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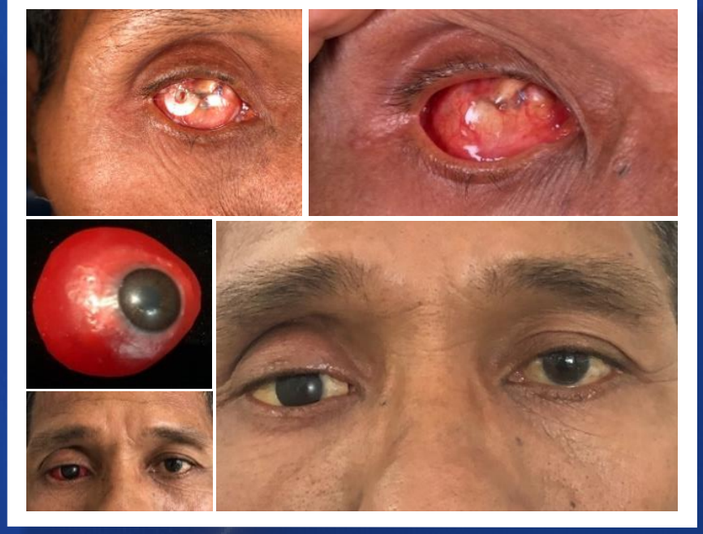

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Contents

Comparison of diagnosis of temporomandibular joint disorders based on RDC/TMD Axis I and DC/TMD Axis I

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ABSTRACT
Introduction: The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) has become the most widely used diagnostic protocol for research in temporomandibular disorders (TMD). The invalidity of RDC/TMD in clinical application causes the revision of RDC/TMD to be the Diagnostic Criteria for Temporomandibular Disorder (DC/TMD). The purpose of this study was to determine the differences in diagnosis of TMD between RDC/TMD examination and DC/TMD Axis I on students of Faculty of Dentistry, Padjadjaran University. **Method**: The type of this research was comparative survey approach using clinical examinations and questionnaires. The sample was collected from 48 people using random sampling techniques. The diagnosis of TMD was obtained by filling in the symptom questionnaire and clinical examination based on RDC/TMD Axis I and DC/TMD Axis I, which is then entered into the RDC/TMD diagnosis algorithm and DC/TMD decision tree. **Results**: The results showed that from 48 samples there were 36 (75%) people with the same diagnosis of RDC/TMD and DC/TMD, and 12 (25%) people with different diagnoses between RDC/TMD and DC/TMD. **Conclusions:** Based on the results of the study, the diagnosis of TMD based on RDC/TMD were still categorized the same as the diagnosis based on DC/TMD.
Keywords: temporomandibular disorders, Research Diagnostic Criteria Axis I

INTRODUCTION

The temporomandibular joint (TMJ) is a joint that connects the mandible or lower jaw to the skull and regulates jaw movement;[1] one of the most complex, vulnerable, and highly used joints in the movement of the human body.[2] Temporomandibular joint disorders (TMDs) are a term commonly used for problems related to the jaw joint, involving the muscles of mastication, the TMJ and related structures or both.[3] The prevalence of TMD is 40-60% of the world's population.[4] The TMDs are most common in people ages 20-40 years, and is more common in women than in men.[5]

The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) has been the most widely used diagnostic protocol for the research of TMDs since its publication in 1992.[6] Then in 2010, a revised RDC/TMD was developed.[7] Diagnosis of RDC/TMD Axis I did not reach the target set at sensitivity 0.70 and specificity 0.95.[8] The invalidity of RDC/TMD in clinical application led to revision of RDC/TMD to become Diagnostic Criteria for Temporomandibular Disorder (DC/TMD).[9] The DC/TMD provides a comprehensive assessment of the most common TMDs, based on a biopsychosocial model of chronic pain.[6]

The two main goals of DC/TMD are to improve and standardize diagnostic groups for further research on TMDs, and to improve clinical care.[10] The differences in clinical examination procedures for RDC/TMD and DC/TMD are in the location of pain, static landmarks, mobility, TMJ examination, palpation of muscles and TMJ.[11]

The DC/TMD also consists of two axises, namely Axis I which is the procedure for clinical examination, and Axis II which is a questionnaire of disease history and psychological factors.[6] Axis I DC/TMD protocol is a very specific and reliable diagnostic criteria that includes valid screening for the detection of pain-associated TMDs as well as valid diagnostic criteria for distinguishing those most associated with pain from TMDs (sensitivity 0.86, specificity 0.98) and intra-articular disturbances (sensitivity 0.80 and specificity 0.97). The Axis II protocol retains the original RDC/TMD screening instrument plus a new instrument for assessing jaw function and additional behavior and psychosocial factors.[6] Based on the above background, this study aims to see if there are differences in the diagnosis of TMDs based on RDC/TMD and DC/TMD examinations.

