percutaneous endosseous implants for use with bone conduction hearing aids in 1977, implants have acquired important role in the prosthetic rehabilitation of patients with craniofacial defects.[13] Implants can vastly improve the retention and stability of a facial prosthesis. Despite improvement in per capita income, financial consideration is among one of the prime barriers in seeking maxillofacial treatment in developing countries.

This article describes a simplified and economical approach for fabricating silicone auricular prosthesis.

CASE

A-18-years-old male, came to the Dental and Oral Hospital of Hasanuddin University with a complaint of losing his left ear due to a traffic accident and often feeling pain in his ear especially when blown by strong winds. The patient wants to make an auricular prosthesis so that his self-esteem returns to normal. Extraoral examination, convex profile, oval-shaped face, symmetrical eyes, nose and lips on the right and left, submandibular lymph nodes exhibit without complaints. The right and left ears are not symmetrical.

Examination of the ear area is carried out to confirm the diagnosis of the patient's defect. Based on the classification according to Luo et al, the patient's ear defects are categorized as type III dis-

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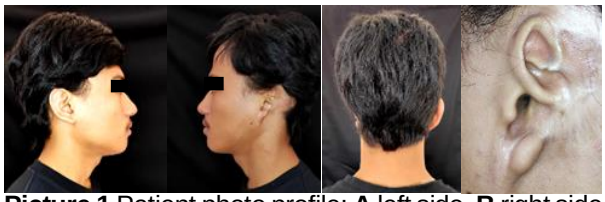
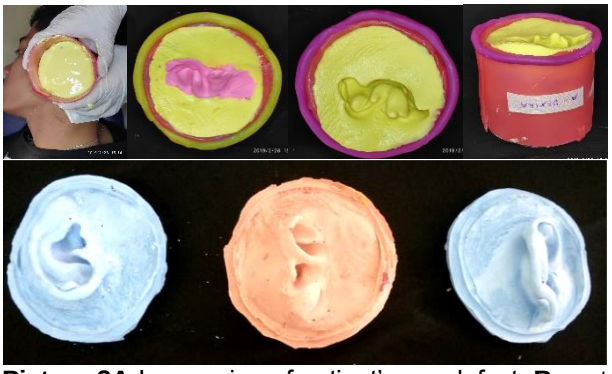


Picture 1 Patient photo profile; **A** left side, **B** right side, **C** back view, **D** defect photo of patient's left ear



Picture 2A Impression of patient's ear defect, **B** cast model of the ear

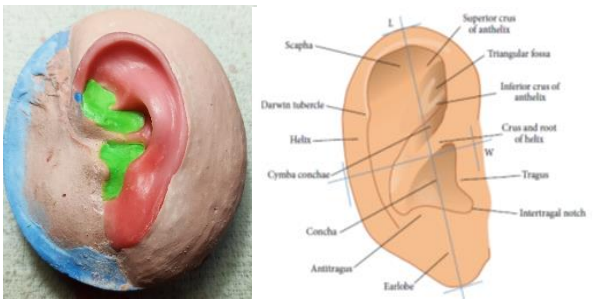
orders, namely most part or total ear loss with periauricular skin intact (Fig.1).

MANAGEMENT

Impression of the patient's auricular defect area was carried out with the patient in the dental unit in the supine position, the head position was adjusted so that the defect area was visible in the horizontal plane, and the patient was given a protective apron to protect his clothes during the impression procedure. The area around the auricular is outlined with a pencil that is not easily erased. The coordinates of the vertical and horizontal axes of the ear are made on the patient's skin. This mark will be transferred to the printout and will be visible on the working model. The image coordinates must be properly oriented during the fabrication of the new auricular prosthesis. Boxing is made using red wax to facilitate the impression process (Fig.2A).

The waxing up process is carried out by carving the shape of the on the working model with wax along the largest helical and lobe dimensions that cover all parts according to the anatomical shape of the ear. The posterior corner that has been completely carved is boxed by pouring the stone into the box area on the lower surface of the posterior helix and lobe. Boxing wax is removed from the superior aspect of the posterior which has been finished forming for easy carving on the external and exterior ear surface (Fig.2B).

The try-in stage for the patient is carried out after the waxing-up process is completed (Fig.3). The following points are checked at try in; the fit of prosthesis on the tissue, the correct horizontal alignment with the natural ear, the projection of the ear in relation to the side of the head, and the integrity of the margins.[15] After this stage is followed by the packing and coloring process.



Picture 3A Wax modelling results, **B** anatomy and landmarks of the auricle (Source: Storck K, Staudenmaier R, Buchberger M, Strenger T, Kreutzer K, von Bomhard A, Stark T. Total reconstruction of the auricle: our experiences on indications and recent techniques. BioMed Res Int 2014; Article ID 373286, 15 pages http://dx.doi.org/10.1155/2014/373286).

Picture 4 Try in process of auricular prosthesis waxing up; **A** front side, **B** back view, **C** side view.

The wax prosthesis is now sealed to the model and the leading edge is thinned as much as possisible so as to allow the silicone edges to feather into the natural skin. A three part mould is necessary to achieve easy placement of silicone. Embed the mould in plaster up to the leading edge. The middle section of the flask is added and stone is filled into the entire undercut section of the mould along the part line. After a suitable separating medium is applied, the remainder of the flask is filled with stone and is closed. Also, the plaster can be soaked in soap solution which acts as a separator. The helix undercut is poured in a hard dental stone. When pouring the section, finish the plaster so that the flash line will be on the undercut side of the helix. Allow to set, and then cut grooves to allow location with the top half of the mould. Mould is again soaked in soap solution (Fig.4).

The next step is to stain the auricular prosthesis by matching the skin color of the patient's ear (Fig.6). The staining technique chosen is the intrinsic staining technique by matching the color of the skin with the color of the silicone to be used.

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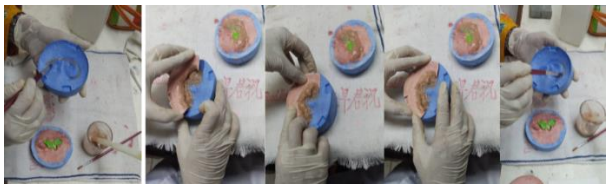

Picture 5. Packing process of auricular prosthesis

Figure 6 Shade matching technique of patient's ear. Source: Krishna PD, Archana AS, Anupama PD. Fabrication of a silicone auricular prosthesis – a case report. NUJHS 2016: 6(1), ISSN 2249-7110

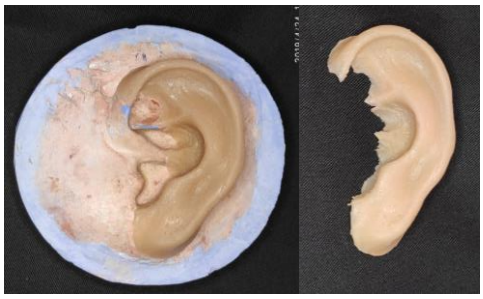

Figure 7A Colored auricular prosthesis, B ready to insert

Figure 8A Adhesive material using to attach the auricular prosthesis, **B** after auricular prosthesis inserted

After the colouring phase is complete, the auricular prosthesis is attached to the patient's defect area using adhesive material.

DISCUSSION

The replacement of anatomical parts is an art and science. Prosthesis form, coloration, texture must be as indiscernible as possible from the surrounding natural tissue. The ideally constructed prosthesis must duplicate the missing facial features so precisely that the casual observer notices nothing that would draw attention to the prosthetic reconstruction. The primary objective of maxillofacial prosthetics is to restore esthetics, function and preserve the remaining hard and soft tissues. The accomplishment of primary objective often leads to the important secondary objective of restoring the individual to the society and enabling them to lead a normal life.

In the initial evaluation of a patient for auricular reconstruction, several variables must be considered. These variables include a) patient-related factors, including medical health, medications, and smoking; b) patient's reconstructive goals cause of the defect; c) type of tissue involved: partial thickness versus full thickness; d) size and location of the defect; e) condition of surrounding local and regional tissues.

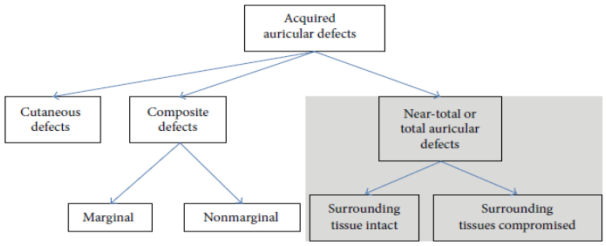

Figure 9 Louis' classification of acquired defects of ear.[14]

There are several advantages to silicone maxillofacial prosthesis. It requires little or no surgery, the patient spends less time away from home and job and the reconstruction is often more natural-looking. However, the drawbacks include the necessity of fastening the appliance to the skin and removing it every day. The function of the prosthetic ear is to direct the sound waves into the auditory canal and to maintain a proper environment for the inner ear membranes. It normally improves hearing by about 20%. The prosthetic ear will retain eyeglasses, and retain a hearing aid if needed. It also serves as a great psychological benefit in the rehabilitation of the patient.

The entire treatment was divided into four appointments: a) impressions, b) fabricating wax pattern, c) making the mould, and d) processing the prosthesis.

The difficulties faced during fabrication of custom-made prosthesis are; obtaining accurate impression of the defect without any compression or distortion of tissue, orientation of ear in harmony with the contra lateral ear, sculpturing the exact anatomy and position of the prosthesis, obtaining a satisfactory shade exactly matching to the skin complexion of contra lateral side of the face.

The location of the prosthetic auricle is predetermined by first observing the topographic relationship of opposite normal ear with facial features in cases of unilateral prosthetic reconstruction and then duplicating its position at the proposed reconstruction site. According to Tolleth, three measure-

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ments must be correct to achieve a proper placement of the auricle; *axis, level* and *distance* from the orbit.[16]

Axis; it is difficult to define exactly the positioning of the axis, but it can be described as the *line of balance* through the long dimension of the ear. Some indicate that axis is parallel to the bridge of nose. An angulation of 20° from vertical position seems to be satisfactory.

Level; the level can be assessed with the head in the anatomic vertical position. The highest part of the helix is on a line roughly with that of the eyebrow, and the lowest part of the lobule is on a line at the base of columella or slightly below that.

Distance from the orbit; the ideal distance of the prosthesis from the lateral orbital rim is about one ear length, or 6.5-7.5 cm.

The retention and stability of the prosthesis is an important factor for the prosthesis; hence the ear prosthesis can be retained by various methods of retention, either by using anatomical undercuts, hair bands, and frame of eyeglasses, adhesives and implants with magnets or bars.[17]

Although implants can provide better retention and stability of the prosthesis, the reported drawback of implants was high number of failure rates due to the effect of radiation therapy on bone morphology, the compromised healing of the skin in the region of the mastoid and accuracy of impression over movable tissues.[18] In addition, cost factor of the implants and the waiting period was not acceptable by the patient.

Another major disadvantage was that due to psychological trauma of undergoing oncosurgery, the patient hardly agrees to undergo another surgery for Implant placement. Thus, due to these factors, clinicians had no better option rather than using custom made prosthesis for such patients.[19]

The skin adhesive may degrade and results in reduced strength and bonding property over a long period of time; some skin adhesives have been reported to cause hypersensitive reactions.[19] Although the success rate of implant supported prosthesis is very high, the prosthesis retained with skin adhesives, anatomical and soft tissue undercuts are more successful due to their ease of application and are comparatively less expensive then implant supported prosthesis.[20]

Silicone elastomeric materials are more commonly used, because they provide better stability and good marginal adaptation, which satisfies patient's cosmetic and esthetic needs; but the major disadvantage is that the manipulation of silicone requires more complex, advanced and multifaceted techniques which are rather more expensive.[21] The silicone elastomeric material possess' excellent physical properties with good heat stability and are chemically inert materials, particularly when they are used in fabrication of prosthesis used to restore body parts.

Silicon elastomeric material possesses soft tissue like consistency; provide additional advantage when they are used to restore the defects in movable soft tissues. Silicon materials are available in various shades provided by manufacturers to give exact shade and texture of skin which closely simulate and resemble shade of patient's skin complexion. The drawback of the silicon prosthesis is that, in the long term the prosthesis material degrades easily and its additives undergo changes when exposed to moisture, high temperature, UV light and sunlight, thus creating a need for replacement by a new prosthesis. To overcome these disadvantages newer polymeric materials have been introduced like polyphopozenes, silicon block polymers, methacryloxy propyl terminated polydimethylsiloxane with enhanced mechanical, chemimical and physical properties, such as increased elongation, high edge strength, improved heat stability, good tear strength, chemically inert, low hardness and viscosity for fabrication of maxillofacial prostheses.[19]

The use of craniofacial implants for retention of extraoral prostheses, such as ears, offers excellent support and retentive abilities[1-3] and improves a patient's appearance and quality of life. The use of implants can eliminate or minimize the need for adhesive and allows for proper orientation and seating of an ear prosthesis by the patient. However, a satisfactory outcome may only be achieved by careful planning in terms of the number and position and orientation of the implants and the proper connection of the ear prosthesis to implant retention structure with a cast or machined bar. Precious alloys are commonly used for construction of a bar because of their excellent strength, but casting precious alloys onto wrought metals may not result in a perfect union.[4] The dental laboratory procedures involved are complex and expensive.[6]

Although our patient's silicone prosthesis could be worn without adhesives by snapping it onto his eyeglass earpiece, many patients require adhesives (eg, *Hollister, Mastisol*) or specially formulated facial prosthetic adhesives (*Daro, Pros-Aide, Secure*). Adhesives require patience and precision of the wearer to obtain correct initial placement of the prosthesis. This may be very difficult for older

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patients who have limited vision and dexterity in addition to the challenge of focusing on one side of the head while looking in the mirror. Silicone-based adhesives require solvents for cleaning the prosthesis, which accelerate deterioration of the prosthetic margins. Allergic contact dermatitis is known to occur with skin adhesives. Some prostheses may be lined with urethane to improve adhesion.[22]

It was concluded that auricular prosthesis is an option to restore the aesthetic function of the patient's face, thereby increasing the patient's self-confidence. Silicone material bonded with adhesive material is the best choice for patients who cannot be implanted as a retention of their auricular prosthesis.

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Individual impression technique by using functional method on the custom ocular prosthesis: a case report

[1]Ervi Gani, [2]Ricca Chairunnisa, [2]Haslinda Z Tamin
[1]Postgraduate Program in Prosthodontics
[2]Department of Prosthodontics
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia
Corresponding author: **Ervi Gani**, e-mail: **ervi.gani@gmail.com**

ABSTRACT
Enucleation leads to contracture of orbital tissue accompanied by reduction in volume and forniceal depth, which results in an inability to sustain a prosthesis. Shallow inferior fornix in contracted eye socket compromises adaptation, retention, stabilization and duplication of palpebral opening similar to natural eye in terms of size, support, contour and convexity make fabrication of custom ocular prosthesis become challenging. Hence, the present article describes the use of ocular prosthesis as conformer to obtain better appearance and enlarge orbital dimension in contracted socket. A 21-year-old male came to Dental Hospital Universitas Sumatera Utara with a complaint of unaesthetic face appearance due to enucleation of left eye in the last 5 years old subsequent to trauma by sharp blades. The patient had already used an ocular prosthesis but lost it 6 years ago and didn't used it until now. In clinical examination, the anopthalmic socket had good posterior wall mobility and absence of infection but, mild contracted socket (Grade 1) with shallow inferior fornix depth was examined. In this case, ocular prosthesis provides aesthetics as well as expanding the lid anteriorly, conjunctiva and fornix posteriorly that were successfully obtained by performing functional impression using imprinted waxed up. This results in a favorable peripheral eye seal.
Keywords: custom ocular prosthesis, waxed up convexity, functional impression, contracted eye socket, conformer

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INTRODUCTION

Eyes are naturally the first features of the face to be noticed. The eye is a vital organ not only in terms of vision but also being an important component of facial expression.[1] The disfigurement resulting from loss of an eye can cause significant psychological as well as social consequences for both the patient and family. This results in the patient becoming visually, esthetically and psychologically handicapped. Restoring the defect with a silicone- or acrylic-based prosthesis not only restores esthetics but also gives back the lost confidence to the patient.[2]

The surgical procedures for removal of an eye, are classified by Peyman, Saunders and Goldberg into three general categories as evisceration (where the contents of the globe are removed leaving the sclera intact), enucleation (most common, where the entire eyeball is removed after severing the muscles and the optic nerve) and exenteration (where the entire contents of the orbit including the eyelids and the surrounding tissues are removed.[1] Enucleation leads to contracture of orbital tissue accompanied by reduction in volume and forniceal depth results in an inability to sustain a prostheses.[3]

Adequate retention of the ocular prosthesis in the anophthalmic socket requires a well-formed inferior fornix, which in turn requires sufficient conjunctival length and a deep recess. Contracted socket is a condition characterized by fibrosis of the anophthalmic socket where shallow or obliterated fornix is a key finding in different stages of the disease and it occurs secondary to conjunctival shrinkage. Shallow inferior fornix occurs possibly as there is no globe and so the inferior rectus muscle is at a higher level in the socket with subsequent elevation of the lower lid retractors and their connections including the fornical conjunctiva.[4]

Several classifications to grade a contracted socket have been published in the literature. The most widely used clinical classification is the Gopal Krishna classification, where the contracted socket is divided into five grades, such as Grade 0: a healthy socket with deep and well-formed fornices, Grade 1: shelving or shallowing of the lower fornix, Grade 2: loss of the superior fornix along with the inferior fornix, Grade 3: involvement of all four fornices (superior, inferior, lateral, and medial), Grade 4: involvement of all four fornices along with a reduction in the horizontal palpebral fissure length or HPFL, Grade 5: recurrence of contraction after repeated failed attempts at reconstruction.[3]

Early management of an ophthalmic socket prevents loss of volume in the anterior orbital area and facial asymmetry. A fundamental objective when restoring an ophthalmic socket with an ocular prosthesis is to enable the patient to cope better with the difficult process of rehabilitation. A mul-

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tidisciplinary management and team approach are essential in providing accurate and effective rehabilitation and follow-up care for the patient. Therefore, the combined efforts of the ophthalmologist, the plastic surgeon and the maxillofacial prosthodontist are essential to provide a satisfactory ocular prosthesis.[5] A properly fitted and accepted custom ocular prosthesis has following characteristics retains the shape of the defect socket, prevents collapse or loss of the shape of the lids, provides proper muscular action of the lids, prevents accumulation of fluid in the cavity, maintains palpebral opening similar to the natural eye, mimics the coloration and properties of the natural eye, has gaze similar to the natural eye.[6]

Ocular prosthesis can be classified as stock shell or ready-made and custom-made prosthesis. The close contact of custom-made ocular prosthesis with the tissue bed improves tissue health by reducing fluid accumulation in tissue-prosthesis interface thereby decreasing the chances of tissue irritation and bacterial growth. Custom ocular prostheses are also known to distribute the pressure more equally and decrease the incidence of conjunctival abrasion as compared to stock ocular prostheses.[5]

CASE

A 21-year-old male patient reported to the Department of Prosthodontics, RSGMP USU with the chief complaint of missing left eye. Patient history revealed that he had an injury type of trauma from sharp blades to the left eye when he was 5 years old, then underwent surgical removal of his entire eyeball eyes (enucleation). The patient once used an artificial eye but had lost it 6 years ago and never use anything until now. Upon examination the ocular defect was healed properly with good mobility of the posterior wall of the ocular defect during full excursive movement, absence of infection, and adequate volume to support the prosthesis. The palpebral fissure was examined in both open and closed position to rule out any anatomical as well as physiological abnormality. The narrowing of inferior sulcus was also examined in this case (Fig.1).

The rehabilitation treatment plan for this case

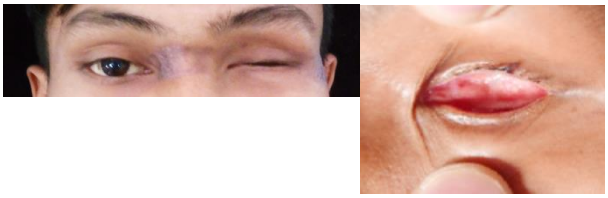

Figure 1 Pre-treatment Photograph

was ocular prosthesis fabrication with custom ocular. Procedure was initiated with application of petroleum jelly to the eyebrows and skin to prevent the impression material sticking to the eyelashes. Then, primary impression was made with irreversible hydrocolloid material (Alginate; Aroma Fine Plus, GC) and a cast was made from type II gypsum on which a special tray was fabricated using visible light curing acrylic with numerous perforations for escape of the impression material (Fig.2). Material was injected into the socket (Fig.3a). After the material had set, impression was retrieved from the socket and checked to ensure that all the surfaces were recorded (Fig.3b).

Figure 2 Custom Tray

Figure 3A Injection of impression material into the socket; B primary impression with alginate

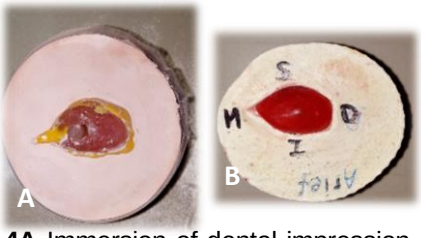

Figure 4A Immersion of dental impression in type II gypsum; **B** wax try-in

A two-piece dental stone cast was poured to immerse the lower part of the impression (Fig.4a). After the stone had set, separating media was applied on the surface, then a second layer was poured. Marking was made on all the four sides of cast for proper reorientation of the cast. Next, the wax pattern was fabricated by pouring the molten wax into the molds. The wax was properly contoured and carved to give it a simulation of the lost eye. (Fig.4b). The wax pattern was tried in patient's socket and checked for size, comfort, support, fullness, and retention by performing the functional movements.

Then, mark the convexity of the wax-up in the form of the peak of the eye convexity and the line

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that marks the medial-distal canthus (Fig.6). The convexity of the waxed-up results is then implanted into the putty (not passing through the largest circle) (Fig 7a), custom tray and the handle were then made using self-curing acrylic resin on the putty mold (Fig.7b) and make an escape hole as a place for excess of impression material. Custom tray was finished, polished and tried to the patient (Fig.8).

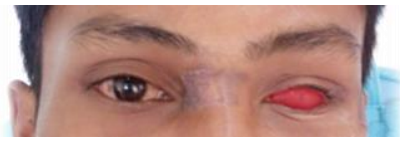

Figure 6 Wax try-in

Figure 7A Impression of waxed up convexity using putty; **B** custom individual tray

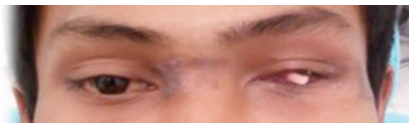

Figure 8 Custom tray try in

The final impression was made with light body addition silicone impression material. Before taking impression, impression tray was made and polished to prevent any irritation to the tissues inside the socket. The custom tray was tried in the socket following the marking line in order to adjust the custom tray sitted in the center of the socket. For final impression, the patient was instructed to tilt the head backward then, light body polyvinyl siloxane impression material (Elite P&P, Zhermack) was injected into the entire left eye socket and at the tray. The tray that had been filled with material was inserted back into the socket. Once filled, the head was moved back to the vertical position and the patient was directed to move his eyes up and down with various eye movements to record the functional impression (Fig.9A). This will facilitate the flow of the impression material to all aspects of the socket. Patient was asked to look at a distant spot at eye level with his gaze maintained in a forward direction. After the material was set, cheek, nose and eyebrow regions were massaged to break the seal. While the patient gazed upwards, the cheek was pulled down and the inferior portion of the impression rotated out of the socket. Impression was checked for accuracy and excess material was trimmed (Fig.9B).

A two-pour technique was carried out using type IV gypsum to obtain the working cast. A wax

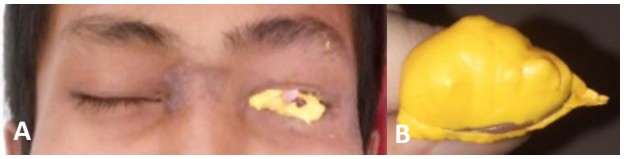

Figure 9A Functional impression; **B** custom individual tray impression

pattern was made by pouring modelling wax into the functional defect area of the cast. The size and the iris position were marked using IPD ruler by asking the patient to gaze straight at an object kept at a distance of 4 feets (Fig.10A) then, the color of iris was obtained by matching with the adjacent eye using oil painted (Fig.10B). Iris button was then produced according to the results of measurements that have been made (Fig.10C).

Figure 10A IPD ruler for measurement of iris size and position; **B** Iris painting with oil painted; **C** iris button

Second try- in of the wax pattern was done to verify size and support from the tissues in order to achieve ease of simulation of eye movement and eyelid coverage. The patient was instructed to fix the gaze of the natural eye in front and at eye level. The position of iris was determined by centertering in relation to the inner and outer canthus and upper and lower lids. Iris button implanted in a predetermined wax pattern followed by try in. (Fig.11A). During flasking, the iris button was secured in its determined position using an acrylic mount (Fig.11B). After dewaxing procedure, packing and curing were done with the selected shade of heat cure tooth colored acrylic resin.

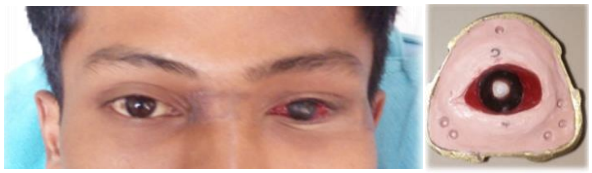

Figure 11A Wax try-in with iris button; **B** flasking of wax and iris button

Afterwards, putty index was made as the reference for sclera in order to reduce the convexity of the sclera and the iris button about ± 2 mm. The sclera staining was performed following the patient's original eye where the sclera was put back on the flask, packed, heated, and cured with clear acrylic resin to restore the sclera concavity (Fig. 12A). The prosthesis was recovered, polished, dis-

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infected and inserted in patient's left eye socket (Fig.12B). During insertion, the ocular prosthesis was evaluated for its esthetic, retention, comfort and ease of performing various eye movements. Post insertion instructions were given for insertion and maintenance of prosthesis.

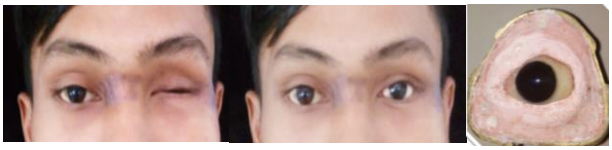

Figure 12A Heat cured clear acrylic resin, **B** post ocular prosthesis rehabilitation

DISCUSSION

There are three general surgical treatment procedures used as primary treatment modality in the surgical removal of the eye such as evisceration, enucleation and exenteration. Enucleation is the surgical removal of the globe and a portion of the optic nerve from the orbit.[7] After enucleation, a plastic conformer and corticosteroid antibiotic ointment is placed in the socket. The plastic conformer is left in place for 4-6 weeks to reduce edema and maintain the socket contours for a prosthetic eye. When surgical site is well healed and dimensionally stable, fabrication of an ocular prosthesis may be undertaken. Early management of an ophthalmic socket prevents loss of volume in the anterior orbital area and facial asymmetry.[5] Choudhury stated that enucleation leads to tissue constriction around the ocular cavity with complications such as enophthalmos and superior sulcus defect.[8]

A number of methods have been employed for early socket expansion in contracted socket mainly mechanical or tension wire expanders, pressure conformers, hydrogel expanders, external prosthesis and progressive-sized conformers. With the first two methods, overly aggressive pressure or tension expansion, often inducing harmful scarring by forcing the socket to conform to the shape of the pressure template.[10,11]

The mechanism behind eye expansion with progressive-sized conformers is the following: while the lids are expanded via anteriorly directed pressure, the conjunctiva and fornix are expanded via posterior and radially directed pressure and therein lies several rubs: each conformer has to be incrementally larger than the previous, but not so much larger that it is painful or impossible to place in the cul-de-sac. However, if it is too easily placed, it may be too small to have dramatic effect on lid dimensions. At the same time, the conformer has to be bulky enough to exert sufficient posterior pressure to induce conjunctival expansion, but not so bulky as to extrude from socket, while still exerting enough anterior pressure to effect lid growth.[9]

Nowadays, hydrophilic expanders have also being used. In the beginning, this hydrophilic substance has a hard consistency and is placed in their dry, contracted states. By taking up water, it expands gradually to their full size via osmosis of surrounding tissue fluid, with up to a tenfold increase in volume. The amount and rate of expansion can be engineered and very precisely controlled. After reaching the proper dimensions of anophthalmic cavity with expander prosthesis, it is possible to install the conventional ocular prosthesis, as has been described before on the current case reported. Besides reconstructing face aesthetics, the ocular prosthesis also restores muscle tone, reduces eyelids atresia and clears tear ducts, restoring the motor facial functional normality.[9]

External prosthesis is indicated for anophthalmic socket grade 1-3 to be used over the anterior surface of the socket and with support on the fornix in order to provide a better appearance. This external prosthesis is good if there is fornix support and adequate orbital volume. The benefits of this external prosthesis are less painful, replaceable, and accepted by parents due to cosmesis. The disadvantages are temporary and needs replacement.[11]

When prosthesis is customized to the patient using proper impression technique, distribution of pressure will be equal to. In addition, intimate adaptation of the modified prosthesis to the tissue surface of the defect increases the movement of the prosthesis and enhances its natural appearance. Other important step in making accurate impression is the close adaptation of the mucosal surface of the ocular prosthesis to the posterior wall of the eye socket. Using light body as an impression material is advantageous because it flows easily and records the details of the eye socket in the functional form which in turn aids in the proper adaptation and ease of functional movements of the ocular prosthesis. The impression was checked for an accurate recording of the posterior wall, the position of palpebrae in relation to the posterior wall, and the greatest extent of superior and inferior fornices of the palpebrae denoting precise impression.[12]

In this case, patient was chosen to use custom ocular prosthesis instead of stock ocular prothesis because custom achieves intimate contact with the tissue bed which helps in restoring natural eye movements without pain or discomfort. Besides

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that, custom-made eye prosthesis simulates the characteristics of the companion eye, helps in restoring the normal facial appearance and gives better movement of eye lids, distribution of pressure enhanced fit, comfortable, and enhanced esthetics gained from the control over the size of the iris, pupil and color of the iris and sclera, obtains exact color match of the sclera and blood vessels. Meanwhile, stock ocular prosthesis available in standard sizes, shapes, and colors and they can be used for interim or postoperative purposes.[13,14]

Enucleation involves removal of the eyeball proper and leads to an enophthalmic socket with a shrunken eye, which has a crippling effect on patient's emotional and social life.[8] A contracted socket with inadequate superior and inferior fornices, with palpebral fissures of unique size and shape and with inadequate anterior-posterior socket depth presents with numerous retention and cosmetic complications. Conformers are used as prosthetic treatment for a contracted socket to expand and shape it.[15] In the case report, the condition of anopthalmic socket post enucleation was categorized in grade 1 (shelving or shallowing of the lower fornix) that has been occurred for a long time because he had lost his ocular prothesis for 6 years that caused narrowing of inferior conjunctiva fornices and constricted of occular cavity volume which affected the fabrication of ocular prosthesis. Ocular prosthesis in this case was used to provide aestethics as well as expand the lid via anteriorly, conjunctiva and fornix via posteriorly. These were successfully be obtained by performing functional impression using imprinted waxed up that had been tried and checked for size, comfort, support in order to get adaptation, retention, stabilization and similar palpebral opening with favorable peripheral eye seal.

Adaptation, retention, stabilization and similar palpebral opening with natural eye of ocular prosthesis in contracted eye socket can successfully be obtained by performing functional impression using imprinted waxed up as custom tray for getting favorable peripheral eye seal.

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Implant survival rate of patients in Dental Hospital Hasanuddin University: 8 years evaluation

[1]Bahruddin Thalib, [1,3]Rifaat Nurrahma, [2]Asmawati, [2]Nurlindah Hamrun, [4]Alqarama Mahardika, [5]Ian Afifah Sudarman, [5]Rezky Wahyuni Syamsuddin

[1]Department of Prosthodontics, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia
[2]Department of Oral Biology, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia
[3]Department of Oral and Maxillofacial Surgery/Oral Pathology, VU University Medical Center/Academic Center for Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands
[4]Department of Dental Material, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia
[5]Prosthodontic Specialist Educational Program, Faculty of Dentistry, Hasanuddin University,
Corresponding author: **Rifaat Nurrahma**, e-mail: **rifaat.nurrahma@gmail.com/r.nurrahma@amsterdamumc.nl**

ABSTRACT

Data on dental implant treatment's success and survival rate are still limited. Meanwhile, the data on the success and survival after implant placement and restoration can be used to evaluate materials, improve the dental implant treatment, and enhance the service quality at Hasanuddin University Dental Hospital. The purpose of this study is to analyze the dental implant survival rate, the contributing factors that enhance the survival rate, and the factors causing the failure of the dental implants at the Prosthodontic Clinic of Dental and Oral Hospital, Hasanuddin University. The final study group consisted of 11 patients with 20 implants. Implant failure was categorized based on implant loss, mobility, or removal due to severe peri-implant infection or implant fracture. Implant survival rates were grouped based on sex, age, smoking habit, placement location, diameter, length, and placement time. The value of implant survival rate was assessed based on the presentation of successful implants. Of all 20 cases, five implants failed, indicating a cumulative implant survival rate of 75%. Based on the failure period, there are initial failure cases before loading and late failure cases after loading. One implant failed within the first six months, and two implants failed 2 years after insertion of the superstructure. The leading cause of implant failure before loading is osseointegration failure. In the case of implants that failed after installing the superstructure, peri-implantitis occurs continously. It was concluded that the implant survival rate for patients at the Hasanuddin University Dental Hospital is 75%. Dental implant survival rates include gender, age, implant placement location, smoking habits, implant diameter, length, and immediate or delayed implant placement. The factors causing the failure of the implant in this study were osseointegration failure and peri-implantitis

Keywords: dental implant, implant survival rate, implant failure

INTRODUCTION

Dental implants are a reliable treatment option in the rehabilitation of partial or complete tooth loss.[1,2] Dental implants are one of the methods to provide retention and support for strength in using dentures, which function to restore chewing, aesthetic, and speech functions.[3] The use of dental implants provides a better quality of life than conventional denture treatment.[4]

The success rate and survival rate based on previous research are high. Some studies have shown success after 5 years of follow-up. When evaluating implant success and failure rates, one should consider the type of load or restoration to be used. The implant success scale is assessed by its durability and is declared a failure if it must or has been removed.

Dental implant treatment in academic institutions is expected to have a high success rate, so it can be one of the choices for implant treatment. However, data on the success and survival of implants that have been placed are still limited. Meanwhile, data on success and survival after implant placement and restoration can be used for evaluation materials that improve service quality and assess the success rate of implant treatment. Therefore, a long-term retrospective study is useful in objectively assessing the relationship between various factors that affect implant survival rates.[5-7]

The of dental implants has been carried out at the Prosthodontic Clinic, Teaching Dental and Oral Hospital, and Hasanuddin University since 2010. Ongoing evaluation using a retrospective study method on the success and survival rate of implants was firstly carried out; the researchers were interested in examining the *implant survival rate* in patients in Hasanuddin University Oral and Dental Hospital. This study aimed to analyze the *implant survival rate* of patients at the Prosthodontics clinic at the Dental Hospital, Hasanuddin University, the supporting factors that can make the implant *survive* in the mouth, and the factors that cause implant failure.

METHODS

An 8-year follow-up study involved patients sequentially treated with dental implants at the Prosthodontic Clinic of Hasanuddin University, Makas-

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sar, Indonesia, between 2013 and 2021. Registered patients were recalled for examination from June 2021 to November 2021. The study group consisted of 21 patients with a total of 33 implants.

All data were taken retrospectively from dental records of patients who had dental implants inserted, including informations on age, sex, general health, time of treatment, implant manufacturer, position, and a number of implants. Patients were recalled for control in this study. This research was approved based on the recommendation of the Health Research Ethics Commission, Faculty of Dentistry, Hasanuddin University (0180/PL.09/KEPK FKG-RSGM Unhas/2021)

Result measurement

Implant failure was assessed based on implant loss, mobility, or removal due to severe peri-implant infection or implant fracture. The following criteria evaluated implant survival rate: (a) absence of clinically detectable implant mobility, (b) absence of subjective pain and discomfort, (c) absence of peri-implant infection, and (d) absence of persistent radiolucency continuously around the implant (e), the gingival sulcus depth is not more than 2-6 mm (f) the *bleeding on probing value is* between 0-1, (g) peri-implant marginal bone loss that is more than half the implant length is categorized as a failure. Periapical radiographs obtained at the time of control were analyzed based on the condition of the marginal bone. The distance between the implant reference point (fixture-abutment junction) and the level of the marginal bone on both mesial and distal sides of the implant was recorded by two blind examiners (BT and RN). Conventional descriptive statistics (number and percentage values) were used for the study materials presented, including *implant survival rate.*

RESULTS

The study group consisted of 21 patients and 33 implants. However, eight patients with nine implants were excluded because they refused to attend the examination and lost contact with two patients. Therefore, the final study group consisted of 11 patients and 20 implants. There were six male patients and five female patients. There were 12 implants in the male and 8 in the female (Table 1), The patients were aged 24-34 years at the study time. Information regarding systemic disease was obtained from patient records. All patients had no systemic disease, and two patients have a history of smoking.

Among 11 patients, 12 implants were placed in 5 male patients. Of these, five implants failed, and the *implant survival rate* was 58.3%. Eight implants were placed in 6 female patients. Of these, no implants were reported to fail, so the *implant survival rate* was 100%.

Based on smoking habits, seven implants were placed in patients who smoked, and five implants failed, so the *implant survival rate* was 28.5%. While the number of implants placed in patients who did not smoke was 13, none of the implants failed, so the *implant survival rate* was 100%.

For implant placement in this study, namely maxillary anterior and mandibular posterior. Four implants were placed in the anterior maxillary re-

Table 1 Characteristics of implant survival rate

Variable	Number of Implants	Distribution (%)	Implant Failed (n)	CSR (%)
Gender				
Man	12	45.4	5	58.3
Woman	8	54.5	-	100
Smoking Prevalence				
Yes	7	35	5	28.5
No	13	65	-	100
Location				
Anterior maxilla	4	20	1	75
Posterior Mandible	16	80	4	75
Implant Diameter				
3.0-3.5	6	30	-	100
3.6-4.0	12	60	5	58.3
4.1-4.5	2	10	-	100
Implant Length				
<10 mm	3	17	85	100
10 mm			5	70.5
Implantation time				
Delayed	16	80	-	100
immediate	4	20	4	0

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Table 2 Implant failure analysis

Gender	Age	Location	Implant Diameter	Implant Length	Restoration Type	Failure Time	Cause of Failure	Failure Type
L	24	12	3.8 mm	12 mm	Single Implant	6 months	Osseoint.Failure	Early Failure
L	33	36	4 mm	10 mm	Single Implant	2 years	Peri-implantitis	Late Failure
L	33	46	4 mm	11 mm	Single Implant	2 years	Peri-implantitis	Late Failure
L	33	37	4 mm	10 mm	Single Implant	2 years	Peri-implantitis	Late Failure
L	33	47	4 mm	10 mm	Single Implant	2 years	Peri-implantitis	Late Failure

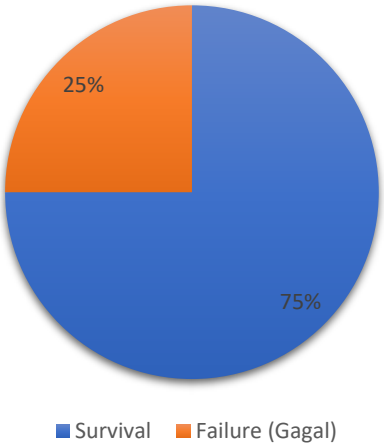

Figure 1 Implant survival rate presentation

region. One implant failed, so the *implant survival rate* was 75%. Furthermore, 16 implants were placed in the posterior mandibular region, and four failed, so the *implant survival rate* was 75%.

Assessment based on the implant diameter, 6 implants were installed with a diameter of 3.0-3.5 mm. None of the implants failed, so the *implant survival rate* was 100%. Twelve implants were placed with a 3.6-4.0 mm diameter, and five implants failed, so the *implant survival rate* was 58.3%. Furthermore, two implants with a diameter of 4.1-4.5 mm, none of the implants failed in this group, so the *implant survival rate* was 100%.

Based on the length of the implants, three implants were installed with a length of <10 mm, no implants failed, so the *implant survival rate* was 100%. Furthermore, 17 implants were installed with a length of 10 mm, and 5 implants failed, so the *implant survival rate* was 70.5%.

The evaluation was based on the time of implant placement. Sixteen implants were installed six months after tooth extraction, and none of the implants failed, so the *implant survival rate* was 100%. Furthermore, four implants were placed immediately, but the four implants failed.

Out of all 20 cases, five implants failed in this study, showing a cumulative implant survival rate of 75% (Figure 1). Based on the failure period, there were cases of early failure before loading and late failure cases after installation of the superstructure. Of these, one implant failed within the first six months; two implants failed between 2 years after insertion of the superstructure. The leading cause of implant failure before loading is osseointegration failure. In the case of failed implants after insertion of the superstructure due to persistent peri-implantitis (Table 2).

DISCUSSION

In this study, a clinical examination was carried out to see the implant survival rate in patients treated at the Prosthodontic Clinic, Hasanuddin University Dental and Oral Hospital. Several factors affect the implant survival rate: age, gender, smoking habits, implant placement location, and implant installation time.

According to a study conducted by Maris Victoria et al., no association was found with patient age,[5] as reported by several studies; although Noguerol et al., reported higher failure rates in patients between 41 and 60 years of age than in those older than 60 years. It can be concluded that advanced age is not a disadvantage in implant treatment.[7] This is in line with the results of this study, which found five failed implants from 2 young male patients, namely 24 and 33 years. However, several factors influence the failure of this patient's implant, such as smoking habits, systemic disease, and immediate implants.