METHODS

This type of research is a comparative survey approach using clinical examination and questionnaires. The population of the study was preclinical students of the 2015 Faculty of Dentistry, Padjadjaran University as many as 186 people. Sampling employed random sampling technique.[12] According to Fraenkel and Wallen[13], the minimum number

of samples for this type of causal-comparison research was 30.

The inclusion criteria in this study were preclinical students class of 2015 Faculty of Dentistry, University of Padjadjaran who were willing to participate in this study. Exclusion criteria were 1) moderate or have performed TMJ treatment, 2) has experienced trauma to the TMJ within 2 months, 3) currently taking non-steroidal anti-inflammatory drugs, and 4) currently under dental treatment.

Tools and materials used 1) basic examination tools; 2) informed consent as the respondent's consent form to participate in this study; (3) Axis I clinical examination questionnaire, 2010 Revised RDC/TMD diagnosis algorithm, Axis I clinical examination questionnaire, and DC/TMD decision tree diagnosis; and (4) a sheet of recapitulation of examination data on the TMJ.

The procedures were 1) submitting ethical clearance to the Ethics Committee of Padjadjaran University; 2) calibrating the RDC/TMD and DC/TMD Axis I examination; 3) screening students who met predetermined criteria; 4) preparing tools and materials to be used in research; 5) explaining to the respondent what would be done and the objectives to be achieved; 6) having understood and was willing to follow all research procedures, the respondent expressed his/her agreement by signing an informed consent form; 7) recording the identity data of the respondents who have filled out the approval letter; 8) examining TMD with RDC/TMD, followed by DC/TMD examination; 9) recording the data obtained in the examination sheet and then processed them using the 2010 revised RDC/TMD algorithm and DC/TMD decision tree.

RESULTS

This research was conducted from November to December 2018 at the Faculty of Dentistry, Universitas Padjadjaran Jatinangor after receiving an ethical clearence letter No. 2/7/UN6.KEP/EC/2018 from the Health Research Ethics Commission of Universitas Padjadjaran. The number of samples were 48 students who were selected based on predetermined criteria. Table 1 shows the distribution of the sample by sex and age; the number of samples were 39 women (83.2%) and 9 men (16.8%). Majority of the samples in this study were women because the population of preclinical students from the 2015 were mostly women.

Table 1 Distribution of samples by gender and age

Variable	Category					
	Male			Female		Total
Gender	9			39		48
	18.8%			81.2%		100%
	20	**21**	**22**	**23**	**34**	
Age	2	37	7	1	1	48
	4.2%	77%	14.6%	2.1	2.1	100

From the 48 research samples, the results of TMD diagnosis based on the 2010 Revised RDC/TMD and TMD/DC are seen at Table 2; the most TMD diagnoses based on RDC/TMD identified were disc displacement with reduction (27%), then myofascial pain (6.3%), and a combination of myofascial pain and disc displacement with reduction (6.3%). In 23 people (47.9%) none of the diagnoses were found. The most TMD diagnoses based on DC/TMD identified were disc displacement with reduction (27.1%), then the combination of myofascial pain and disc displacement with reduction as many 6.3%, in 21 people (43.75%) found none of the diagnoses.

From the results of the TMD diagnosis based on the 2010 Revised RDC/TMD and DC/TMD, conclusions were drawn about the similarities and

Table 2 Results of TMD diagnosis based on 2010 Revised RDC/TMD and DC/TMD Axis I

Diagnosis Results	RDC-TMD		DC-TMD	
	f	%	f	%
Ia Myofascial Pain	3	6.3	1	2.1
Ib Myofascial Pain with Limited Opening	1	2.1	1	2.1
IIa Disc Displacement with Reduction	13	27.0	0	0.0
IIb Disc Displacement without Reduction with Limited Opening	0	0.0	1	2.1
IIc Disc Displacement without Reduction without Limited Opening	0	0.0	2	4.2
IIIa Arthralgia	1	2.1	13	27.1
IIIb Osteoarthritis	0	0.0	0	0.0
IIIc Osteoarthrosis	2	4.2	0	0.0
Ia, IIa, IIIa	1	2.1	-	-
Ia, IIa	3	6.3	2	4.2
Ia, IIa, IIb	1	2.1	-	-
Id, IIa	-	-	2	4.2
Ie, IIc	-	-	1	2.1
None	23	47.9	3	6.3
Total	48	100.0	48	100.0

Table 3 Comparison of TMD diagnosis results based on RDC/TMD and DC/TMD Axis

Comparison of TMD Diagnosis	f	%	p-value
The same results of the diagnosis	36	75	
Disc displacement with reduction	11	22.9	
Myofascial pain	1	2.1	
Arthralgia	1	2.1	0.0966
Degenerative joint diseases	2	4.2	
No diagnosis found	21	43.7	
Different diagnostic results	12	25%	

Note: p-value is obtained from the results of the Wilcoxon-Mann/Whitney Test

and differences between the two methods. In Table 3, 36 people (75%) had the same diagnosis, while 12 people (25%) had different diagnosis. The findings of the diagnosis using the two methods were then analyzed using the one sample Wilcoxon–Mann/Whitney test method. Based on the results of hypothesis testing with the Wilcoxon-Mann/Whitney test, a p-value of 0.096 was produced. This value was greater than the 0.05 significance level, so the conclusion is that there was no difference in the diagnosis results between RDC/TMD and DC/TMD Axis I.

DISCUSSION

Several studies have shown that TMDs were more common in women than in men.[5,14,15] This may be due to hormonal factors which are one of the factors causing TMDs. The TMDs have been linked to the female hormones that disrupt the pain threshold. According to Menezes[16], women's estrogen levels may lead to higher joint tissue tenderness, resulting in a lower ability to withstand functional stress. However, this contradicts Gray *et al*.[17] which claims based on an epidemiological survey, the number of women and men with TMDs showed almost the same results in the population.

The same diagnosis between RDC/TMD and DC/TMD was myofascial pain, disc displacement with reduction, disc displacement without reduction with limited opening, disc displacement without reduction without limited opening, arthralgia, and osteoarthritis along with osteoarthrosis or degenerative joint diseases. The only diagnosis on RDC/TMD and not on DC/TMD is myofascial pain with limited opening. Meanwhile, the only diagnoses in DC/TMD and no RDC/TMD were local myalgia, myofascial pain with referral, headache attributed to TMD, and disc displacement with reduction with intermittent locking.

The diagnosis of RDC/TMD Group II was disc displacement divided into right and left joints. However, for testing the hypothesis, it is not differentiated so that it equates with the diagnosis of DC/TMD which is not distinguished from right or left. Thus, if the respondent has disc displacement in one joint, disc displacement is detected. The diagnosis of RDC/TMD of osteoarthritis and osteoarthrosis is also equated with the diagnosis of DC/TMD of degenerative joint diseases, because osteoarthritis and osteoarthrosis represent a subdiagnosis of degenerative joint diseases hypothesis is not distinguished.

Based on Table 2, the diagnosis for RDC/TMD Group I were 9 people and DC/TMD were 10 people. To diagnose myofascial pain in RDC/TMD, it is necessary to have pain in at least 3 of the 20 areas of muscle palpation.[18] The RDC/TMD diagnostic algorithm for Group I is simpler than DC/TMD because there are only 2 subdiagnosis, while on DC/TMD there are 5 subdiagnosis. Five subdiagnoses in DC/TMD Group I made the decision tree diagnosis in Group I more complicated than RDC/TMD.