As many as 7 of the 12 implants placed in male patients showed successful treatment, whereas, in 8 implants in female patients, the implants were still well placed in the oral cavity. The results of this study found that gender did not affect the success of dental implant treatment. This is in line with the research conducted by Jang et al which stated that there was no significant difference between male and female gender in the success of dental implants. In addition, a study states that from the results of periapical radiographic examination, the success of dental implant placement in men is better than in women due to the anatomy of the maxillary sinus in women.[8,9] However, in this study, there were five implants from two male patients who experienced failure, due to patient's smoking habit.

Smokers must anticipate complications after implant placement that require surgical intervention. Smokers have a higher incidence of complications,

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especially with screw implants. However, most complications will not lead to failure. While the association between implant complications and smoking, smoking duration, implant type, and implantation time was significant, it cannot be assumed that they were the only or the most significant factors. Implant patients should be noticed that smoking can have harmful effects on dental implants. Limiting or reducing smoking will reduce the complications of endosseous dental implants.[10]

Another factor that can affect the success of a dental implant is the location of the implant. Of the four implants placed in the maxillary anterior region, 1 implant failed to survive. In line with the previous article (zone 1), this region often has a history of bone infection and trauma to the alveolar ridge. There were 4 failures out of 12 implants in the posterior mandible in the posterior area. This area is tricky due to vertical bone deficiency, proximity to the inferior alveolar canal, and insufficient blood flow causing poor healing of the implant area.[11]

In line with research on the relationship between success and implant placement, Alsaadi et al.'s study concluded that the anterior mandibular region experienced less bone loss than the mandibular posterior region and the maxillary region. Jacob's study supports it, that bone loss was more in the maxilla than in the mandible because the cortical bone in the maxilla was thinner, and the trabecular bone was less dense. When compared to the anterior (incisor) and posterior (molar) regions, the chewing load and the force during clenching were, on average, three times greater in the posterior region. In contrast to the study conducted by Lang et al. who found no statistically significant difference regarding the success of implants placed in the maxilla and mandible.[12,13]

Immediate implants require higher primary stability, and their attachment to tissues (soft and hard) is more susceptible to bacteria and poor micro repair during the healing process, leading to an increased risk of implant failure.[14] It has been reported that the risk of implant failure in an infected post-extraction socket is three times greater than in an infection-free post-extraction socket.[15] However, the placement of an immediate implant has the following advantages: maintaining the shaping network soft and hard. Therefore, research on immediate implant placement continues.

The loading factor is also very influential on the stability of the immediate dental implant.[16] Menchini et al., suggested that the placement of an immediate dental implant with a single restoration can be an option in missing one tooth.[17] It has been proven either on short or long research period (approach 100%) and bone damage marginal (0.42-2.69 mm).[17] Immediate implant placement requires adequate osseointegration to enhance a direct functional and structural relationship between the bone and the implant surface. This osseointegration process does not occur immediately but occurs gradually over time. Several factors play a role in the success of osseointegration, including a good adaptation between the implant material and stable surrounding bone. Comparison of post-retraction immediate implant placement techniques is also a consideration.[18] In addition, patients who experience implant failure have been reported to have a smoking habit. This is also a predisposing factor for immediate implant failure. Non-immediate implant placement increases implant success. *Early implant failure* is generally linked with a healing wound that is not suitable and hinders or prevents osseointegration. Other influencing factors including variation in surgical technique, the inadequate quality of bone, post-operation infection and inflammation, and excess occlusal. *Late failure implant* was often caused by a damage on osseointegration, the burden functional from prosthesis which supported implant. Late failure implants are generally linked with excess occlusal (biomechanics) or peri-implantitis.[18]

It is concluded that the implant survival rate for patients at the Hasanuddin University Dental Hospital is 75%. Dental implant survival rates include gender, age, implant placement location, smoking habits, implant diameter, length, and immediate or delayed implant placement. The factors causing the failure of the implant in this study were osseointegration failure and periimplantitis.

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Prosthetic approach following traumatic evisceration: a case report

[1]Mariska Juanita, [2]Riezky Ramdhani, [3]Irfan Dammar
Department of Prosthodontics
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
Corresponding author: **Mariska Juanita**, e-mail: **mariskajuanita@gmail.com**

ABSTRACT
A 20-year-old male patient was referred to Prosthodontic Department, Dental Hospital of Hasanuddin University, Makassar with chief complaint of disfiguration of the face. Medical history revealed a significant trauma to the left eye 6 months prior which stayed after evisceration. Patient has never used prosthetic eye afterwards. Examination of the left eye socket revealed a healthy conjunctiva covering the posterior wall of the anophthalmic socket with synchronous motions and absence of infection or inflammation signs. Sulcus depth was sufficient enough to retain prosthetic eye. This article presents rehabilitation of the ocular defect with customized acrylic-based ocular prosthesis to increase patient's appearance and to prevent further shrinkage of the eye socket. Preliminary impression was done using customized tray fabricated from modelling wax and hydrocolloid irreversible impression material. An intraocular custom tray for secondary impression was fabricated with acrylic resin and modified with a syringe that attached to the custom tray. Secondary impression of the defect was recorded using polyvinyl siloxane light viscosity material followed by wax pattern fabrication using modelling wax. The wax pattern was tried in patient's socket and checked for size, comfort, support, fullness, and then packed with tooth colored heat cure acrylic resin. After determining the location and diameter of the iris with an optical vernier pupillary distance ruler, the color of sclera was determined by shade guide and confirmed with technician using digital photo. Ocular prosthesis was fabricated afterwards and inserted into the eye socket and evaluated for suitability, aesthetic and also movements with the contralateral eye. It is concluded that customized ocular prosthesis was significantly more aesthetic than pre-fabricated one with better contouring, color matching, and coordinated movements with the contralateral eye. This prosthetic approach may restore patient's appearance, increase their self-esteem, and improve their quality of life.
Keywords: eye trauma, evisceration, eye socket, anophthalmic socket, customized ocular prosthesis

This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

The loss or absence of an eye may be caused by a congenital defect, trauma, or other pathologic condition, including tumor. This can have a physical, social, and psychological impact on those affected. Therefore, ocular prostheses aim to improve patient's esthetics, restore and maintain health of the remaining structures, and consequently provide physical and mental well-being, even though the visual function did not return. The function of the surrounding tissue will be affected by the loss of the eyeball for a long time if it is not quickly replaced with an ocular prosthesis, and eyelids may atrophy. Between the upper and lower eyelids, the ocular prosthesis serves as a barrier for foreign objects that might enter the eye chamber.[1]

Depending on the severity of the situation, surgical management may include: evisceration, enucleation, or exenteration. Evisceration is a surgical procedure wherein the intraocular contents of the globe are removed, leaving the extraocular muscles, and optic nerve intact. Enucleation is the surgical removal of the globe and a portion of the optic nerve from the orbit. Exenteration is the en bloc removal of the entire orbit, usually involving partial or total removal of the eyelids.

Based on fabrication technique, ocular prosthesis is divided in two types, prefabricated and customized prosthesis. Customized ocular prostheses have several advantages which makes it more favorable than the prefabricated one such as: even distribution of pressure on the eye socket, highly esthetic iris, better comfort and better eyelid movements.[2]

Orbital implants and ocular prostheses are two kinds of rehabilitation for loss of eyeball cases. Fabricated and nonfabricated ocular prostheses are the two types of ocular prostheses. The advantage of fabricated ocular prosthesis is that they take less time to manufacture because they don't require any laboratory stages. Iris sizes and colors are available in three different sizes and hues in the fabricated ocular prosthesis. Gradually there will be difference in size between the prosthetic eyeball and the socket which cause a water sac forms where bacteria can grow, producing discomfort and infection. Another downside is that color discrepancies in the iris can cause aesthetic issues.[4,5]

Non-fabricated ocular prosthesis are self-made ocular prostheses. The advantages of the ocular prosthesis are the color of the prosthesis can be modified to match the remaining eye, the cost is less expensive, and it fits to the patient's eye socket condition. The downside of nonfabricated eye

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prostheses is that laboratory techniques take time to complete. After evisceration and enucleation surgery, a non-fabricated ocular prosthesis indicatted. Patients who are allergic to acrylic and have an eye retention socket that is poor in retention are contraindications to use a non-fabricated ocular prosthesis.[4]

After enucleation and evisceration with or without implant implantation, blind eyes with corneal scarring, and congenital anophthalmia/microphthalmia are all indications for ocular prosthesis.[8]

Patients who experience eye defects due to the action of enucleation of the eyeball often experience sighting dysfunction, aesthetic and psychological disturbance. To overcome those problems, rehabilitation efforts are carried out by making non-fabricated ocular prosthesis.

CASE

A 20-year-old male patient was referred to the Prosthodontic Department of Hasanuddin University Dental Hospital, Makassar with a chief complaint of disfiguration of the face. Medical history revealed a significant trauma to the left eye 6 months ago which had been thereafter eviscerated. Patient has never used prosthetic eye afterwards (Fig.1).

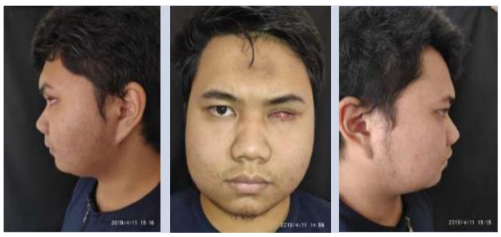

Figure 1 Profile of patient

Examination of the left eye socket revealed a health conjunctiva covering the posterior wall of the anophthalmic socket with synchronous motions and absence of infection or inflammation signs. Sulcus depth was sufficient enough to retain prosthetic eye.

MANAGEMENT

Anamnesis and objective examination were performed to confirm the diagnosis of anopthalmic socket post evisceration. The treatment planned to rehabilitate the ocular defect with customized acrylic-based ocular prosthesis to increase patient's appearance and to prevent further shrinkage of the eye socket. Preliminary impression was done using customized tray from modelling wax and hydrocolloid irreversible impression material (Fig.2).

An intraocular custom tray for secondary impression was fabricated with acrylic resin and modified with a syringe attached to the custom tray. Secondary impression of the defect was recorded using polyvinyl siloxane light viscosity material. Before inserting the impression material, the eyelashes and around the eyes were smeared with petroleum jelly so it did not stick with the impression material when inserted into the socket (Fig.3).

Impression material was injected slowly into the socket through the tray hole. The patient was asked to move the socket and palpebra so that the impression material fills all aspects of the socket. Within 1-2 minutes, the impression material formed the desired consistency and the impression material and tray were removed from the socket. The mold was then filled with gypsum. The hardened cast was then used as a working model for custom tray ocular using self-cure acrylic resin followed by wax pattern fabrication using modelling wax. It's best to avoid leaving any impression material in the eye socket (Fig.4).

The patient was instructed to sit upright and relax. The upper eyelid was raised and upper edge of the sclera wax model was inserted. The lower eyelid was pulled so that the lower edge of the wax pattern can be inserted. The wax pattern was tried in patient's socket, while areas of over extensions were adjusted by trimming the wax. The contour and support of the eye lid was checked while the eye was in open and closed positions by evaluate its size, comfort, support, fullness, and then packed with tooth colored heat cure acrylic resin that had been decided before.

The opening and closing movements of the eyelid

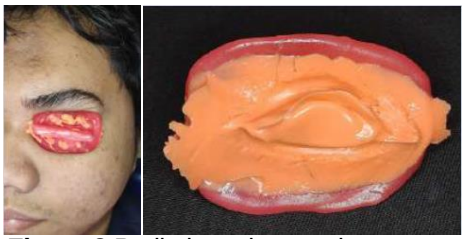

Figure 2 Preliminary impression

Figure 3 Fabrication of intraocular custom tray

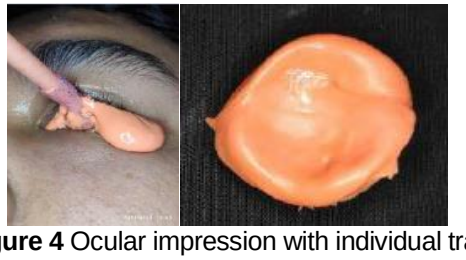

Figure 4 Ocular impression with individual tray

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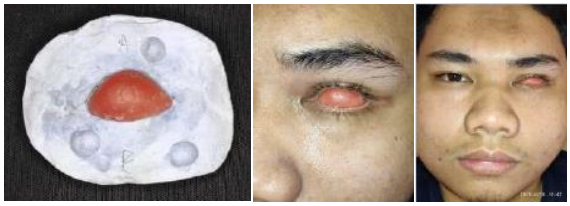

Figure 5 Sclera wax model on patient

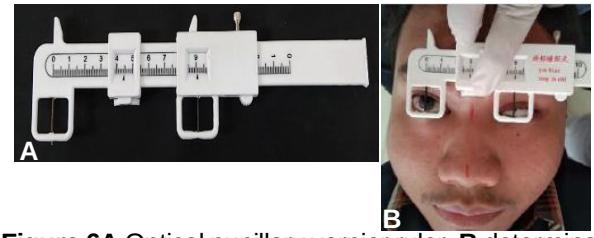

Figure 6A Optical pupillary vernier ruler, **B** determination of inter-pupil length, location & diameter of the iris

and the shape of the sclera wax were observed from all directions so that it resembles the eye next to it (Fig.5).

In the next appointment, we determined the location and size of the iris with an optical vernier pupillary distance ruler, by place it at the base of the nose. Then three reference lines were made at the base of the nose, healthy eye and anopthalmic parts place by mark a dot on scleral blank using a marker (Fig.6).

Scleral blank is removed from the eye socket followed by making a circle on the center of the mark.

After that, the color of scleral blank was determined by shade guide and confirmed with technician using digital photo. Ocular prosthesis was fabricated afterwards then inserted into the eye socket.

Prior to insertion of the finished prosthesis, it was disinfected and thoroughly clean with saline solution to prevent chemical irritation, it was inserted and evaluated for fit, aesthetic and also movements with the contralateral eye. Follow up appointment was performed 24 hours, 1 week and 6 months after the insertion and showed no inflammation with excellent adaptation of the ocular prosthesis (Fig.7)

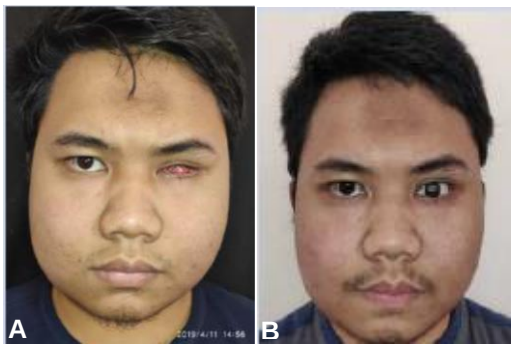

Figure 7A Insertion, **B** control

DISCUSSION

Making a prosthesis following enucleation or evisceration necessitates preparation both before and after the procedure. This should be inserted as soon as possible after enucleation or evisceration. The goal is to protect the suture line, keep the fornix in good shape, prevent contractures, and make the patients as comfortable as possible. Prosthetic eye also keeps the eyelids in better shape and prevents eyelashes from entering the socket, that can cause irritation.[9]

Acrylic or methyl methacrylate was chosen because of its good tissue adaptability, good aesthetics, durability, ability to shape according to the socket, low cost, and ease of manipulation.[10]

During insertion, the ocular prosthesis must be retained, stabilized, and comfortable. One week after insertion, a control and evaluation of socket alterations in the use of nonfabricated ocular prosthesis was performed. Because the ocular prosthesis is built to match the contour of the eye socket, the movement of the ocular prosthesis is satisfactory in this patient. This ocular prosthesis is superior from an aesthetic standpoint because the sclera and iris drawing are adjusted to the opposite eye. Nonfabricated eye prosthesis are more patient-acceptable than fabricated eye prosthesis because they fit the contour of the patient's eye socket better.[1]

Ocular prosthesis can last an average of 5-7 years, depending on the quality of accuracy, comfort and patient compliance to clean the prosthesis regularly. Cleanliness of the eye sockets and hands must be considered before installing prosthesis. Maintenance of acrylic ocular prosthesis is easy to do. The prosthesis can be immersed in water, saline solution, or contact lens fluid to remove deposits that have formed and are attached to the ocular prosthesis. These deposits originate from the production of non-infectious mucus. The prosthesis is brushed with a soft brush and then rinsed with clean water to remove the remnants of soap, then dried with a clean cloth. For harder deposits, wet tissue can be used to scrub the entire surface without scratching it. The patient must be able to maintain the cleanliness of the prosthesis so that the prosthesis can last a long time.[1]

Ocular prosthesis can last anywhere from 5-7 years, depending on the precision, comfort, and care provided by the patient. Before putting on a prosthesis, make sure your eye sockets and hands are clean. Acrylic ocular prostheses are simple to maintain. To eliminate deposits that have accumulated and are connected to the ocular prosthesis,

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the prosthesis can be immersed in water, saline solution, or contact lens fluid. These deposits are formed when non-infectious mucus is produced. The prosthesis is washed with a soft brush before being rinsed with clean water and wiped with a clean cloth to eliminate any soap residue. Wet tissue can be used to scrub the entire surface without scratching it for tougher deposits. The patient must be able to keep the prosthesis clean in order for it to survive as long as possible.

Delayed treatment of an ophthalmic socket with prosthesis may result in its settling and sinking into the socket, compromising the esthetic appearance and adequate eyelid support of the defect region.

Prosthesis rotation within the socket, loose fit, decentration of the cornea, cosmetically significant ptosis, or discoloration of the prosthesis are several signs that indicate ocular prosthesis replacement.

It is concluded that the custom-made ocular prosthesis presented in this case can give the patient with an eviscerated eye a more natural final look. This technique also permits the finished prosthesis to generate an equal distribution of pressure and intimate adaptation to the surrounding tissue which may reduce the psychological trauma associated with the loss of an eye, increasing their self-esteem and improving their quality of life.

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Definitive obturator rehabilitation onthe maxilla defect post-tumor surgery

Abd. Karim
Wahidin Sudirohusodo Hospital
Makassar, Indonesia
Corresponding author: **Abd. Karim,** e-mail: **abdulkarimprosto@gmail.com**

ABSTRACT
Obturator is a prosthesis to replace the tissue lost after a tumor surgery in the maxilla called maxillectomy. Obturators are made of acrylic and consist of operative, intermediate and definitive obturators. The definitive obturator is made using the hollow bulb technique to be lightweight and stable when used. In this case, a definitive obturator was made for a patient who was using an intermediate obturator. This article is aimed to inform that obturators can rehabilitate maxillary defects to restore the patient's masticatory, digestive, phonetic, aesthetic, and mental functions. A 28-year-old male presented for post cleft surgery management. The diagnosis is post-op hemi maxillectomy dextra. The procedures were impressions to obtain a study model and fabrication of individual trays, grinding the remaining teeth for occlusal rest placement. Double impressions were taken to obtain working models and bite block fabrication. Then, bite block trial on the patient and placed on the working model for fixation on the articulator, followed by tooth color determination and laboratory instructions, trial of the wax obturator and checking of occlusion, articulation, aesthetics and phonetics. The following visits were the installation of the definitive obturator and follow-up. It was concluded that definitive obturators can rehabilitate postoperative defects of maxillary tumors.
Keywords: maxillary defect, definitive obturator, hollow bulb technique

INTRODUCTION

An obturator is a prosthesis, which is a removable device that is made and used to replace tissue lost in the maxilla due to surgery, accidental trauma, birth defects, radiation and others.[1] Without rehabilitation of the lost tissue, this defect causes problems in the form of difficulty in mastication, swallowing food or drink, impaired speech function, aesthetics, psychology and others.[2]

Obturators are most often made and inserted as a result of surgery for the presence of tumors in the maxilla called maxillectomy.[1] Maxillectomy is cutting and removing part or all of the soft tissue and hard bone of the upper jaw which causes perforation of the maxillary sinus which even reaches orbital floor and can even involve nasal floor.[3]

The obturator is usually made of acrylic, both hot curing and self-curing acrylic, a combination of hard acrylic with soft acrylic, a combination of hot curing acrylic, metal and soft acrylic, and others.[4,5] Especially for the intermediate obturator and definitive obturator, usually is made using a technique called a Hollow bulb so that the prosthesis is light in the mouth, not too burdensome for the patient and so that it does not fall easily. The hollow bulb is a cavity created in the center of the obturator that is inserted into the surgical gap.[6]

There are three stages of obturator insertion for surgical defects with different time, namely surgery obturator (made before surgery and inserted immediately after surgery in the operating room), intermediate obturator (made and inserted 2 weeks after surgery), and definitive obturator (made and inserted 3-4 months after surgery).[3,7]
In this case report, a definitive obturator was made and inserted for a patient who had previously used an intermediate obturator which can restore the mastication, swallowing of food and drink, speech, aesthetic and psychological functions.

CASE

A 28-year-old male came to the Oral and Dental Clinic, dr. Wahidin Sudirohusodo Hospital, Makassar, consulted from the Department of Tumor Surgery of the hospital for treating the defect of post-surgery. The patient was in healthy and there were no physical or psychological complaints (Fig.1).