From the results of the diagnosis of Group I, there was only 1 person who had the same diagnosis, namely myofascial pain. The discrepancy was attributable to the greater number of subdiagnoses in DC/TMD Group I. New diagnoses in DC/TMD Group I, namely local myalgia, myofascial pain with referral, and headache attributed to TMD led to a significant difference in the diagnostic results in Group I diagnoses. Headache attributed to TMD was added to DC/TMD because there is an increasing in evidence that several forms of headache can occur in association with TMD.[19] The differential diagnosis in this study was most pronounced in Group I. The difference in detecting local myalgia and myofascial pain was that in local myalgia the absence of pain that extends beyond the palpated area, as opposed to myofascial pain.

The DC/TMD can be said to be more sensitive in diagnosing Group I disorders because there are more subdiagnosis. This is in line with Steenks[18] and Schiffman *et al*[6] which stated that DC/TMD is very pain oriented. However, this is not in line with Look *et al*[20] which stated that the RDC/TMD protocol can diagnose myofascial pain well.

Based on Table 2, the most common diagnosis

from this study was disc displacement with reduction. The prevalence of disc displacement with reduction increases with age, 6% in childhood, about 34% in adolescents, and 31-34% in adulthood.[21] According to Farrar and McCarty[22], nearly 70% of patients with TMDs experience disc displacement. In this study, 18 samples detected with disc displacement with reduction, 18 people in RDC/TMD and 17 people in DC/TMD. One of the symptoms of disc displacement with reduction is an abnormal mouth opening pattern, namely deviation.[23]

All samples that experienced disc displacement with reduction experienced clicking symptoms. In most cases, 70-80% TMJ clicking sound is caused by disc displacement in various directions, but mostly in anteromedial direction.[24] Abnormalities in joint structure and function, such as deformation of joint structures, and changes in synovial fluid quality lead to joint sounds on temporomandibular. This abnormality causes increased friction between the joint elements, resulting in joint sound.[25]

The most samples with the same diagnosis between RDC/TMD and DC/TMD was disc displacement with reduction so that it can be said that in diagnosing this disease, RDC/TMD is still reliable. This is in line with Look *et al*[20] and Lausten *et al*[26], which stated that the reliability of the RDC/TMD protocol can be trusted for the diagnosis of myofascial pain, arthralgia, disc displacement with reduction, and disc displacement without reduction with limited opening. However, what distinguishes between RDC/TMD and DC/TMD is the calculation of the RDC/TMD diagnosis algorithm which is divided into left and right joints.

Samples diagnosed with disc displacement without reduction without limited opening on DC/TMD were not diagnosed with RDC/TMD. This is in line with Look *et al*[20] which stated that the reliability of RDC/TMD for disc displacement without reduction without limited opening and osteoarthrosis was unreliable.

The undiagnosed sample with disc displacement without reduction without limited opening was caused by the calculation of the RDC/TMD diagnosis algorithm which included other combinations, namely Maximum Assisted Opening and Passive Stretch, namely Max 35 mm and Stretch 4 mm. This does not result in any diagnosis in the RDC/TMD diagnosis algorithm. The DC/TMD decision tree diagnosis is simpler in diagnosing disc displacement without reduction without limited opening because there is only a Maximum Assisted Opening requirement of 40 mm. This diagnosis in DC/TMD also does not take into account whether the sample has clicked during opening, closing the mouth, lateral movement, and protrusion movement as in RDC/TMD.

Degenerative joint disorders are confirmed by the presence of joint crepitus sounds.[27] Osteoarthrosis is a subdiagnosis of degenerative joint diseases in DC/TMD Group III. From this study, there were 2 samples with osteoarthritis in RDC/TMD Group III, and degenerative joint diseases. This is not in line with Look *et al*[20] saying that RDC/TMD cannot be relied upon in diagnosing osteoarthritis, because samples can still be diagnosed using RDC/TMD examination.

Bernhardt *et al*[28] found the prevalence of osteoarthritis of the TMJ joint on clinical examination and MRI was 25% in the 20-49 years age group. The sample of this study was 20-24 years old, so it was included in the prevalence. Schmitter *et al*[29] found that the prevalence of osteoarthritis was 70% in the 73-75 years age group.

Steenks[18] said that RDC/TMD tends to result in too many diagnoses leading to overtreatment. This may be due to the RDC/TMD diagnostic algorithm that distinguishes the right and left joints in Groups II and III thereby increasing the possibility of differential diagnosis between the right and left joints. In this study, there was 1 person who had a different diagnosis between the right and left joints. Overdiagnosis also occurred in 1 person who was diagnosed with myofascial pain and arthralgia. The occurrence of overdiagnosis due to RDC/TMD arthralgia was assigned to Group III (other joint diseases), while DC/TMD arthralgia was assigned to Group I. Thus, it was impossible for a sample to experience more than 1 diagnosis in one group.

Based on Table 2, there were 23 people and 21 samples, respectively, whose diagnosis of TMD was not found. In Table 1, it can be seen that the age range of the sample in this study was 20-24 years. Factors that cause TMDs are psychological factors, such as anxiety and stress, structural factors (occlusion), functional (bruxism), genetic factors, orthodontic treatment and external trauma.[30] According to Kindler *et al*[31], psychological factors can trigger muscle hyperactivity, followed by biomechanical changes and pain. Psychological factors can also lead to increased production of neurotransmitters and serotonin, catecholamine imbalance, which causes pain, especially pain in the temporomandibular region. This thing shows that the possibility of stress levels in preclinical students from the 2015 Faculty of Dentistry, Universitas Padjadjaran, is not too high.

In this study, there were 21 people who were not detect TMDs. This suggests that TMD is less common among university students, as in the study of Minghelli,[32,] who evaluated university students in the health sector and found the prevalence of TMD to be only 37.3%. However, this contradidicts the study of Oliveira *et al*[33] on college students in Brazil, where the prevalence was 68.6%.

Based on Table 2 there are 48 samples in this study. The samples who had the same diagnosis were 36 people (75%) and no diagnosis was found in 21 people. Meanwhile, the other 12 people or 25% found different diagnosis results. This shows that RDC/TMD and DC/TMD show the same diagnostic results are still more dominant than the results of different diagnoses so that it can be said to be the same. This is in line with Reiter's[34] statement, that there was no significant difference between RDC/TMD and DC/TMD for Axis I diagnoses, including Group I (muscle disorders), Group II (disc disorders), and Group III (arthralgia, degenerative joint disease). However, this is not in line with the statements which state that DC/TMD is more valid than RDC/TMD.[6,35,36]

The conclusion of this study is the diagnosis of TMD based on RDC/TMD is still in the same category as the results of the diagnosis of DC/TMD with a similarity level of 75% which indicates that the same diagnosis is still more dominant than the results of different diagnoses.

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Rehabilitation of partially edentulous arch using semi precision attachment: an aesthetic approach

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ABSTRACT
The restoration of normal function and esthetic appearance with a dental prosthesis is a major challenge in the rehabilitation of patients who have lost their teeth. In such situation, a fixed removable prosthesis allows favorable biomechanical stress distribution along with restoration of esthetics, phonetics, comfort, hygiene and better postoperative care and maintenance. Prime function of attachment retained partial denture is to distribute the masticatory forces to the wide area thereby reducing the damage to the abutments, soft tissues and bony ridges in addition to improved esthetics and proprioceptive responses. In this case series patient's esthetic and functional requirements were fulfilled with attachment retained cast partial denture using semi-precision attachments
Keywords: semi-precision attachment, claspless, esthetic approach

INTRODUCTION

Precision attachments open a new horizon of possibilities in prosthodontic rehabilitation.[1] From patient's perspective, retention is one of the important factors for its acceptability.[2] Use of attachment in providing retention to removable prosthesis is an old treatment modality with better success. It highly improves the comfort, aesthetic, function, and patient satisfaction.[3] Precision attachment is an interlocking device, one component of which is fixed to an abutment and the other is integrated into a removable partial denture to stabilize and/or to retain it.[3]

There are two types of attachments, namely precision attachment and semi-precision attachment. A precision attachment is fabricated from milled alloys and tolerances are within 0.01 mm. They are generally intracoronal and non-resilient. Their advantages include consistent quality, controlled wear and easier repair. They have standard parts which are interchangeable.[1]

A semi-precision attachment is fabricated by the direct casting of plastic, wax, or refractory patterns. They are considered "semi-precision" since in their fabrication they are subject to inconsistent water/powder ratios, burn out temperatures and other variables. The resulting components therefore, vary to a small degree. They are less costly, easy to fabricate and may be cast in alloy. They are generally extra coronal and resilient.[1]