About four months ago, surgical removal of the tumor in the maxilla dextra area was performed and caused a large defect or hole. Bone and soft tissue were lost from the anterior maxilla to the anterior region of the soft palate. The patient was wearing an intermediate obturator made of acrylic with a broken clasp at teeth 26, which causes the obturator to be unstable. After examination, it turned out that the obturator was no longer compatible with the defect. Obturator is loose and often falls in the mouth, broken clasp, no complaints of pain.

After surgery in the operating room, a surgery obturator was inserted, and two weeks after the use of the surgery obturator, an intermediate obturator was inserted. There was no history of congenital/acquired/developmental disorders.

Extra oral examination, head was normal, there were folds of skin with stitches under the eyes, neck was normal, the right eye looks wider than the

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Figure 1A Extra oral facial appearance, using interim obturator, **B** Intra-oral condition with interim obturator.

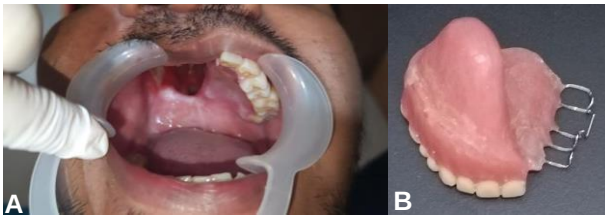

Figure 2A Intra-oral condition with defects in the maxilla post hemimaxillectomy, **B** interim obturator

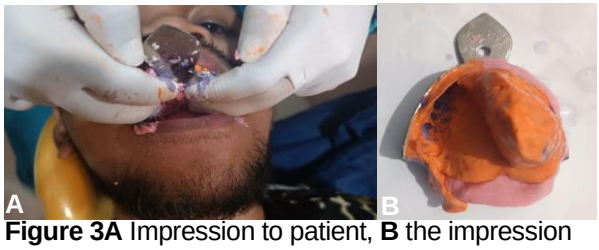

Figure 3A Impression to patient, **B** the impression

left, lips were normal, saliva was normal, TMJ was normal, extra oral muscles were normal. Intra oral examination, there is a defect or wide gap in the right hard palate with the borders of teeth 21 and 22 to posterior until the soft palate with a height almost to the base of the eye which seems to have healed from the surgical wound. Dental status were teeth 22,23,24,25,26,27 and 28 was sound with no caries but there was food debris; teeth 21,11,12, 13,14,15,16,17 and 18 is missing (Fig.2A,B). There was no follow-up examination. The diagnosis was post-op hemimaxillectomy dextra and was planned to make a definitive obturator.

MANAGEMENT

On the first visit, the history taking, physical, extra oral, intra oral, and dental examination is performed and the diagnosis is decided. After that the impression is done to obtain a study model and to make the individual tray. This impression is done by using a tray which is usually used in impression of natural teeth and jaws and hydrocolloid impression material (Alginate). Initially, the defect or cavity post-surgery is blocked with a tampon; then, the impression material on the tray is coated with *cling-wrap* to prevent the material to flow deep into the defect so it does not create retention which makes the impression material difficult to remove or cause pain due to surgical wound injuries. The tray with impression result is then filled with gypsum.

On the next visit, grinding was performed on the remaining teeth for the placement of occlusal rest in order to avoid jamming with the opposing teeth during occlusion with the occlusal rest. Furthermore, by using the individual tray and using the silicone impression materials (putty and light body), impression is carried out to get a working model. The tray with impression result is filled with gypsum. After the dental stone has been set, a biting block is made with red wax.

On the third visit, the bite block that is made with red wax is inserted into the mouth in the defect area and the patient is instructed to bite properly to get the correct occlusion. The correct occlusion is marked with bite marks on the bite block and transferred to the working model for further fixation and implantation to the occludator or articulator. During this visit, the tooth color is determined. The model that has been implanted in the occludator or articulator is sent to the dental laboratory for the manufacture of metal frames and the arrangement of artificial teeth by including information on the clasp design and teeth color.

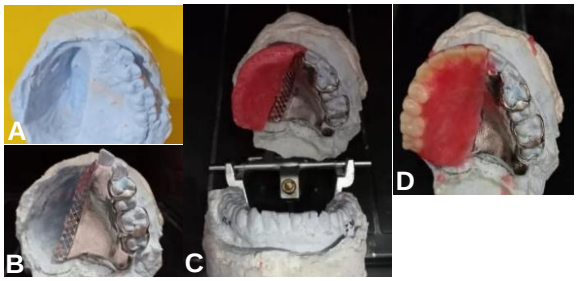

Figure 4A The working model, **B** metal frame from the laboratory to connect with acrylic hollow bulb, **C** hollow bulb made with red wax from the occlusal direction, **D** wax model with artificial teeth from the occlusal direction.

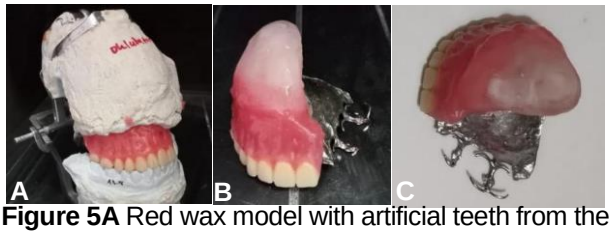

Figure 5A Red wax model with artificial teeth from the horizontal direction, **B** obturator with metal frame, acrylic hollow bulb and soft acrylic, **C** the definitive obturator view from the frontal direction.

On the fourth visit, the metal plate obturator and artificial teeth arrangement that were still attached to the red wax were inserted into the mouth and checked for bite relation, occlusion, articulation, aesthetics and speech function.

Insertion of the definitive obturator is done on

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the fifth visit, by checking the occlusion, articulation, aesthetics, stability, swallowing, comfort, pain occurrence and others.

On sixth visit, follow up is done by checking the presence or absence of prosthesis pressure to the soft tissue that causes pain, and re-examination of the occlusion, articulation, stability, comfort in swallowing food and drinks and others.

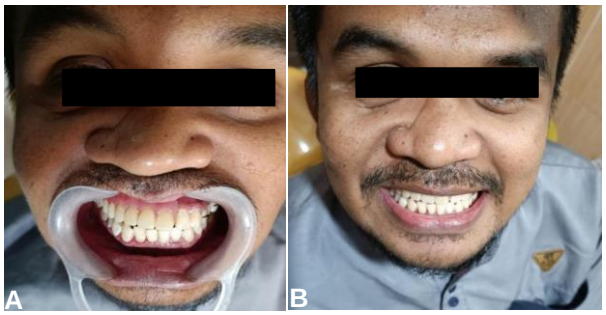

Figure 6A Insertion of the definitive obturator, **B** the patient's smile line with the use of the definitive obturator

DISCUSSION

Patients who have had maxillectomy surgery have lost their mastication, swallowing, speech, aesthetic and psychological function.[1,8] The job of a prosthodontist is to provide services that restore these functions as much as possible. The main goal is to replace the missing body part in the maxillary or mandibular region.[2,6] Obturator is a maxillofacial prosthesis for patients after maxillectomy surgery with the aim to restore the function of mastication, speech, and psychological healing.[9] The maxillectomy performed in this patient according to the Aramany classification was class 1, i.e. unilateral maxillary defect up to the median line and the remaining teeth were located on the other side.

Obturator is made of acrylic resin is the treatment of choice in cases of defects caused by maxillectomy surgery. Making a definitive obturator with the hollow bulb technique which is extended into the defect, in addition to closing the defect, the prosthesis will be lighter and can increase the retention and stability of the prosthesis.[6-8]

The definitive obturator was placed two months after using the interim obturator. The requirements for inserting a hollow bulb obturator must meet 3 three objectives, namely 1) forms a good seal to make the function of swallowing and speaking effective; 2) provides retention support and stability. The basic principle in making a definitive obturator depends on the condition of the defect; and 3) improving the shape of the face after losing part of the facial bone is very helpful for the patient's psychology.[6]

Insertion of the obturator can provide benefits in terms of function and convenience. It is necessary to consider the size and location of the defect, the number and position of the remaining teeth, as well as the distribution of the maximum load to support the obturator. This can be done by involving as many of the remaining teeth as possible, using an occlusal or cingulum rest and extending the plate as wide as possible.

The definitive obturator in this case can benefit from maximum retention because it has 3 abutments.[10] The teeth used as abutments were 24, 26, and 27. The anterior teeth were not used due to aesthetic considerations. The base used in this case is made of acrylic combined with titanium metal with the aim that the patient still feels the hot and cold sensation of food and drink which can be transmitted to the patient's palate. The obturator for this case uses a 2-piece hollow bulb which is expanded into the defect, namely to close the defect and the prosthesis becomes lighter with the presence of a cavity in the obturator and can increase retention and stability of the obturator in accordance with *the principle concepts and practice in prosthodontics* which stated that extension to the defect can increase retention and existence, which can be made with a hollow to make the obturator lighter.[11]

Evaluation of the patient after using an acrylic base definitive obturator with a combination of cast metal base and clasps showed improvement in phonetic, aesthetic, mastication and swallowing functions. This is in accordance with the statement of Kapoor et al. that the use of an obturator can improve the patient's aesthetic, phonetic and mastication function.[12]

At the time of the first one week follow up after the prosthesis insertion, a subjective examination was carried out, there was no pain, pressure or looseness when used to function. Likewise, on objective examination, the occlusion was good, the pronunciation of letters and speech was clear and there was no irritation of the oral mucosal tissue.

It is concluded that patients with post maxillectomy cases using hollow bulb obturator prosthesis with combination of acrylic and cast metal base and clasps can speak and chew normally, and can restore aesthetics and psychology. Therefore, obturators with a hollow bulb can rehabilitate defects resulting from surgery of maxillary tumors.

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Retentive ocular prosthesis restores post evisceration patients' physical and psychological

[1]Steven Syahputra, [2]Ariyani Dallmer, [2]Putri Welda Utami Ritonga, [2]Haslinda Z Tamin
[1]Postgraduate Program in Prosthodontic
[2]Department of Prosthodontic
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia
Corresponding: **Steven Syahputra**, e-mail: **steven.syahputra@hotmail.com**

ABSTRACT
Loss of eye does not only affect facial esthetics but also psychological health of the patient and leads to social disability. A custom-made ocular prosthesis is a good alternative to promote physical, psychological and esthetically pleasing appearance that can improve social acceptance of the patient. A 5-years-old female patient and 18-years old male patient were reported to Dental Hospital USU with the chief complaint of loss of an eye, making them often insulted by schoolmates, while the male patient lost confidence on socializing around. In these cases, ocular prostheses with modification of custom tray was made by using a putty index obtained from wax pattern to produce a better fitting ocular prosthesis so it expected to be retentive as to produce comfort and increase patient confidence. Contact between ocular prosthesis and tissue bed is necessary to evenly distribute the pressure obtained with proper impression technique. This technique ensures a good fit of the custom tray thereby produce accurate adaptation to the tissue surface can increase the movement of the prosthesis and provide a good natural esthetic outcome. Post evisceration patients need psychological support to restore confidence and self-esteem in today's cosmetics challenging world. For these cases, patients' self-confidence was restored and socializing as before without any embarrassment.
Keyword: physical and psycological, ocular prosthesis, evisceration, custom tray

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INTRODUCTION

Eye is an important component of facial expression and is a vital organ of vision. Loss or absence of the eyeball can be caused by congenital defects, irreparable trauma, tumors, sympathetic ophthalmia, or conditions that require histologic confirmation of the suspected diagnosis. Surgical intervention is performed for the treatment of trauma, infecfection, and tumors that cause eye defects. This surgical procedure can be classified into three categories: enucleation, evisceration, and exenteration. Evisceration involves removing the contents of the eyeball and leaving the sclera intact. Enucleation is the removal of the entire eyeball after cutting the optic nerve and muscle. In contrast, exenteration is a more invasive surgical procedure, which involves removing the entire orbital contents including the eyelid and surrounding tissue.[1,2]

In evisceration, since the extra ocular muscles are intact, mobility of the eviscerated globe implant is good, the prosthesis best suited is the custom ocular prosthesis. A minimum of one mm thickness is required. Most patients remove ocular prostheesis at night since the remaining globe is very sensitive. Ocular prosthesis is a simulation of human anatomy by using a prosthetic material to create the appearance of a healthy eye and the normal surrounding tissue, as well as to maintain the volume of the eye socket.[3,4]

Apart from decreased visual function, eye loss also results in physical deformities that increase the psychological burden of the patient. Early rehabilitation with ocular prosthesis is recommended to ease the mind of the patient.[1] Ocular prosthesis is divided into stock shell and custom prosthesis. Close contact between the custom ocular prosthesis and the underlying tissue can improve tissue health by reducing the accumulation of fluid in the intersurface of the prosthesis-tissue thereby reducing the possibility of tissue irritation and bacterial growth. Custom ocular prostheses are also known to distribute pressure more evenly and reduce the incidence of conjunctival abrasion compared to stock ocular prostheses which are the problem in evisceration case that presence of sensitive eye tissue.[3,5] So, this article is aimed to discuss two cases about rehabilitation ocular defect post evisceration.

CASE

Case-1

An 18-year-old male patient was reported to the dental hospital USU with the chief complaint of missing left eye. From the patient's history it was known that he had a traumatic injury to his left eye 10 years ago, therefore he underwent surgery to remove the eyeball by evisceration procedure. Based on examination the ocular defect had healed well with good mobility of the posterior wall of the ocular defect during a full excursion.

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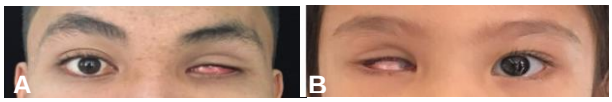

Figure 1 Ocular defect of left eye (patient-1), **B** right eye (patient-2).

The palpebral fissure is examined in the open and closed positions for anatomic and physiological abnormalities. The conjunctiva and sloughing of the inferior fornices were obtained on examination (Fig.1A).

Case-2

A 5-year-old female had an eye injury followed by a subsequent infection, which resulted in evisceration of her right eye a month ago (Fig.1B). Upon examination, the ocular defect had healed well with good mobility of the posterior wall of the ocular defect during full excursion, absence of infection, and sufficient volume to support the prosthesis. The presence of deep superior fornices is recognized by clinical examination.

MANAGEMENT

Both cases were rehabilitated by fabricating ocular prostheses. The difference is that the younger patient needs to be accompanied while the whole process required more patience from both the operator and the patient family. Petroleum jelly is applied to the eyebrows and skin to prevent the mold material from sticking to the eyelashes. Preliminary impression using a custom made of visible light cure (VLC) acrylic resin with the addition of several holes for excess of impression material (Fig.2). Impression material used irreversible hydrocolloid, injected into the eye socket. After setting, the material was removed from the eye socket to check that all surfaces have been imprinted properly.

Figure 2 Custom tray

Split model was fabricated by pour the bottom of the mold first using gypsum type II. After the bottom model set, apply the separating media to the surface of the mold. Then the second layer is poured back with gypsum type II. Markings are made on all four sides of the model for proper reorientation of the model. Wax pattern was created by pouring liquid wax into the mold. The wax is contoured and sculpted appropriately to provide a simulation of a missing eyeball (Fig.3). The wax pattern then inserted into the patient eye socket and checked for proper size, comfort, support, fullness, and retention with functional movement.

Figure 3 Wax try-in of case 1

Marking on the convex point of the wax pattern that defines the peak of the convexity of the eye and make line that marks the medial-distal canthus (Fig. 4). The wax-up convexity was then implanted into the putty impression material, then a custom tray made using self-curing acrylic resin on the putty index (Fig.5), a hole was made at the centre of custom tray as the entry point of impression material. Escape-holes were added for excess impression material.

Figure 4 Try-in wax patient-1

Figure 5 Custom individual tray

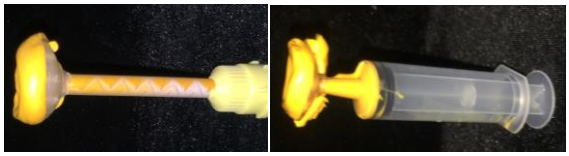

Figure 6 Custom individual tray impression

Final impression was taken using PVS light body, the patient sits upright with his head supported and was instructed to hold his gaze in a straight forward position. The custom tray then placed in the socket following the guide line that has been made to adjust the position of the custom tray in the center of the socket and impression was made by injecting light body material, the patient then instructed to close his and then perform various eye movements to record functional movements. Impression removed from the eye's socket and examined for the result (Fig.6).

The split model technique was generated using gypsum type IV to obtain a working model. Final

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wax pattern was made by pouring modeling wax on final cast. The size and color of the iris is determined by the left/right healthy eye. The iris button is then made according to the results of the measurements that have been made. Final wax pattern try in was performed to verify the size and support of the tissue to simulate eye movement and eyelid coverage. Patient was instructed to keep the eye on the object at least 3 feet in front and at eye level. The position of the iris is determined by connecting the inner and outer canthus and the upper and lower lids. The iris button was then implanted in a final wax pattern (Fig.7). During flasking, the iris button position was maintained using an acrylic mount. After the dewaxing procedure, packing and flasking heat cure acrylic resin with a color that has been adjusted to the color of the sclera.

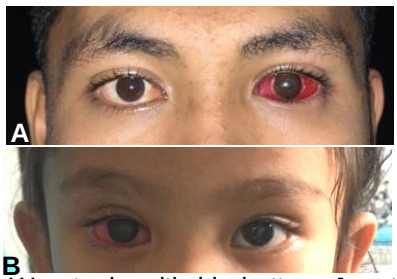

Figure 7 Wax try-in with iris button; **A** patient-1, **B** patient-2

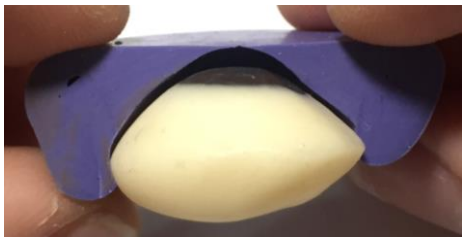

Figure 8 Putty index

The acrylic sclera was then polished continue creating a putty index (Fig.8) as a guide to reduce the convexity of ±2 mm of the sclera and iris botton. Colouring the acrylic sclera according to the patient's eye condition, insert the sclera back into the mold, packing heat cured clear acrylic resin to restore the convexity of the sclera. The prosthesis then removed from the flask, polished, disinfected, and delivery into the patient's eye socket (Fig.9). During insertion, the ocular prosthesis was evaluated in terms of aesthetics, retention, comfort, and ease of performing various eye movements. Post-fitting instructions are provided for the installation and maintenance of the prosthesis.

DISCUSSION

Ocular prosthesis is an artificial replacement for the eyeball. After the surgeon performs surgical

Figure 9 Post ocular prosthesis rehabilitation; left: before and right after; **A** patient-1, **B** patient-2

evisceration or enucleation of the eye, the prosthodontist will make an ocular prothesis to overcome the suffering caused by eye loss. A properly made ocular prosthesis can maintain its orientation when the patient performs various movements.[6]

Anophthalmic socket post evisceration has several advantages: the presence of the scleral, capsule of Tenon, conjunctiva, extraocular muscles, optic nerve which is still intact and leaves the cornea in place. Because the extraocular muscles are intact, this allows the ocular prosthesis to follow the patient's natural eye movements. However, with the cornea and optic nerve left behind, sensitivity to the prosthesis may occur, requiring a more careful procedure. Impression procedures on post-evisceration eye sockets with sensitive tissue remaining should use low-viscosity impression materials such as ophthalmic irreversible hydrocolloids and light body silicone elastomers with suitable, less-pressure impression tray.

The ideal socket for insertion of an ocular prosthesis should have 1) a well-placed implant with extraocular muscle is still available, 2) adequate superior and inferior fornix for positive retention of the prosthesis, 3) the palpebral fissure is the same size and shape as the natural eye tissue, 4) adequate anterior-posterior depth for the socket, 5) adequate support of the superior and inferior tarsal plates, 6) minimal scar tissue adhesion in the socket, 7) adequate eyelid mobility, 8) multiple tissue abnormalities in the socket depth for positive adaptation of the prosthesis.

Contracted socket with inadequate superior and inferior fornices, with palpebral fissures of unique size and shape and with inadequate anterior-posterior socket depth leads to impaired retention and cosmetic complications. Prosthetic treatment of a contracted socket involves constructing a conformer that applies gradually greater pressure to widen and shape the eye socket.[3]

In this paper, the discussion is carried out regarding prosthetic rehabilitation due to post evisceration defects. All cases were successfully rehabilitated with custom made ocular prostheses. In case 1, anophthalmic socket post evisceration

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occurred over a long period of time causing narrowing of the inferior conjunctival fornices, in contrast to case 2 where premature eye loss provided adequate superior and inferior fornices. Custom tray that has been adjusted to the shape of the patient's eye socket can give good results in both cases. Custom trays are adapted to the patient's extant anatomy thereby accurately fit into the sockets and assisting in obtaining accurate impressions of the patient's eye sockets.[7]

Another important step in creating an accurate impression is the tight adaptation of the intaglio surface of the ocular prosthesis to the posterior wall of the eye socket. Using PVS light body as an impression material can provide an advantage because the impression material can flow easily and record the eye socket clearly in a functional state which will ultimately result in tight adaptation and facilitate functional movement of the ocular prosthesis.

Beumer et al. stated that resin stock shell eyes should not be used in evisceration sockets because contact between the ocular prosthesis and the eye tissue is required to distribute pressure evenly. In addition, close contact between the ocular prosthesis and tissue bed is necessary to evenly distribute the pressure obtained with proper impression technique.

Replacement of the lost eye immediately is necessary to promote not only physical but also psychological healing which can improve patient's social acceptance.[8] An ocular prosthesis installation still during childhood adds an inestimable social contribution to the physical and psychological benefit in global rehabilitation of the patient. The extra effort and time put into fabrication of custom-made ocular prostheses has been a boon to patients who cannot afford other alternatives, including implants, and ensures a better drape of lid tissues, and provides a superior natural appearance to both patient and the observer.[9] This technique ensure a good fit of the custom tray thereby produce accurate adaptation of the custom ocular prosthesis to the tissue surface can increase the movement of the prosthesis and provide a good natural esthetic outcome that lead to increase patient's confidence.

It is concluded that rehabilitation ocular defect post evisceration is challenging and require long-term follow up. Post evisceration patients need psychological support to restore confidence and self-esteem in today's cosmetics challenging world. For these cases, self-confidence was restored and socializing as before without any embarrassment.

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Improve the quality of life with magnetically implant-supported overdenture

Darmiaty, Sitti Arfa, Edy Machmud, Ike Damayanti Habar
Department of Prosthodontics
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
Corresponding author: **Darmiaty**, e-mail: **ammimanis11@gmail.com**

ABSTRACT
A 50-year-old female came to Hasanuddin University Dental Hospital Makassar with chief complaint of masticatory problems due to a denture that had been used for 9 years was loose, causing pain when eating. Intra-oral examination showed that the patient is completely edentulous. The mandibular alveolar ridge had resorbed. The patient was treated with an implant-supported overdenture with magnetic retention in the mandible. The maxilla is treated with conventional denture as there was still part of the maxilla that could be used for retention. After obtaining the patitient's consent and confirming that the patient had no parafunction, two implants were placed on the body of the mandible using single stage implants. Right and left implants were 12.0 mm long and 4.0 mm diameter. Both the magnet and the attachment shield were coated with titanium nitride (TiN). It is concluded that magnetically implant-supported overdenture can restore masticatory function and the quality of life.
Keywords: implant, magnetic overdenture, resorbed alveolar ridge, quality of life
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INTRODUCTION

Continued bone resorption in mandibular edentulous patients is a major challenge in prosthetic rehabilitation with conventional dentures. Loss of retention, stability and support is a serious problem for mandibular complete dentures compared to maxilla, especially if the mandible is very flat.

Treatment with implant-supported overdenture (ISO) may be the best solution for this case. ISO is a complete removable denture combined with an implant to increase stability in the oral environment, provide greater retention by using magnets, and support the underlying tissue.[1]

Advantages of an ISO due to its removable properties are easier to clean, improved denture movement and phonetics; prevention of parafunction, increased masticatory efficiency and maximum myoelectric output.[1,2]

The magnets consist of two parts, the one magnet attached to the denture side and the other one to the implant side. They are simple and convenient for the patient. However, they are susceptible to corrosion by saliva, which is why they are rarely used clinically.

The current development of a new generation earth magnets is made of aluminum-nickel-cobalt (AlNiCo), which is resistant to corrosion. This new attachments may still be the treatment of choice for edentulous patients with Parkinson's disease, as they are unable to keep the denture stable, but also require less force to insert and remove dentures.[3,4]

The AlNiCo alloy magnets have been used in dentistry for many years. Initially, repulsive forces such as polar magnets are utilized from the open-field AlNiCo alloy embedded in the base of the upper and lower dentures, so that the repulsive forces will keep the denture on the residual ridge. However, this approach achieved little popularity because of its weak strength, and the direction of the force it was likely to be repelled by the denture out of the mouth. A more popular method is to attach a ferromagnetic metal guard (generally made of stainless steel) to a tooth or implant for traction by magnets embedded in a nearby denture base; This arrangement is known as magnetic guard unit.[5]

The magnetic system developed at this time introduced the rare alloys of samarium (SmCo) and neodymium (NdFeB) in a closed field system. Rare earth alloys produce stronger and more stable magnetic forces than ever before available because it has high magnetization and high resistance to demagnetization. In a near-field system, a magnetic field or flux is contained in the magnet-keeper unit and earn a lot an attractive force that is greater per unit measure than possible with an open field system. Newer closed-field magnets also have higher attractive forces per unit of measure when guard and magnet are in contact, although this force diminishes rapidly when magnet and guard lose contact.[5]

In addition, a new system has been introduced for seal the metal capsule around the magnet and thus to protect it from corrosion in the mouth. According to for its manufacture, less than 1 in 10 capsules associated with overdentures in natural teeth separated from the denture base for 8 years clinical trials; more interesting, no experience loss of magnetic attraction.[5]

This article is aimed to discuss a case about to improve the quality of life with magnetically implant-supported overdenture.

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CASE

A 50-year-old female came to Hasanuddin University Dental Hospital Makassar with chief complaint of masticatory problems caused by 9-years-old denture that felt loose and wobbly, causing pain when eating. Intra-oral examination showed that the patient is completely edentulous. The lower jaw alveolar ridge had already gone through resorption (Fig.1, 2). The patient forgot when the last tooth extraction was performed and needed a new removable denture that accommodates mastication and has good retention.

MANAGEMENT

The treatment plan was aimed to restore oral function including mastication, using an implant-supported overdenture with magnetic retention in the mandible while in the maxilla a conventional denture because there was still a portion of the maxilla that could be used for retention. After obtaining the patient's consent and confirming that the patient had no parafunction, two implants were placed on the body of the mandible using a single stage (Fig.3, 4, 5).[3] Right and left implant had a length 12.0 mm and a diameter of 4.0 mm. Both the magnet and the attachment guard are coated with titanium nitride (TiN) as self-healing resin.

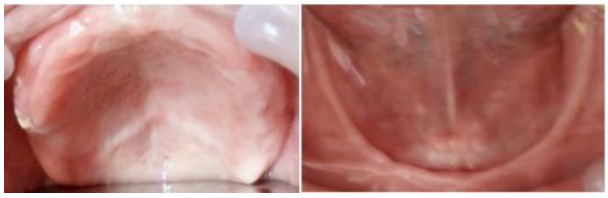

Figure 1 Intra oral view, the maxilla and mandible, before insertion of the implant

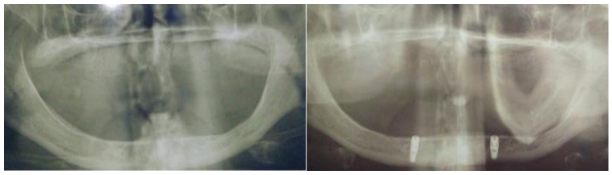

Figure 2 Panoramic radiograph, before and after insertion of the implant

DISCUSSION

In conventional dentures, there is increased bone loss and soft tissue abrasion due to horizontal movement of the prosthesis under lateral loads. Mandibular jaw movement and muscle action can lift the denture from the soft tissues during function and speech. To address this problem, an ISO is indicated. Implant placement will improve the support, retention and stability of the denture. Installalation of 2 implants on the left and right in the caninus region will maintain the height of the aleolar ridge and maximize retention so that the denture does not rotate and is stable in place. This condition will provide good support for the tissue under the denture so that it does not cause excessive resorption.

In a retrospective study, it was concluded that from both biological and prosthodontic aspects, there was no difference in performance of complete dentures supported by only 2 implants on the left and right of the arch, due to increased retention, stability, and occlusal equilibration of the denture and not the number of implants used as supports.[6]

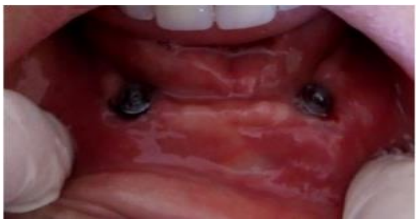

Figure 3 The two magnetic attachments supported by the implants

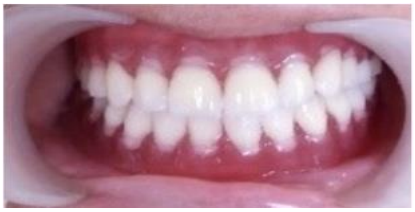

Figure 4 Conventional complete denture on maxilla and mandible implant-reteined overdenture with magnet

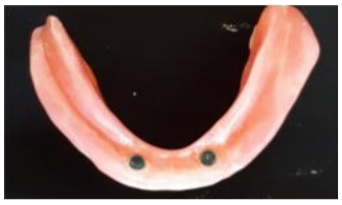

Figure 5 Two magnets bonded to the mandible overdenture

However, two implants support overdenture requiring minimal surgical intervention, that is much cheaper to manufacture, easier to clean, readily accommodates aesthetics and phonetics variable, providing better support for facial muscles, and offer higher levels of patient satisfaction attached more efficient to obtain retention and stability of denture teeth.[7-9]

The manufacture of implant support overdentures provides retention and stability and maximum denture support. The wearer is not afraid the denture will fall out, can speak well and most importantly the wearer can use it to chew food well so that nutritional intake is guaranteed. This condition will improve their quality of life.

It was concluded that magnetic attachments

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can be used to retain mandibular implant overdendenture. Patient satisfaction over the first year was excellent, especially for patients who had been less than satisfied with mechanical attachments. This new generation of magnetic attachment can be applied in a straight forward manner and offers the potential for long-term durability. Mandibular overdenture, implant support can increase the wearer's confidence, so that it will improve the quality of life Aknowledgment None.

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Role of finish lines design on stress distribution in fixed partial denture

[1]Felix Hartanto Ongko, [2]Syafrinani, [2]Putri Welda Utami Ritonga
[1]Postgraduate Program in Prosthodontics
[2]Department of Prosthodontics
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia.
Corresponding author: **Felix Hartanto Ongko**, e-mail: **felix.h.ongko@gmail.com**

ABSTRACT
All-ceramic restorations have been widely used in prosthodontics as metal-free restoration because of their esthetics, biocompatibility, and inert properties. However, fracture remains a complication for all-ceramic restorations. All-ceramic posterior restorations encounter significant fracture after 5 years of usage than anterior region. Stress distribution in all-ceramic restorations during mastication is higher on cervical margin than other surfaces according to finite element analysis. Shoulder and chamfer finish line are recommended designs for maximum fracture resistance of restoration and had influence in stress distribution. Mechanical properties of restoration material such as flexural strength, modulus of elasticity (ME), and fracture resistance are important factors that must be considered for its durability. Increasing ME of restoration material will increase strength of fracture. Zirconia usually used because of its superior fracture resistance among other ceramic material (ME±205 GPa). Shoulder is recommended in zirconia because of greater fracture resistance but other literature suggests chamfer. Lithium disilicate has an improved physical properties and translucency ceramic restoration and is recommended as an alternative treatment (ME±96 GPa). In lithium disilicate, shoulder and chamfer have almost equal fracture resistance. PEEK is a thermoplastic semi-crystalline material with ME near human cortical bone (±3.6 GPa) with shock absorption properties. This literature review role of all-ceramic restoration finish lines design on stress distribution. Shoulder and chamfer still the main choice in FPD but which design is most appropriate still undecided.
Keywords: finish lines design, zirconia, lithium disilicate, PEEK, stress distribution

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INTRODUCTION

Over the past decades, all ceramic dental materials have been widely used in prosthetic dentistry as metal free restoration due to their good esthetics, biocompatibility, and excellent inert properties.[1,2] Improvement of microstructure and physical properties from all ceramic crowns have been developed to the posterior region as an alternative treatment for dental defects, and it has been suggested that these material are as reliable as metal-ceramic crowns, therefore all ceramic crowns are currently considered the gold standard. However, fractures remain a complication of all ceramic restorations. One of the main problems with all ceramic restorations is the possibility of fracture under occlusal and lateral forces.[1,3,4]

The most important factor influencing the fracture rate of an all-ceramic crown is the position of the restored tooth in the mouth, this position determining the magnitude and direction of the occlusal force. Ferrario et al reported that the greatest force occured in molars, decreased in the premolars, and became only one-third to one-fourth of the original value for the incisors. Goodacre et al. reported that the clinical fracture rates of ceramic crowns differed between types of restored teeth, namely 21% for molars, 7% for premolars, and 3% for anterior teeth. In a systematic review by Xiaodong et al., all ceramic crowns showed an acceptable 5-years fracture rate of 4.4% regardless of the materials used with molar crowns (8.1%) showing a significantly higher 5-years fracture rate than premolar crowns (3.0%), and the difference between anterior crowns (3.0%) and posterior crowns (5.4%) also achieved significance. Fractures were classified as core fractures or veneer fractures. The determinants of fracture of an all-ceramic restoration depends on the fracture resistance of the material, finish line design, appropriate thickness of the material, magnitude and direction and frequency of applied loads, interfacial defects of restoration cement, and oral environment effects. Finite element analysis studies has been applied to investigate fracture in fixed partial denture. The results showed that stress was mostly concentrated in the cervical region of the restoration. Therefore, finish lines design may affect the fracture resistance of fixed restoration.[1,2]

This literature review is aimed to discuss the role of finish lines design on stress distribution in fixed partial denture

LITERATURE STUDIES

Restoration material

Restorative material considered to be a factor that influence the biomechanics, that is stress distribution and cusp deflection, during masticatory movements. It has been reported that some crown

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fracture due to the relatively low mechanical resistance of the ceramic crowns, which may be related to the large masticatory forces applied to the premolars and molars as well as to the brittleness of the inherent of ceramics. Ceramic materials are very susceptible to tensile stress and mechanical resistance which is also greatly affected by the presence of superficial flaws and internal voids. The defect may represent sites of the crack initiation. The modulus of elasticity of restorative materials is an important factor in crack initiation and propagation in dental ceramics. Scherrer and de Rijk reported that the fracture load increased as the elastic modulus of the material or supporting structure increased. Farah et al. reported that the base material should have the highest possible modulus of elasticity to support restorations from intermittent forces during mastication. The choice of crown material has a great influence on the maximum principal stress in the crown. Increasing the stiffness of the crown material concentrates more stress within the crown, whereas crowns made from a material with a lower stiffness transfer more stress to the cement layer and the tooth supporting core.[5]

Leucite-reinforced glass-ceramic have been used for more than 30 years for the esthetic appearance in the anterior region for single crown. In 1998, pressable lithium disilicate all-ceramic material IPS Empress 2, which exhibits higher mechanical strength than its predecessor and is suitable for three-unit fixed dental prostheses in the anterior region, was introduced on the market. Due to its opacity, this material needs to be veneered. In 2007, IPS e.max Press material, which is a new pressable lithium-disilicate glass ceramic, was used to improve its mechanical properties with good esthetics and translucency. In addition, the range of indications for use include anterior and posterior teeth. Lithium disilicate has a modulus of elasticity of ± 96 GPa.[6]

Meanwhile, zirconia material is currently considered as the most suitable material for posterior restorations because it has higher flexural strength, fracture strength and fracture toughness of 6-15 $MPa.m^{1/2}$, flexural strength of more than 900 MPa, high Vickers hardness 1200-1350 HVN and modulus of elasticity ±205 GPa compared to other ceramics such as alumina, glass ceramics and lithium disilicate. A yittria-tetragonal zirconia core with its stabilized tetragonal phase is indicated in the high stress sector because of its ability to resist crack propagation. However, the high incidence of veneer chipping and porcelain veneer fracture is a frequently reported technical complication. The clinical survival rate of tooth supported by zirconia-based all ceramic crowns can be as high as 95.9–98.5% after 5 years but decreases by 10 years to 67.2%. Beuer et al. reported a significantly higher fracture load (2286 N) in a single zirconia crown with a shoulder finish line design compared to the other conservative finish line designs. Ezatollah et al evaluated the effect of two different finish line designs namely chamfer and deep chamfer of zirconia core restoration and from these results showed that both finish line designs had high fracture resistance over masticatory forces so that both designs could be used. However, since fracture resistance tends to favor chamfer finish line design, it is recommended because of its efficiency in biomechanical characteristics of posterior single all ceramic crown restorations. Compared to other ceramics, zirconia shows the highest stability as a framework material. However, the most frequent technical problem in fixed dental prostheses with zirconia framework is minor chipping or extensive fracture of the ceramic veneer.[3,6–9]

Recently, PEEK material has been used as an alternative to single crown restorations due to its material properties but research on this material is still ongoing. Polyetheretherketone (PEEK); thermoplastic crown type is a new material that has been introduced in the field of dentistry, namely bioactive high-performance polymer (BioHPP); containing 20% ceramic filler. This PEEK thermosplastic material is characterized by good biocompatibility, good wear resistance, chemical stable, light weight and adequate mechanical properties allowing it to be a suitable alternative material for ceramic restorations. BioHPP is indicated for the manufacture of implant fixtures, crown/bridge fixed denture prosthesis frames and removable den-tures, as well as for implant frames and restorative implant parts. The modulus of elasticity of this material is 4-6 GPa close to the modulus of elasticity of bone allowing it to act as a load absorber agent; thereby, reducing the forces transmitted to the restoration and the tooth roots. The advantages of using this material are the elimination of allergic reactions, good polishing properties, and low plaque adhesion. In addition, despite its low modulus of elasticity and hardness, its high wear resistance makes it competitive with metal alloys. However, research evaluating the material properties of these materials is still limited.[1,5,10]

Finish lines design

The tooth preparation is a very important factor in determining the strength of all ceramic crown.

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Shoulder and chamfer finish line design are the most widely used designs for fixed partial dentures. Shoulder finish line design is usually chosen for full all crown restorations. The wide ledge of the shoulder finish lines provides resistance to occlusal forces, minimizes stresses that can cause porcelain fracture and leaves space for healthy restoration contours and maximum esthetics. The disadvantage of the shoulder finish line design is that the tooth structure is less conservative and the stress concentration is at an internal angle of 90° on the finish line, making it susceptible to coronal fracture. Chamfer finish line is a concave extra coronal finish line that provides greater angulation than the knife-edge design and a smaller width than the shoulder design. The advantage of chamfer finish line design is more conservative, has clear margins, easy to identify, and provides room for more adequate bulk of material and the development of anatomically precise axial contours. Chamfer finish line design requires care to avoid leaving a lip of unsupported enamel. Several studies have been carried out to evaluate the effect of finish line design on load at fracture, but the results of these studies are inconclusive. Some studies have found that finish line design has an effect on fracture resistance, while others have seen no such effect. A larger rest area for margins, such as shoulder finish line design, is suggested to ensure a better pattern of stress distribution during occlusal loading, but the results of studies on this subject are inconsistent because some authors have found no relationship between the finish line design and the fracture strength of all ceramic crowns, while significant results were found by other authors. Shoulder finish line design and several other authors have proposed a deep chamfer finish line design for maximum fracture resistance of fixed restorations. Jalalian et al. suggested deep chamfer finish line design for higher fracture resistance to improve the biomechanical performance of zirconia posterior single crown restorations. Pasha recommends chamfer finish line design because it has high fracture resistance against posterior bite forces for better biomechanical performance.[1,10–13]

Stress distribution

Finite element analysis (FEA) is a digital test carried out by simulating experimental studies, this analysis test always represents a simplification of clinical scenarios. The FEA has become a powerful test technique in dental biomechanics due to its flexibility in calculating stress distributions in complex structures. The FEA allows the study of stress distribution through model simulation, which can be used to examine the role of various design. The advantages of the FEA test compared to in vitro laboratory tests are lower costs and faster. The disadvantage is that it is a computerized in vitro study in which clinical conditions may not be fully replicable.[3,6,14,15]

It is known that the design of the finish line is one of the factors affecting the marginal adaptation and fracture resistance of the crowns. The fracture pattern of a fractured crown during clinical use indicates the origin of the fracture is at the cervical margin of the crown or from the intaglio surface of the crown. In one study, FEA was used to study stress distribution during mastication in the maxillary second premolars restored with metal ceramic crowns and compared with the non-restorable tooth, a large stress was recorded on the cervical line of the restored tooth. The load on an all-ceramic crown during mastication has been reported to be higher near the cervical margin than on the occlusal surface, and thin margins may be the cause of fracture according to fractographic and FEA. The cervical margins have also been reported to be vulnerable, and during clinical use, cracks may be induced from the occlusal surface to the thin margins.[1,3,15]

DISCUSSION

In the literature, data showed that differences in the finish line design clearly affect the stress distribution to the crown margin. Stress distribution can be used as an indicator of the biomechanical behavior of crown restorations. The FEA helps in analyzing stress distribution within crown. Most studies of stress distribution in single crown restorations have shown that the cervical area has high stress. The location of the stress depends on the crown structure, the abutment material and finish line design. The best choice of finish line design for fixed dentures is still uncertain. Rammersberg et al, agree that chamfer finish line design has the greatest stability for posterior all ceramic crowns. Jalalian et al. stated that fracture resistance with the shoulder finish line design was lower than the chamfer finish line design of the InCeram full ceramic restoration. Jalalian et al. in another study showed lower fracture resistance of CAD/CAM zirconia posterior crowns with a shoulder finish line design compared to chamfer design. However, Di Lorio et al, evaluated the effect of the shoulder and chamfer finish line design on fracture resistance of the Procera full ceramic crown core and concluded that fracture resistance with shoulder finish line

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design was higher chamfer finish line design. De Jager et al, performed a FEA to assess stress distribution on full ceramic restorations and concluded that chamfer finish line design was more suitable for posterior restorations. Cho et al, evaluated the effect of finish line design on fracture resistance of composite-reinforced ceramic restorations and demonstrated that the fracture resistance of chamfer finish line design samples was significantly higher than shoulder finish design. Potikel et al, assessed the fracture resistance of the teeth restored by different full ceramic systems and showed no significant difference between the groups. Roh et al and Ahmadzadeh et al demonstrated that shoulder and chamfer finish line design did not affect the fracture resistance of the IPS-emax posterior single crown. Rocha et al. stated that finish line design of crown proved susceptible to fractture with maximum stress in the area using FEA. Turk et al. in his study using 3D-FEA method showed that rounded-shoulder finish line design had a higher Von-Mises stress value than chamfer finish line design model. D'Souza et al. concluded that the area with maximum stress was concentrated in the cervical third region of the single crown root of the mandibular posterior teeth when given the maximum bite force using FEA. Magray et al, using FEA evaluates von Mises stress having the highest value in the chamfer finish line design compared to the shoulder finish line design. Miura et al, stated that using 3D finite element analysis, shoulder finish line designs can show better clinical performance and can be expected to reduce fracture risk in all ceramic crowns.