Based on location, the semi precision attachments are divided into[4] 1) intracoronal attachments, that were placed within the contours of the crown form. The advantage of an intracoronal attachment is that the occlusal forces exerted upon the abutment tooth are applied close to the long axis of the tooth. An intracoronal attachment however, usually requires a box preparation to allow the attachment to fit within the crown contour. If it is not possible to create a box preparation that will totally incorporate the female element, then an extracoronal attachment should be considered. Since all intracoronal attachments are nonresilient, double abutting is recommended;[4] 2) extracoronal attachments, that positioned entirely outside the crown contour. Advantages of extracoronal attachments are that the normal tooth contour can be maintained, minimal tooth reduction is necessary and the possibility of devitalizing the tooth is reduced. Also, the path of insertion is easier for patients with dexterity problems. Most extracoronal attachments have some type of resiliency (stress redirectors). Even with resilient attachment, double abutting is recommended whenever possible. It is, however, more difficult to maintain hygiene with extracoronal attachments and patients should be instructed on the use of dental floss and hygiene accessories. This will help prevent unnecessary tissue irritation caused by food entrapment or calculus build-up;[5,6] 3) radicular and intraradicular stud type attachments that are connected to a root preparation. The female or male is soldered or casted to a root cap coping. The female element of intraradicular stud type attachments fits within the root form contour. The SwissLogic, Zest and the ZAAG are examples of this type of attachment. Some stud type attachments, such as the UniAnchor and the Direct O-Ring, are directly cemented into the prepared root without requiring a cast coping. Stud type titanium implant attachments are

also available to screw directly into implants or tissue extensions;[4] 4) bar type attachments span an edentulous area and connect abutment teeth, root or implant. The removable bridge, partial denture, or over denture fits over the bar and is connected to it with one or more retention sleeves, riders/ clips, or retentive plungers.[4]

Based on function, it is important to differentiate between a solid and resilient type restoration. Abutment/tooth supported restorations are considered solid, where abutment/tooth and tissue supported restorations are considered resilient. Abutment/tooth supported attachments are sub classified into two types, nonlockable and lockable. Resilient attachments are categorized into 5 classifications ranging from vertical to universal resiliency. The higher the number of classifications, the less torque transferred to the abutment, root or implant.[5]

Based on modes of retention, they are frictional, mechanical, frictional & mechanical, magnetic and suction types. Frictional retention is resistance to the relative motion of two or more surfaces in intimate contact with each other. Mechanical retention is resistance to the relative motion of two or more surfaces due to a physical undercut. Magnetic retention is the resistance to movement caused by a magnetic body that attracts certain materials by virtue of a surrounding field of force produced by the motion of its atomic electrons and the alignment of its atoms. Magnets do not provide lateral stability and are contraindicated for flat ridges. It is used in limited applications, heat curing will weaken magnets and they are liable to corrode. Frictional and mechanical retention combines both features of frictional and mechanical retention as discussed. The score-PD attachment is a good example. Suction is a force created by a vacuum that causes a solid object adhere to a surface. An example would be a well-fitting denture.[7]

So, in this article is reported a rehabilitation of partially edentulous arch using semi precision attachment as an aesthetic approach

CASE

A 52-year-old female patient reported to the Department of Prosthodontics with a chief complaint of multiple missing teeth in maxillary and mandibular arch, and inability to chew food properly and unaesthetic appearance. On intraoral examination, maxillary arch was completely edentulous and in mandibular arch 16, 17, 18, 24, 25, 26, 27 teeth were missing. All the teeth are still intact with good periodontal conditions (fig.1).

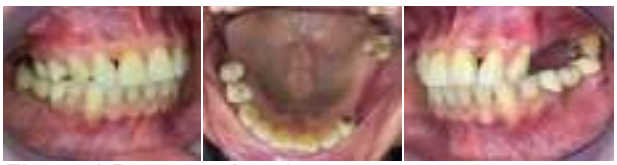

Figure 1 Pre-operative photos

MANAGEMENT

Patient was explained about various available treatment options like fixed partial denture combine with cast partial denture, overdenture and implant. Final treatment plan was chosen on considering the clinical conditions and patient's esthetic need, functional requirement and economical condition. Maxillary arch was rehabilitated with splinting crown porcelain fused to metal on teeth 22-23, 14-15 which the Rhein 83[8] extracoronal attachments were attached.