It is concluded that shoulder and chamfer finish line design still the main choice in fixed partial denture. Wide ledge of shoulder design provides resistance to occlusal forces and gives space to healthy restoration with maximum esthetic but it is less conservative of tooth structure and stress concentration at 90° internal angle of finish line hence conducive to coronal fracture. Chamfer finish line has concave form. It provides greater angulation than knife edge and less width than shoulder. Chamfer are more conservative with distinct margin and easy to identified. The most appropriate finish line design for longterm durability is still undecided. The choice of crown restorative material has an influence on the stress distribution for a longterm crown restoration. Careful planning of the finish line design and selection of restorative materials is important before carrying out treatment.

Further research in stress distribution evaluatting proper finish line design that complement with restorative material for long term of fixed restoraration is needed to provide a further explanation.

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Management of palatal defect post hemimaxillectomy: a case report

Pra Purnama Ramadhan, Ike Damayanti Habar, Eri Hendra Jubhari, Imran Irsal, Irsal Wahyudi Sam
Department of Prosthodontics
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
Corresponding author: **Pra Purnama Ramadhan**, e-mail: **ramadhanprapurnama@gmail.com**

ABSTRACT
A 42-year-old woman was referred to the Department of Prosthodontics, Hasanuddin University Dental Hospital with speech, swallowing and chewing difficulties caused by a fractured and non-reusable acrylic obturator. The patient had been using the obturator since maxillary tumor resection in 2012, which resulted in a significant and deep defect in the right maxillary region. Intraoral examination revealed a defect in the midline of the palate that extended to the left alveolar bone, and 21, 22, 23, 24, 25, 26, 27, 16 were edentulous. The maxillary defect did not appear inflamed or infected, and the surrounding area appeared normal. The treatment plan was fabrication of a maxillofacial skeletal partial denture to rehabilitate the maxillary defect. Primary impressions were made with irreversible hydrocolloid material with a stock tray to obtain a study model. Custom tray was made for individual impressions with polyvinyl siloxane material to obtain working models. A survey was conducted, and framework and bite rim were made. Maxillary denture was designed with Akers clasps at 35, 37, RPI at 45, full palatal palate as main connector. The denture framework was tried on, followed by determination of vertical dimensions. Denture alignment was done in the articulator using A3 color. The was prostheses were tried in and evaluated of retention, articulation, phonetics, and aesthetics; then sent to dental laboratory for processing and the obturator was then inserted into the patient's mouth. Patient follow-up was scheduled 24 hours and 1 week after insertion. It is concluded that the maxillofacial partial denture is a rehabilitation device that can result in decent retention and stabilization, especially in cases of acquired defects. The prosthesis can improve patient adaptation and ability with speech, mastication and swallowing functions.
Keywords: hemimaxillectomy, metal frame, obturator, maxillofacial prosthesis
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INTRODUCTION

The tumor lesions in the maxillofacial area are often treated surgically, such as resection of the maxillofacial area to remove tumors or local lesions that cause the defects in the form of perforation of the palate.[1] A surgery on the facial area can cause the facial defect, impaired speech, swallowing, mastication, aesthetics, and psychological functions. The magnitude of the problem that occurs depends on the extent of the resection and how to restore the shape of the face into the normal conditions as well as the psychological factors of the patient to accept the reality he was experiencing.[2]

Hemimaxillectomy is a maxillary resection surgery done by removing a portion of the maxillary bone on one side. The size of the defect that occurs after surgery depends on the cause and the surgical technique performed. Maxillectomy is differentiated into three categories; total, radical, and marginal. Total maxillectomy is a partial excision of the maxillary bone to the median line involving the maxillary sinus but still below the orbital floor. The radical maxillectomy is the cutting of the maxillary bone involving the maxillary sinus and orbital floor. The marginal maxillectomy is a partial excision of the maxillary bone without involving the bone, palate and maxillary sinus. The type of maxillectomy chosen for treatment depends on the bone defects.[3]

Defects that occur after maxillectomy can vary depends on the diagnosis and the resection performed. According to Aramany, the classification of the defects is divided into six classes. Class I is a unilateral maxillary defect affecting all anterior and posterior teeth. Class II is a unilateral maxillary defect affecting the posterior teeth. Class III is a defect in the middle of the palate without involving the teeth. Class IV is the bilateral maxillary defects crossing the median line with remaining teeth in the posterior region of one side. Class V is the bilateral maxillary defects in the posterior region with remaining teeth in the anterior region of both sides, and class VI is the bilateral maxillary defects in the anterior region with the remaining teeth in the posterior region of both sides.[4] Meanwhile, Veau classified the maxillary defects into several groups, such as clefts in the soft palate only, clefts in the soft and hard palates extending forward to the incisive foramen, clefts of the lips and unilateral complete palate starting from uvula, soft and hard palate to the alveolar bone and lip on one side, and the cleft lip and palate bilaterally from the uvula, soft and hard palate, to the alveolar bone and lips on both sides.[5]

To restore the dental and oral tissues that were removed at the time of maxillectomy, rehabilitation is urgently needed by making a maxillofacial prosthesis.[1] The defects was closed by replacing the

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hard, soft tissue, and the missing teeth using an obturator as an intraoral maxillofacial prosthesis.[6] Obturator is a kind prosthodontic appliance that is used to close the cleft palate, assist swallowing, improve the speech function so as to avoid nasal or hissing sounds, maintain maxillary arch width and tooth arrangement and to improve the palatal growth.[7]

Obturator is aimed to restore the function of speech and chewing, helping the healing process of soft tissue and the psychological condition of the patient. Maxillofacial prosthesis should be made immediately after surgery, to prevent contraction of the facial muscles that can reduce the retention so that the patient becomes disabled and disappointed.[8] This article is aimed to manage of palatal defect post hemimaxillectomy.

According to Da Breo et al, the requirements of an obturator should meet three goals, such as: to form a good oral seal to make the effective swallowing and speech functions, to provide retention and stabilization support for the prostheses and to improve the facial shape after partial loss of facial bone. This will be very helpful for the psychological conditions of the patiens.[9]

The general principles of partial denture design also apply to obturator design, including the need for a connector, the presence of supporting components for stabilization and retention, the presence of rests placed on the abutment teeth as support, the designs with maximum support, and the passive direct retainers and rests that the loads that are not excessive on the abutment teeth, and controlling occlusal forces against the defect, especially when natural teeth are involved.[4]

Obturators with metal frames are made with consideration for the comfort and strength because it also made to support dentures that replace missing teeth in the anterior and posterior parts that resist a large masticatory load.[10]

CASE

Figure 1 Extra oral profile of the patient

A 42-year-old female patient has had a tumor in the maxilla since 1992, then surgical removal of the tumor in 2012 left a wide and deep defect in the left maxillary region. The patient had used an obturator prosthesis made of acrylic, but the prosthesis was broken so that the patient felt uncomfortable and had some troubles in speaking, chewing, and swallowing.

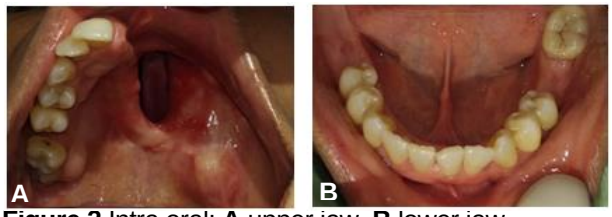

Figure 2 Intra oral; **A** upper jaw, **B** lower jaw

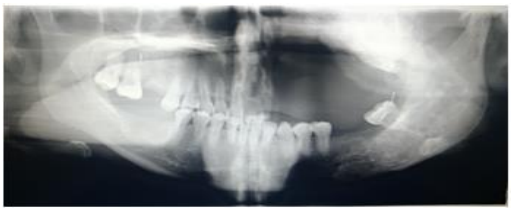

Figure 3 Panoramic radiograph view

Intra oral examination showed a defect in the midline of the palate extending to the left alveolar bone, and the missing teeth were 16, 21, 22, 23, 24, 25, 26, and 27. The defect showed no signs of inflammation or infection and the surrounding looked normal. The patient's oral hygiene is good (Fig.2).

Radiographic examination with panoramic view revealed an image of the missing maxillary bone in the left region as a defect in the maxillary bone in that region. Multiple missing teeth can be seen in the panaromic view (Fig.3).

MANAGEMENT

After discussed with the patient, the prosthesis of choice was metal frame obturator with a combination of acrylic resin to rehabilitate the defect on palate and replace missing teeth in the maxilla. For the mandible, a metal frame partial denture was chosen. Before starting treatment, patients were asked to sign an informed consent.

At first visit, preliminary impression was done with the irreversible hydrocolloid impression material using a stock tray. Before the impression material was inserted into the mouth, a gauze was placed on the side of the defect to prevent the impression material from entering the nose. The results of the maxillary impression showed that the impression material looked prominent, indicating

Figure 4A Physiological impression of the maxilla, working model of **B** maxilla, **C** mandible

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that the impression material entered the defect and printed the shape of the defect. Then this mold was filled with dental stone to obtain an anatomical model. The next stage was followed by the stage of making the obturator design.

At the second visit, physiological impression was carried out using an individual impression tray which was previously done with border molding to get a good border adaptation from the obturator, especially in the defect area. The impression of the working model used polyvinyl siloxane material, then was poured with dental stone to obtain the working model.

The working model was then surveyed to get the path of insertion of the metal frame dentures. The working model and the design of the denture were sent to dental laboratory to make a metal frame. A C-clasp retainer was used in the upper jaw for 13 and a double Akers for 14, 15 and 17, 18. An Akers clasp was used in the lower jaw for the 35 and 37, an RPI used on 37. The maxillary major connector was a full metal frame palatal plate with modified mess that extends to the cleft palate. A lingual bar was used for the lower jaw.

At the third visit, after the metal frame and the bit rim were finished, the frame was tried in (Fig.5A) and the relationship between the maxilla and mandible was measured by using the two dots method. At this stage, the path of insertion of the metal frame was also checked, then the frame and its bite rim were fixed and transferred to the working model and then mounted in the articulator. The arrangement of the teeth was carried out in the mean value articulator, with A3 as the tooth color.

At the fourth visit, a try in was done for the wax obturator and dentures (Fig.5B). At this stage, the retention, stabilization, occlusion, articulation, phonetics, and aesthetics of the denture were examined. The purpose of this examination was to ensure that the denture is able to withstand the forces that can release it both at rest and when functioning. In addition, it was ensured that there was no premature contact at the time of occlusion and articulation as well as phonetic examination in the form of clarity of word pronunciation. After the denture can function properly and the patient agrees, the wax prosthesis was sent to the dental laboratory for the processing.

The fifth visit was the insertion of the obturator and the removable denture (Fig.6). Retention, stabilization, occlusion, phonetics, and the aesthetic examinations were performed. The obturator did not fall off when it functions, showing good retention and stability. The examination of the occlusion with articulating paper showed that there was no traumatic occlusion. The phonetics were clearer. The aesthetics of the patient's smile was also satisfactory. The patient was given some instructions on how to insert and remove the dentures and how to maintain it. For initial adaptation, the patient should wear the dentures for 1x24 hours, then after that the dentures are removed every night before going to bed and placed in a container filled with water. The patient was scheduled for a follow-up one week after insertion (Fig.7).

At the time of the follow-up, subjective and objective examinations were carried out. Subjective examination revealed no complaints of pain, and the patient could bite and chew better. Patient also communicate with a clearer voice and felt more self-confident. Objective examination found no soft tissue inflammation due to the use of the dentures. In addition, retention, stabilization, occlusion, articulation, and phonetics were all good. The aesthetic appearance of the obturator was good because it covered the defect in the left buccal region

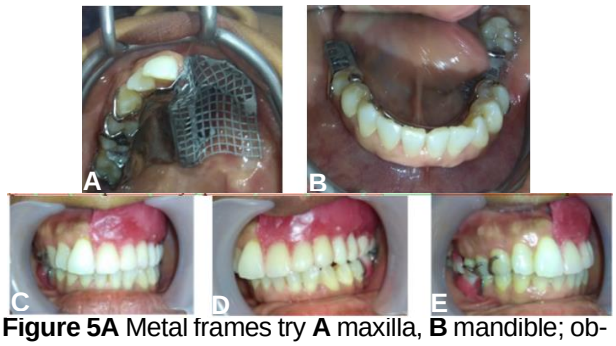

Figure 5A Metal frames try **A** maxilla, **B** mandible; obturator wax try in, **C** frontal view, **D** buccal left view, **E** buccal right view.

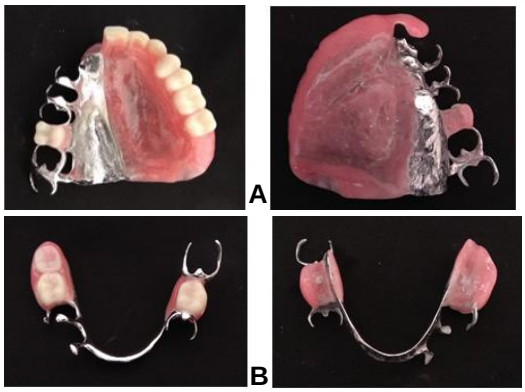

Figure 6A Maxillary obturator, **B** mandibular removable denture

Figure 7 Insertion of maxillary obturator; **A** frontal view, **B** palatal view, **C** insertion of mandibular removable denture.

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Figure 8 Extra oral profile of the patient after insertion of the obturator and the removable denture.

that was visible when the patient smiled (Fig.8).

DISCUSSION

Obturator is a maxillofacial prosthesis to rehabilitate maxillofacial for restoration of speech, chewing function, and healing process acceleration of psychological trauma. To help reduce the suffering of the patient, it is advisable to immediately make a prosthesis to rehabilitate the patient's condition; an obturator.[11] The maxillofacial prosthesis requires three goals, such as forming an oral seal to make swallowing and speech functions more effective, providing retention and stabilization support for prostheses and improving facial shape after facial bone loss, where this will increase self-confidence for patients.[9]

Obturators with metal frame are made with consideration for comfort and strength because the obturator also functions to support the dentures that replace the missing anterior and posterior teeth that receive a large masticatory load.[12]

The basic principles in constructing a definitive obturator depend on the condition of the defect and which provides the greatest benefit in function and comfort.[13] Consideration must be given to the size and location of the defect, the number and position of the remaining teeth, and the distribution of the maximum load to support the obturator. This can be accomplished by involving as many of the remaining teeth as possible, using an occlusal or cingulum rest, and extending the metal frame plate as widely as possible.[14]

The definitive obturator made in this case used a C-clasp, Akers, and double Akers. The teeth used as abutments were 13, 14, 15, 17, and 18, because these teeth have a large crown and wide root surface. The major connector used was a bilateral metal framework palate plate with an extension of the mess to the defect area for retention of acrylic resin that enters the defect. This is in accordance with Owall et al who stated that an extension towards the defect can increase retention and stabilization as well as increase the accuracy in making a peripheral seal of the obturator.[15] A good seal makes sound and pronunciation of letters clearer because there are no gaps between the prosthesis and the mucosal tissue. This is in accordance with the opinion of Hammond and Berger who stated that the loss of maxillofacial structure not only changes the articulation space of speech but can also affect voice clarity and pronunciation.[16]

Evaluation of the patient after using an acrylic resin metal framework obturator prosthesis showed improvement in phonetic, aesthetic, masticatory, and swallowing functions. This is in accordance with research by Kapoor et al. which states that the use of an obturator can improve the patient's aesthetic, phonetic and masticatory functions.[17] The use of an obturator in the case of cleft palate provides an increase in the patient's phonetic function because the nasal voice is reduced, and the patient's speech becomes clearer.

It is concluded that the use of a metal frame obturator combined with acrylic resin in cleft palate patients after hemimaxillectomy influences pressure and has excellent durability because it has a very strong structure. This also has an impact on retention and stabilization which is very good and stable during use because it is supported by a solid grip. Thus, the patient will feel more comfortable and satisfied where the nasal sound can be reduced when speaking, as well as correcting the masticatory and swallowing functions.

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Calibrated pressureless impression technique of ocular prosthesis for eviscerated socket: a case report

[1]Henny Kartika, [2]Ariyani, [2]Ricca Chairunnisa, [2]Haslinda Z.Tamin
[1]Postgraduate Program in Prosthodontics
[2]Departement Prosthodontics
Faculty of Dentistry, Universitas Sumatera Utara
Corresponding author: **Henny Kartika,** e-mail: **kartikahenny90@gmail.com**

ABSTRACT
Ocular prosthesis for post evisceration socket often has feeble adaptation to the surrounding tissue due to high sensitivity. Excessive pressure given by impression technique would lead to irritably intaglio and bulky palpebral contour of the prosthesis. This article describes a modified method of functional impression which made it easier not only to record the tissue bed surface of the defect but also to get the right contour of the palpebral surface at the same time. A 60-year-old male came to Dental Hospital Universitas Sumatera Utara with evisceration defect as a result of traumatic injury 40 years ago. He complained a facial disfigurement that made him formidable with social interaction. Pressureless impression combined with calibrated tray was planned for the patient. Light body PVS material was injected into the socket under slight pressure and the conformer made from visible light cure acrylic resin was in position as a tray. Vertical and horizontal lines marked in the conformer calibrate with the facial marking as a guidance for 3-D position. The method is intended to get the fast, accurate position offering the patient ocular prosthesis with great comfort as well as to provide facial contours that improve the patient's psychological and physical outlook.
Keywords: evisceration, customized ocular prosthesis, functional impression, pressureless impression, calibrated conformer
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INTRODUCTION

Loss of facial tissue or organs can have significant physiological, social, and psychosomatic effects on the affected individual and may arise as a result of congenital defects, trauma, neoplastic disease or surgical intervention.[1] Surgical management of eye removal can be classified into three categories: evisceration, enucleation, and exenteration.[2,3] Exenteration is the removal of the entire contents of the orbit, including the extraocular muscle. Enucleation is the surgical removal of the entire eye opthalm and part of the optic nerve from the orbit. Evisceration is an excisional procedure to remove intraocular contents, leaving the sclera, and sometimes the cornea.[4]

Prosthetic rehabilitation can be performed with stock ocular prosthesis (prefabricated) or custom-made ocular prosthesis.[5] Stock ocular prosthesis are available in standard sizes, shapes, and colors and can be used for postoperative temporary purposes. Custom made ocular prosthesis have several advantages over stock eye prosthesis such as better esthetics obtained from control over iris and pupil size as well as iris and sclera color, their surface is in close contact with the surrounding tissue which makes for better eye movement and a more even distribution of pressure, making it more comfortable to use.[6,7]

Fluid accumulation in the prosthesis surface and eye tissue is often become a problem due to unfitness of ocular prosthesis caused by over compressive impression. Fluid accumulation can cause tissue irritation and promote bacterial growth in the eye.[8] This article suggests a novel impression technique to get a fast and accurate positioning to provide post-evisceration ocular prosthesis with the aim of achieving tight tissue contact for better comfort and esthetics.

CASE

A 60-year-old male came to Dental Hospital Universitas Sumatera Utara with evisceration defect as a result of traumatic injury at work 40 years ago (Fig.1). He had a complaint of facial disfigurement that made him uncomfortable with social interaction. Upon examination, the defective right eyelid was retracted. Intra ocular tissue bed and muscles were intact and free of inflammation. For the contralateral eye, lid position and palpebral fissure in the open and close position was normal, no nystagmus and no history of strabismus. A custom-made polyethylene ocular conformer was fabricacated (Fig.2A). Separating medium is applied to the patient's eyebrows and eyelashes and preliminary impression was taken using irreversible hydrocolloid (GC aroma fine plus normal set). The material was mixed according to the manufacturer's instructions, put into a disposable 3 cc syringe and injected into the defective right eye socket (Fig.2B).

Figure 1 Pretreatment photograph

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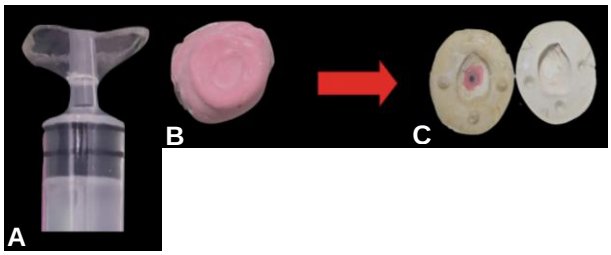

Figure 2A Custom made polyethylene ocular tray, **B** preliminary impression, **C** split cast with indentation grooves

A split cast with four indentation grooves was made using dental stone type II (Fig.2C). Molten wax was poured into the split cast to obtain wax pattern of the sclera. Try in the wax pattern to examine size, contour and retention in functional movement.

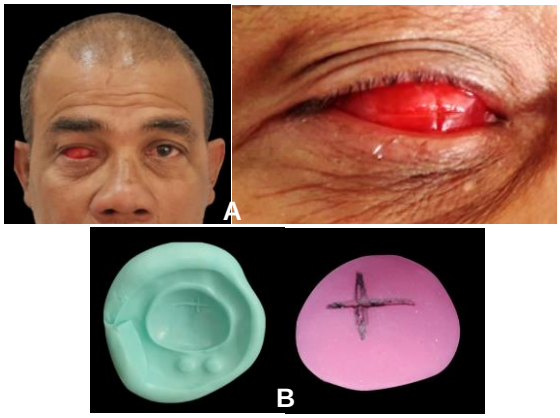

Figure 3A Wax pattern try-in, **B** putty mold for fabrication of functional impression conformer

After the wax pattern is confirm (Fig.3A), a horizontal line from mesial to distal canthus and vertical line marking on the wax-up convexity was made. The marked wax pattern was then copied to the putty as a mold for custom functional impression conformer to obtain the palpebral contour. When putting the wax into the putty, it should not pass through the largest part of the convexity to maintain the right countour of the palpebral. Custom functional impression conformer with escape hole were then fabricated using visible light cure acrylic resin (Fig.3B).

Functional impression was taken using light body addition poly-vinyl-siloxane (PVS) elastomeric impression material (Zhermack elite P&P). The patient was instructed to sit upright with the head back and hold his gaze in a straight-forward position. The PVS was injected into the socket under slight pressure and the conformer made from visible light cure acrylic resin was in position as a tray. Vertical and horizontal lines marked in the conformer calibrate with the facial marking as a guidance for 3-D position to avoid excessive pressure on the eye socket. Patient was then instructed to perform eye movements while the impression material sets (Fig.4A).

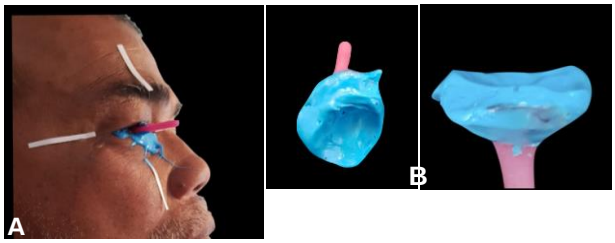

Figure 4A 3-D position was obtained, **B** functional impression

The impressions are then removed and examined for the results of the functional impression (Fig.4B). Following the functional impression, work model was made by split cast technique using type IV dental stone material and wax pattern of sclera was being made. The size and position of the iris were determined from the contralateral eye using inter pupillary distance (IPD) ruler (Fig.5A). The colour of iris was obtained by oil color painting (Windsor & Newton oil colour) (Fig.5B) and colour of sclera was obtained by using dental shade guide (Vita classical) (Fig.5C).

Figure 5A Obtaining iris position and diameter, **B** oil painted iris disk, **C** finished iris button

The iris button was mounted onto the wax pattern. Try in of wax pattern ensuring size, tissue support to simulate eye movement and eyelid coverage as well as iris color and position during movement and at rest (Fig.6A). Flasking and dewaxing was carried out. During flasking, the iris button position is maintained using an acrylic mount (Fig. 6B).

Packing of heat cured acrylic resin with a color

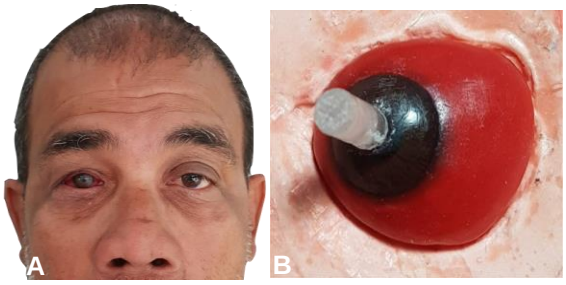

Figure 6A Try in final wax pattern, **B** iris button mounting

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that has been adjusted to the color of the patient's sclera (Fig.7A). After completion, the sclera was then trimmed and its convexity was then reduced by ± 2 mm for staining and veining of the scleral by attaching red dacron polyester fibers to the prosthesis using the monomer-polymer syrup mimicking the contralateral eye and packed with heat-cured clear acrylic resin to restore the initial convexity of the sclera. The ocular prosthesis was polished, cleaned and inserted to the patient eye socket (Fig.7B).

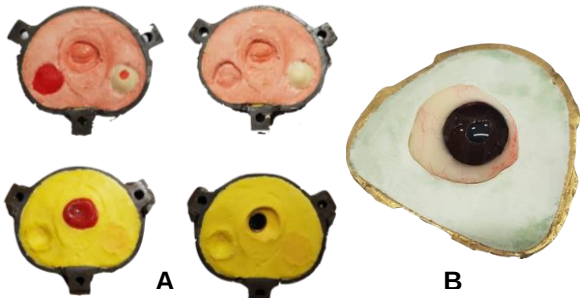

Figure 6A Flasking dan dewaxing, **B** custom ocular prosthesis after polishing

During insertion, the ocular prosthesis is evaluated for esthetics, retention and comfort. Postinsertion instructions were explained to the patient and the patient was instructed for periodic controls for 1 week, 1 month and every 6 months (Fig.8).

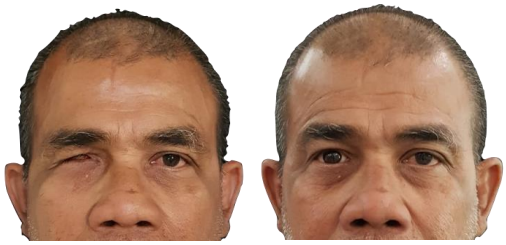

Figure 8 Before-after photograph

DISCUSSION

Compared to custom made ocular prostheses, stock ocular prostheses have several disadvantages, such as unfitness, constant tissue irritation due to bacterial growth in the fluid that accumulates at the prosthesis-tissue interface and poor aesthetics. Custom made ocular prosthetic prevents drooping of the eyelid, supports muscle function in the eyelid, maintains the palpebral opening, and provides a similar appearance to the real eye.[10]

Post evisceration eye socket still has sensitive tissue remaining which requires more careful work procedures, especially the impression procedure. Impression has a big role in the final result of the prosthesis. Good and accurate impression will produce artificial eyes that are fit and comfortable to use. Post evisceration eye socket impression procedures should use low-viscosity impression materials such as irreversible hydrocolloids and light body silicone elastomers with custom made pressure-free impression tray.[7,11]

In this case report, the discussion focuses on the functional impression procedure. In this case, the post-evisceration anophthalmic socket has been present for a long time to cause the superior palpebral conjunctiva to retract because it is not supported by the eye opthalm. Physiologic impression tray plays an important role to cover the convexity of the artificial eye opthalm to be made so that the superior palpebral conjunctiva can be supported again. In this case, the convexity is maintained by making marks on the tray and the area outside the eye socket to get the exact 3-D position of the tray, so that an accurate impression is obtained. Another important step in the impression is the tight adaptation of the intaglio surface of the ocular prosthesis to the posterior wall of the eye socket and must not over press against the posterior wall of the eye socket. Using a light body as an impression material can provide an advantage because the impression material can flow easily and imprint the eye socket clearly in a functional state which will eventually result in tight adaptation and facilitate functional movement of the ocular prosthesis. The impression technique in this case can maintain the position of the impression tray well where there is no excessive pressure on the eye socket that affects the accuracy of the intaglio area of the resulting ocular prosthesis.

It is concluded that ocular prosthesis for post-evisceration socket often has feeble adaptation to the surrounding tissue due to high sensitivity. The technique for fabricating custom ocular impression tray and the physiologic presureless impression technique in this case by marking the tray and calibrating it to the area outside the eye socket contributes to provide a fast and accurate impression in terms of convexity and well fitted intaglio of the prostesis so that an even distribution of pressure throughout the defect can make a tight adaptation of tissue-ocular prosthesis interface, solving the issue of unfitness and discomfort of the ocular prosthesis.

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Comprehensive approach for highly resorbed mandibular ridge with complete denture

[1]Alfian Rahmat, [1]Permatasari Nina, [2]Eri Hendra Jubhari
[1]Postgraduate Program in Prosthodontics
[2]Department of Prosthodontics
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
Corresponding author: **Alfian Rahmat**, e-mail: **alf.vhian@gmail.com**

ABSTRACT
A 66-years-old female patient was referred to Dental Hospital of Hasanuddin University with a fractured lower denture that impaired patient's masticatory ability. Clinical examination showed full edentulous in both maxilla and mandible with flat mandibular ridge, absence of inflammatory signs, flabby tissues, and bone prominences as well. The treatment plan was fabrication of complete denture with semi-adjustable articulator and modification in impression technique in order to produce retentive dentures. Preliminary impression and fabrication of anatomic cast followed by bolder molding and physiological impression. Two-dots method was used to determine the maxillomandibular relation and measure vertical dimension. Position of the maxilla was transferred using facebow, which attached to the centric tray followed by mounting the cast on a semi-adjustable articulator with guidance from centric tray. Artificial teeth were arranged in lingualized occlusion scheme on wax-pattern and try-in was done. After processing, remounting and selective grinding were performed followed by *finishing and polishing*, and lastly with insertion of both dentures. It is concluded that impression technique is one of the primary factors in management of flat mandibular ridge in order to utilize surrounding tissues to have both active and passive retention in dentures.
Keywords: flat mandibular ridge, impression of flat ridge, complete denture, lingualized occlusion

INTRODUCTION

Bone resorption occurs following tooth extraction, and if atrophy occurs, it'll be followed by excess bone resorption that causes decrease of distance from mental foramen to alveolar ridge crest. Alveolar ridge crest that underwent resorption will eventually form flat or concave ridge. Excessive resorption of alveolar crest leads to flat ridge due to loss of cortical plate layer.[1]

Continuous excessive resorption is problematic due to its effect that compromises full denture function and thus creating disbalanced occlusion. According to Atwood, resorption on mandible is four times bigger than in maxilla. Altough resorption rate of alveolar bones varies from individuals. Highest resorption occurs 6 months after extraction of anterior teeth. Three years following extraction, resorption on maxilla is lower than on mandible.[1]

Ridge with severe atrophy will cause increase in interarches distance, denture instability, and unretentive denture with an inability to withstand masticatory pressure. Treatment for individual with anthropic ridge is a challange faced by dentists around the globe due to the nature of severe ridge resorption that will cause difficulties in the process of making adequate denture. Severe-atrophy ridge often found in the mandibular residual ridge than the maxilla because the supporting tissue in the mandible is less than that in the maxilla; hence resorption in the mandible occurs in a faster rate than that in the maxilla.[1]

Along with age, physiological changes also arise in the oral cavity. Physiological changes in the oral cavity experienced by elderly patients are 1) changes in oral mucosa. Increasing age causes epithelial cells in the oral mucosa to experience thinning, reduced keratinization, reduced capillaries and blood supply, and thickening of collagen fibers in the lamina propria. As a result, clinically the oral mucosa appears paler, thinner and dry, with a slow healing process. This causes the oral mucosa to be more easily irritated by pressure or friction, which is exacerbated by reduced salivary flow;[1] 2) changes in arch size. Most of the aging process is accompanied by osteoporotic changes in the bones. Studies demonstrated that axial inclination of the teeth in the human skull, followed by loss of teeth, is one of the reasons for the initial reduction in the alveolar bone height. Generally, the maxillary teeth are directed downwards and outward, thus the reduction of bone generally also occurs upwards and inwards. Due to this, the outer cortical plate of bone is thinner than the inner one. Resorption of the outer part of the bone cortical plate takes place more and more rapidly, thus, the maxillary arch will be reduced to a smaller size in all dimensions and also the surface of the tooth base will be reduced. In the mandible, the inclination of the anterior teeth is generally upward and forward from the occlusal plane, whereas the posterior teeth are more vertical or slightly tilted lingually. The outer surface of the bone cortical plate is thicker than the lingual surface, except for the molar area, also the lower edge of the mandible is the

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thickest cortical layer, so that the bite rim direction of the mandible looks more lingually and downward in the anterior region and buccal in the posterior region. Resorption in the mandibular alveolar bone occurs downward, backward, and then forward. There were changes in the muscles around the oral cavity, the relationship between the interarches distance, and changes in the space of the mandibular and maxillary positions;[1] 3) alveolar rim resorption. Bone will experience resorption where atrophy is always excessive.[1] Excessive resorption of the mandibular alveolar bone causes the mental foramen to approach the crest of the alveolar ridge.[2] Alveolar crest that underwent resorption will form flat or concave ridge with knife edged shaped crest. Excessive resorption at the crest of the alveolar bone results in a flattened ridge due to loss of the cortical layer of bone. Excessive and continuous ridge resorption is problematic because it causes poor complete denture function and imbalance occlusion. The main risk factors for this resorption are the degree of previous bone loss, excessive occlusal forces during mastication and bruxism.[3] Residual alveolar ridge resorption has been put forward in many theories and research results. The resorption in the mandible is four times that of the maxilla.[4] The greatest resorption occurred in the first six months after the extraction of the upper and lower anterior teeth. After three years, the resorption was very small compared to the mandible; 4) changes in salivary flow. Many elderly patients receive medication or develop systemic diseases that also affect salivary function and may lead to dry mouth or xerostomia. Reduced salivary flow will interfere with denture retention, because it reduces the salivary adhesion bond between the denture base and soft tissues and causes mucosal irritation. This situation causes decrease in the ability to use dentures to and leads to lower masticatory ability, denture fitness is reduced, the patient's sensitivity to friction from dentures increases.[1]

In the case of the lower jaw with a flat ridge due to resorption, muscles attachments are located at the top of the ridge thus it will easily cause dentures to move and dislodge. The fabrication of complete dentures in the lower jaw with a flat ridge has its own problems in achieving good and satisfactory results. Difficulties were mainly found in obtaining the retention, stabilization and support of complete denture. In case of continuous resorption of the alveolar ridge, facial muscles namely the lips and cheeks, are ultimately unsupported and tend to fall into the oral cavity. At the same time the tongue enlarges to fill the space previously occupied by teeth and alveolar bone. Furthermore, a space will be formed in the oral cavity in edentulous ridge, which is called denture space. Resorption of the alveolar ridge will reduce the amount of mucoperiosteal attachment to the bone thus reducing buccal and lingual vestibular space. These changes make it difficult for the clinician to distinguish anatomical and functional boundaries of the oral cavity.[5]

Resorption in the lower jaw will cause flat ridge because muscle attachments are located at the alveolar crest. These conditions greatly affect mandibular complete denture where reduced vestibulum will cause difficulty for the clinicians to distinguish anatomical and functional boundaries of the oral cavity. There are several ways to overcome these problems during mandible full denture fabrication. For example, by performing lingual sulcus deepening and vestibuloplasty to create beneficial ridge shape that will provide good supporting area for dentures. However, patients often suffer disadvantage due to various side effects after undergoing surgical procedures, namely postoperative defiguration, anesthesia and neuralgia pains. In addition to vestibuloplasty, denture implants can also be made in patients with flat ridges. However, this method is performed on patients who really meet both local and general indications. In addition, the surgical steps carried out in the process of making these implants can also cause various side effects and failures, such as trauma on mental nerve and jaw fracture. Seeing the various side effects that can occur in the methods described above, in order to obtain satisfactory mandibular complete denture, a special impression technique can be used to understand and look for various retention possibilities from the location of the muscles around the denture. The main effect of mandibular alveolar ridge resorption on complete dentures is retention of denture. Muscle bundles located at the top of the ridge cause great dislodging force. The effect of these forces on retention and stability of dentures, as described above, is closely related to the impression technique used. A good denture will have good retention if it is produced from a good impression. However, the shape and size of the ridges affect retention and stability of complete dentures, with radical changes in the edentulous mandibular arch due to resorption, impression techniques used in the fabrication of complete dentures will not produce the expected results.[5]

Impression technique is one of the most importportant stages in the fabrication of a mandibular complete denture with flat ridges to get adequate results, and can be performed in two stages; the

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initial and then functional impression. Functional impression is intended to record the supporting tissue structure and form a peripheral seal well. This situation provides maximum retention and stabilty of the denture. Impression on flat ridge is intended to take advantage of all possibilities of tissue fixation both active and passive in dentures. As previously described, alveolar bone with flat ridges is inferior for retention and stability in complete dentures. Muscle attachments are located close to the crest of the ridge and cause a very large dislodging force on denture. For this reason, the limits of muscle movement and the space in which the denture can be extended without removing the denture must be accurately recorded on the impression. Impression like this can be obtained from the dynamic impression method. Dynamic impression technique is an impression technique that can record movable muscle in mucosal area for the extension of the denture border without causing the denture to be dislodged. The advantages of dynamic impression technique are avoiding dislodging effect in the form of an improper denture border, and utilizing as much active and passive tissue fixation. These advantages are a direct result of the impression material being formed by functional movements of the muscles and muscle attachment along the border of the denture base. In dynamic impression technique, the impression is formed by the functional activity of muscles and muscle attachments, thus clinicians do not really need to do as many estimations as in convensional technique. Estimation for posterior extension or lingual flange extention according to Schreinmokers suggestion are not required in the dynamic impression technique.[5]

Dynamic impression

This impression technique maximizes the support aspects of denture base with two approaches, namely functional and anatomical. Impression is acquired using close mouth technique and for the last phase, open mouth technique is performed to acquire anatomical support.

Step by step procedures are 1) fabricate both maxillary and mandibulary occlusal rim on diagnostic model and individual tray; 2) both maxillary and mandibulary occlusal rims should be occluded to acquire vertical dimension. It is imperative to note that both rims are occluded without any inclination; 3) after acquiring correct occlusion and vertical dimension, border extensionshould be performed using tissue-conditioning materials. Lingual border can be formed by asking patients to do specific tongue movements such as touch the cheeks and touching upper lips with patient's tongue. Physiologic movement should also be recorded in this step by instructing patient to say 'ooo' and 'eee' as they occlude the rims. It should be noted, for the first application the conditioning material it must be applied in a thicker consistency to obtain maximum expansion; 4) repeat step number 3 as many times possible to obtain desired border extension. Each repetition, conditioning material applied should be in a thinner consistency compared to the first on. Remove excessive border extension using warm knife. Overextended impression tray border could be identified by observing which area causes the impression tray to be dislodged during normal mandibular movement; 5) after proper border molding and extension with conditioning material were finished, final impression should be made using polysulphide rubber with open mouth technique and proper border molding scheme. This process minimize pressure during closed mouth impression and produce better surface; 6) beading and boxing is not necessary for this type of technique because it is a tedious and time-consuming process. Cast should be poured immediately to avoid tissue conditioner and polysulphide distortion.

Sublingual impression technique

This impression is intended to obtain the horizontal extension for the lingual flange up to sublingual area to obtain adequate retention and stabilization from nearby muscles. Stabilization force obtained from muscle is obtained from the tongue muscles, which hold the denture in place by leaning on the lingual flange. In addition to muscle forces, there is also atmospheric power obtained from the border seal due to the expansion of the base.

Step-by step of this impression technique are 1) first impression using irreversible hydrocolloid or compound impression material; 2) fabrication of individual tray, after study model is obtained, it is then outlined covering labial, buccal and sublingual areas. In sublingual areas, relief should be made with 3 mm thick wax. Afterwards, individual tray is fabricated using baseplate wax or self-curing acrylic followed by baseplate trimming. The borders of lingual flanges should be localized in moveable grooves between sublingual floor and sublingual eminence. Similar procedures should also be conducted for buccal and labial area; 3) next, muscle trimming is performed, in the lingual area of the impression tray material is added to record the border of the periphery and then functional movements are carried out so that the genioglossus and frenulum muscles can be free, then patient is ins-

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structed to stick their tongue out. The formation of a margin in this area should provide a good border seal for adequate retention when the patient opens the mouth and moves the tongue; 4) lastly, physiological impression is carried out, beforehand holes should be drilled on individual tray in areas that need pressure-relief. Then the zinc oxide eugenol impression material that has been mixed well, is applied to an impression tray and inserted into the patient's mouth. In this position, a swallowing motion is then performed to activate the lingual paraprosthetic muscular system. Next, the patient is asked to make relief on the lingual frenulum and the genioglossus muscle. Lateral movements should also be performed to record movement of the floor of the mouth. After that the cast is poured to make a working model.

CASE

A 66-year-old female patient (Fig.1) came to the Unhas Dental Hospital with a complaint of a broken lower denture that made it difficult for the patient to chew food (Fig.2). The patient has been using full denture 21 years ago. The patient wants to have a new denture made so that he can chew food properly again.

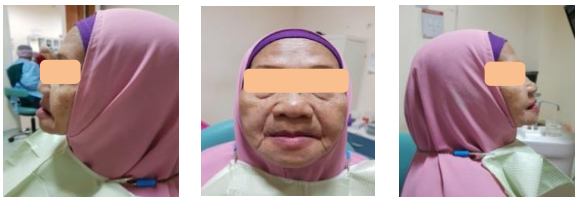

Figure 1 Extraoral profile photograph

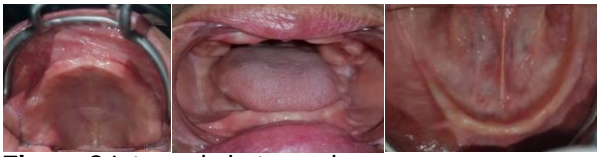

Figure 2 Intraoral photograph

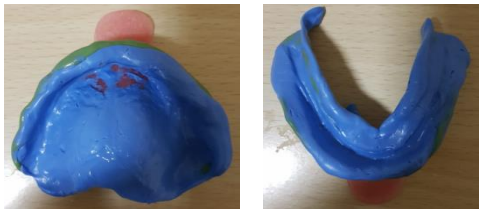

Figure 3 Border moulding and physiological impression

MANAGEMENT

First, it was done anatomical impression and fabrication of anatomical model. Then fabrication of physiological impression tray, border moulding, and physiological impression. Individual tray was fabricated using acrylic; border molding was performed by imitating functional movements using green stick compound; physiological impression using PVS impression compound (Fig.3). Then, it was done beading, boxing, and working model fabrication (Fig.4).

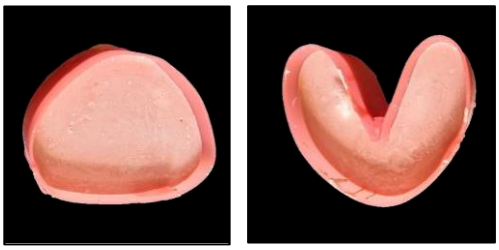

Figure 4 Beading and boxing of physiological impression followed by making working model

After fabrication of base and bite rim, it was followed by performed measurement of upper bite rim height, adjusting labial fullness, parallelism, determination of vertical dimension, determination of centric relation and fixation the rims.

The bite rims were fixated, then removed from the patient's mouth and placed on the working model, which were then mounted into a semi-adjusted articulator via facebow transfer to articulator (Fig.5). Mounting to articulator, artificial teeth arrangement, and try in (Fig.6)

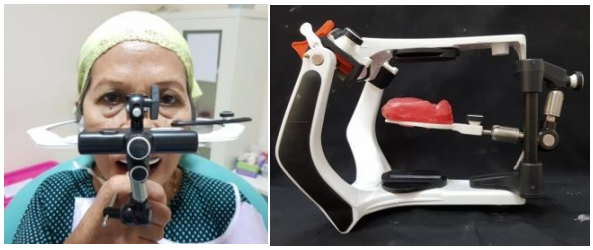

Figure 5 Facebow transfer to articulator

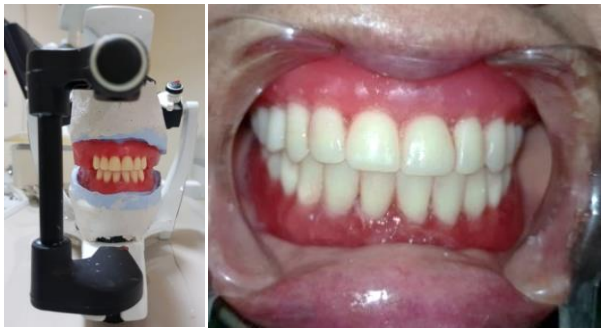

Figure 6 Artificial teeth arrangement and try-in

Arrangement of the artificial teeth using concept of lingualized occlusion due to the fact that mandibular posterior ridge is flat, thus this occlusion scheme was selected to minimize pressure in the area. Anterior teeth were arranged just like normal anterior teeth arrangement; in this case, upper and lower incisor relation was as follow overbite = 0 mm, overjet = 1-2 mm; mandibular teeth arrangement

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was set in a way that matches the upper arrangement. Posterior teeth were arranged as non-anatomical teeth on lower posterior area and upper molars palatal cusp contacts central mandibular molar fossa during occlusion.

Denture processing flasking, packing, curing, deflasking, finishing, and polishing and remounting. Laboratory remounting to check if there were any occlusal changes after processing and clinical remounting was perfomed when checking centric relation (Fig.7).

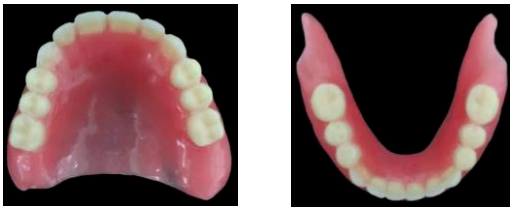

Figure 7 Acrylic model

At try-in and insertion stage, denture inspection (Fig.8), that is borders to ensure there wasn't any sharp area, denture adaptation using PIP (Fig. 9), retention and stability were checked, and occlusion and articulation were checked.

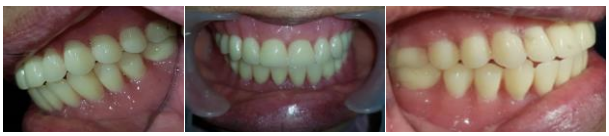

Figure 8 Try-in and occlusion inspection

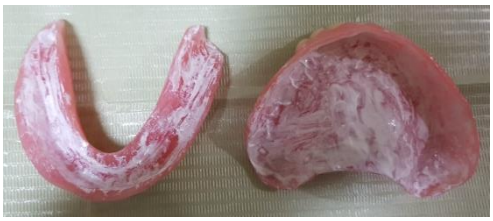

Figure 9 Tissue adaptation and insertion

Post insertion instructions were told to the patient, to maintain oral and denture hygiene, wear dentures continuously for the first 24 hours for adaptation, clean dentures under running water, remove dentures at night to give supporting tissue some rest, when removed dentures should be kept in a container whilst keeping the dentures in damp condition.

At first control I (one day after insertion), a thorough inspection of the dentures and oral cavity were performed, that is inspecting if there was any etythematous areas, If tissue irritation occur the flanges or intaglio of dentures that caused it were trimmed; retention, stability, occlusion, articulation, phonetic and esthetic were checked (Fig.10). The patient was instructed to maintain oral and denture hygiene, use denture only to chew soft food, avoid hard and sticky food, remove denture before going to sleep, clean denture under running water, keep denture in a container whilst ensuring that dentures are in damp state and come for a second control visit 3 days after the first control visit.

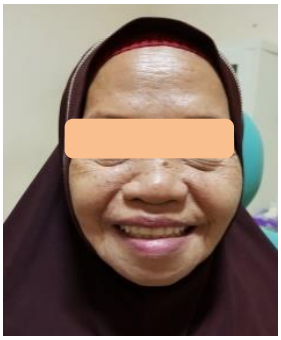

Figure 10 First control visit after insertion

At control II (three days after insertion, examination were performed; subjective examination that is patient has no complaint wheter retention, stability, occlusion, phonetic, or esthetic, and there were no any part that cause irritation or discomfort; objective examination that is no complaint, no gingival irritation. The patient was instructed to maintain oral and denture hygiene, use denture only to chew soft food, avoid hard and sticky food; remove denture before going to sleep; clean denture under running water; keep denture in a container whilst ensuring that dentures are in damp state; come for a third control visit 7 days after the first control visit.

At control III, examination were performed like subjective examination: patient has no complaint wheter retention, stability, occlusion, phonetic, or esthetic, and there weren't any part that cause irritation or discomforts; objective examinations: no complaint, no gingival irritation. The patient was instructed to maintain oral and denture hygiene, use denture only to chew soft food, avoid hard and sticky food; remove denture before going to sleep, clean denture under running water, keep denture in a container whilst ensuring that dentures are in damp state, periodic control every 6 months to check if there's any problem

DISCUSSION

Impression technique is a vital step in the fabrication of a complete denture for a patient with flat mandibular ridge to ensure adequate results. Impressions are usually done in two steps, which are preliminary impression and functional or secondary impression. Functional impressions aim to record the supporting tissue structure and form

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a peripheral border that can cover the border seal well. This situation provides maximum retention and stability of the denture. Impression for the flat ridge should aim to take maximum advantage of all possible of tissue fixation both active and passive for fabricating dentures.[6]

It is concluded that difficulties were mainly found in obtaining the retention, stabilization and support of the complete denture. Therefore, the impression is one of the main factors in the success of the denture with a flat ridge by utilizing the surrounding tissue to have active and passive retention.

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Altered cast impression technique in the fabrication of metal frame partial dentures with distal extension: A case report

[1]Sutiyo, [1]Rezki Wahyuni Syamsuddin, [2]Bahruddin Thalib, [2]Muhammad Ikbal
[1]Postgraduate Program in Prosthodontics
[2]Department of Prosthodontics
Faculty of Dentistry, Hasanuddin University
Makassar, Indonesia
Corresponding author: **Rezki Wahyuni Syamsuddin**, e-mail: **Rezkiwahyuni1991@gmail.com**

ABSTRACT
Metal frame denture is a more ideal treatment than the conventional acrylic denture for its narrower, thinner, rigid, and harder material, so that the design can be made ideally. The aim of this case report is to demonstrate the treatment of an edentulous case using altered cast technique to improve support for a partial denture with distal extention. A 48-year-old female patient came to the Halima Dg.Sikati Makassar with complaints of chewing difficulty and lacking of confidence due to the loss of all her maxillary teeth and part of her mandibular teeth. The patient had never worn any denture and had no history of systemic disease. The patient wanted to have a denture made to restore the appearance and mastication. Then a panoramic x-ray was performed on the patient. Radiological images appear to be missing all teeth in the maxilla, available teeth: 33, 32, 31, 41, 42 and 43, no impacted teeth, no foreign bodies, no inflammation or neoplastic tissue, good bone density, residual the roots of teeth 15 and 28. The pre-prosthetic treatment plan was carried out by scaling and extracting the remaining roots on teeth 15 and 28. The prosthodontic treatment plan was the manufacture of partial metal frame dentures using the altered case molding technique. Altered cast is a molding technique used in the saddle free end of removable partial dentures. This impression technique can produce master case with maximum tissue support, within the limits of physiological tolerance and can accurately record the relationship between the tooth and the residual ridge. It is concluded that metal frame partial denture with Alter cast impression technique provides better and stable denture.
Keywords: metal frame partial denture, altered cast technique, distal extension

INTRODUCTION

Metal frame partial denture is a removable denture that uses metal, although its use is not as popular as acrylic dentures because the price is relatively expensive. Metal frame partial dentures are basically more ideal than acrylic dentures because they can be made narrower, thinner, and more rigid. The material allows the transfer of heat and mastication forces better. Metal frame partial denture also have excellent mechanical qualities and maintain the health of the periodontal tissues of the abutment teeth.

One of the factors that stabilize a removable partial denture while functioning is the use of an impression procedure that can accommodate the resilience difference between hard and soft tissue. The altered cast printing technique can produce impressions with maximum tissue support, within the limits of physiological tolerance and can record the relationship between the teeth and the residual ridge accurately.

Free-end saddle dentures or free end/distal extensions have more problems than other removable dentures because they only have abutments on one side and require special handling. In addition, this denture is unstable and tilt easily, which can cause the resorption of the alveolar ridge to run more quickly. A tipped denture during function can cause periodontal abnormalities in the abutment teeth. This is due to differences in the compressibility of the support, both between posterior mucosa and the anterior mucosa of the free-end saddle and between the mucosa and the periodontal tissue of the abutment teeth with occlusal support. When the denture is exposed to the chewing load, denture saddle rotates or is tilted or unstable. The absence of abutment teeth distal to the saddle that can be used as a backrest or retainer also causes the distal end of the saddle to move more freely compared to the mesial end of the saddle.

This article reports the handling of an edentulous case using the *changed cast* to improve support for metal frame partial dentures with distal extension.

CASE

A 48-year-old female came to the Dental Hospital of Halimah Dg.Sikati Makassar with chief complaint of difficulty chewing and lacking of confidence due to the loss of all of the maxillary teeth and some of the mandibular teeth. The patient had never used dentures and had no systemic disease. The patient wanted to make dentures to restore appearance and mastication (Fig.1).

Radiographically, all maxillary teeth are missing. Remaining teeth: 33, 32, 31, 41, 42 and 43. No

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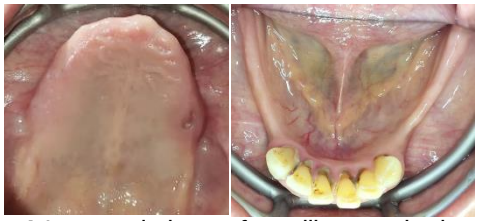

Figure 1 Intra-oral photo of maxillary total edentulous and mandible with bilateral free end

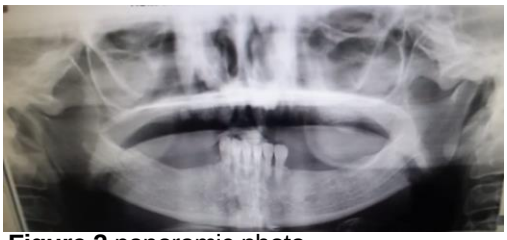

Figure 2 panoramic photo

impacted teeth, no foreign bodies, no inflammation or neoplastic tissue, good bone density, residual roots of teeth 15 and 28, left condyle position and right side looks balanced, mandibular bone resorption based on Wical and Swoope is Class I (Fig.2).

The patient's diagnosis based on tooth loss was total edentulous in the maxilla and Class I Kennedy in the mandible. Preliminary impressions were made with an irreversible hydrocolloid (alginate) to obtain a diagnostic model (Fig.3). Next, the diagnostic model is placed on top of the surveyor for inspection and design of the metal frame.

Figure 3 Maxillary and mandibular diagnostic models

MANAGEMENT

Pre-prosthetic treatment was carried out by scaling and extracting the remaining roots. Making individual print trays for the upper and lower jaws with self-curing acrylic, then border molding with greenstick compound. Physiological printing was carried out using hydrophilic polyvinyl siloxane and beading and boxing were done (Fig.4).

The metal frame of the mandible is tested on the patient (Fig.5). Custom acrylic resin tray attached to

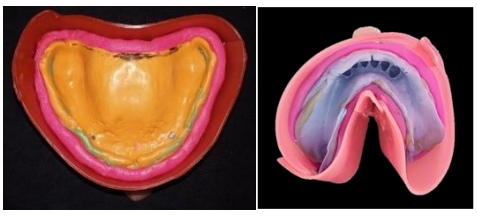

Figure 4 Beading and boxing

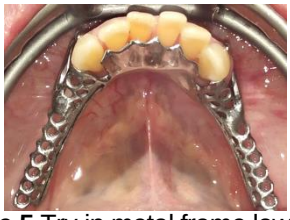

Figure 5 Try in metal frame lower jaw

Figure 6 Custom acrylic resin tray lower jaw metal frame, border molding and molding using hydrophilic PVS.

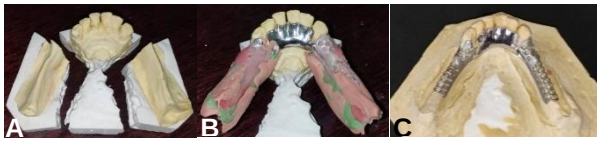

Figure 7A Cutting the mold, **B** the metal frame denture is placed over the grooved mold, **C** the altered-cast.

the metal frame of the lower jaw and border molded using a greenstick compound (Fig.6). Furthermore, an examiination of the suitability of the metal framework on the teeth and soft tissues was carried out. Impression was performed using hydrophilic PVS. During the final physiological impression, finger pressure was only given on the part of the metal framework that was in direct contact with the tooth, so there was no pressure on the edentulous mucosal area.

An additional procedure in the laboratory for the altered cast technique was performed by splitting the master cast using a saw. The first cut was made distal to the tip of the tooth and perpendicular to the edentulous ridge to the medial part of the lingual vestibule. The second section is made parallel and medial to the edentulous ridge, which extends from the most posterior aspect to the most medial aspect of the first section (Fig.7).

On the cut surface of the mold that has been split, grooves or hollows are made to assist the retention of the plaster to be mixed. The metal frame denture is placed over the grooved mold. The final physiological impression was then made with beading and boxing before being cast with plaster so that an altered cast was obtained.

Making the bite rim of the upper and lower jaws and determining the alignment (Fig.8A), vertical dimensions, with the bite rim made from the last impression, then face-bow transfer and installation on the articulator. At this stage, don't forget to determine the color of your teeth using the VITA 3D-Master shade guide (Fig.8B).

Try-in arrangement of teeth, starting from the anterior teeth and continued to the posterior. Acry-

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Figure 8 Alignment, and determination of color.

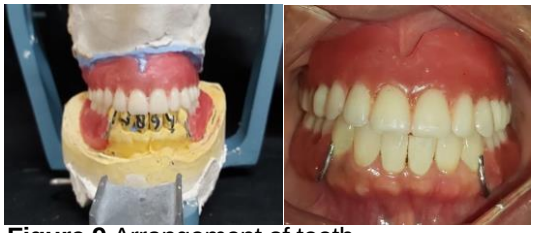

Figure 9 Arrangement of teeth

Figure 10 Denture insertion

lic processing (packing, curing, finishing and polishing), selective remounting and sharpening (Fig.9).

The denture was inserted and controlled, the denture was checked again for occlusion, articulation, retention and stability. The patient was instructed to use the denture to chew soft foods first, remove the denture before going to bed, clean the denture under running water, store the denture in a container with damp conditions and perform routine dental check-up, at least every 6 months (Fig. 10).

DISCUSSION

Teeth loss will have an impact on masticatory function, phonetics, lower self-confidence and interfere with social interactions. Removable denture is an alternative treatment for tooth loss that serves to replace one or several teeth and surrounding tissues so that impaired function can be restored and prevent further damage.

Free-ended removable partial dentures are common cases. Rehabilitation for cases like this is a challenge for the prosthodontist. This is because the free-ended denture has more problems. The main problem with free-ended dentures is unstable dentures, i.e. they are easy to shift and tip. This is because there is a difference in support compression between the posterior part of the free-toed saddle and the anterior part. Unstable dentures can cause faster alveolar bone resorption in the patient.

The advantages of using a metal frame as a denture frame are that it is more comfortable to wear because it can be made thinner, narrower but still rigid, the design of the parts of the denture can be made optimally and ideally, the forces caused by mastication can be channeled properly. As for the disadvantages of using this denture the metal part can still be seen, causing the appearance to be less aesthetic.

Special impressions such as alter cast can reduce the pressure on the ridge during mastication. The benefit of the altered cast printing technique is to get maximum support for the edentulous area. The principle used in the altered cast impression technique is the impression of edentulous tissue in a condition that allows for the expansion of the denture base and maximum support is obtained without causing tissue movement or excessive tissue compression.

The procedures were altered cast impression technique must be preceded by adjustment of the position of the metal frame. The goal is to make sure all the rests fit into place so that there is no movement in the metal frame. The area of contact between the tooth and the metal frame, i.e. at the minor connector to the occlusal rest, is very important. If there is excessive contact in this area while the denture is worn during mastication, it will cause a force that can damage the tooth.

The first procedure was that the initial impression was made using irreversible hydrocolloid and the study model was obtained. The study model is then placed on the surveyor for inspection and design of the metal frame. The teeth were prepared and imprinted using an elastomeric impression material. The second mold is placed on the surveyor for inspection and design of the frame mold.[6]

The finished frame is checked for fit with the study model. Then tested into the patient's oral cavity. After that, a modified acrylic impression spoon was applied to the metal frame of the mandible. This spoon is then molded around the edges according to the desired extension. The final impression was made using a zinc oxide impression paste and finger pressure was applied to only one part of the metal frame in contact with the teeth. The model was then modified in the laboratory. Two pieces are made next to each other. The cut surface is then threaded to aid retention of the newly poured stone. Full adaptation of the frame to the essential model before fixation with sticky wax. The final mold is closed and boxed and then

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cast a plaster cast. Carry out the packing process. After that, it is inserted into the patient.

It is concluded that in free-end dentures, the main problem is the pressure difference between the supporting tissues of the posterior part of the free-end saddle and its anterior. This situation causes the dentures to be unstable. The expanded base will put pressure on the underlying bone and can distribute the pressure force evenly. Several suitable methods can be chosen to reduce the leverage of free-ended dentures using the altered cast technique.

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