Clinical procedure

Impressions were made and the diagnostic casts were mounted on the articulator. Tooth preparation was done in 22, 23, 14, and 15 for overdenture abutments. Measuring depth of preparation using putty index and the depth is 1.5 mm because the final restoration that we used is porcelain fused to metal (fig.2).

Final impression was made with light body elastomeric impression material and poured in die stone. The provisories crown was fabricated using putty index and cemented using temporary acrylic (Charm-temp, Dentkist, Korea). Wax patterns were fabricated for all the prepared teeth, and a wax custom bar running over edentulous deficit ridge was connected to these prepared wax patterns. Ball attachment patterns (Rhein 83, USA) were attached to the custom bar (fig.3). Selection criteria for precision attachment were based on location and length of the edentulous span.

Figure 2 Measuring preparation using putty index)

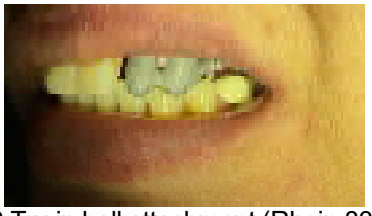

Figure 3 Try-in ball attachment (Rhein 83 USA)

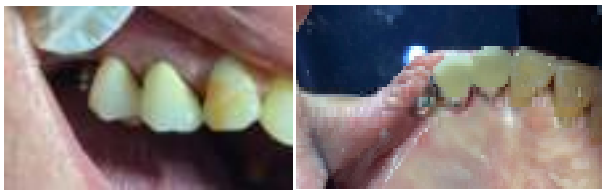

Figure 4 Try-in porcelain fused to metal crown

After try-in, the next step was porcelain veneering on metal coping, then another try-in to check on PFM crown margin on teeth and, also check on the palatal side (fig.4).

Next impression used light body elastomeric impression material, with splint crown are attached to abutment. This impression was done to construct removable partial denture.

The wax occlusal rim was fabricated covering the edentulous area. The jaw relation was recorded followed by articulation (fig.5) and teeth arrangement was done to achieve unilateral balanced occlusion with disclusion of all nonworking side teeth on lateral excursion. Waxed denture try-in was performed followed by acrylization with heat-polymerized acrylic resin (Trevalon HI, Dentsply, India). Laboratory remounting, finishing and polishing of the prosthesis were done. Standard retention caps were inserted in the slot present on the intaglio surface of the RPD.

Figure 5 Jaw relation recorded on articulator

Cementation of a metal framework with auxiliary attachment was done using Type 1 Glass ionomer cement (GC Gold Label 1, Japan) and the removable denture was attached to this framework using the ball attachment. Postinsertion, hygiene, and home care instructions were explained to the patient. Recall visits of 1- and 3-month follow-up of the prosthesis were found to be satisfactory in terms of function and esthetics (fig.6).

Figure 6 After insertion photos

DISCUSSION

In case of partially edentulous mouth, retention provided by the usage of precision attachments may have many advantages like comfort, chewing ability, as well as adequate distribution of occlusal loads and preservation of abutment teeth and less postoperative adjustments in patients with removable partial denture. Precision attachments provide balance between functional stability and cosmetic appearance in partial denture.[3]

Conventional clasp type of removable partial denture is also a popular treatment choice as its lower cost, easy fabrication method and maintenance. But if patient demands for esthetics and abutment treatment of choice, precision attachment is an answer.[2]

The goals for the successful treatment in attachment retained cast partial denture include 2 main factors; developments of a stress directing attachment design and distribution of forces between the abutment teeth and residual ridge.[4]

This article describes rationale and technique for fabricating fixed-removable prosthesis using a precision attachment for rehabilitation of edentulous arch. Precision attachment retained RPD is a treatment option in unilateral or bilateral distal extension condition and if patient is more concerned about esthetic condition, but does not permit the use of dental implants, then precision attachment retained cast partial denture would be an excellent option as it provides adequate retention, stability, esthetics, and function.

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Modification closed mouth functional impression technique for flabby and flat ridge: a case report

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ABSTRACT
In fabricating complete denture, flabby ridge and flat ridge require special impression technique. Pressure causes by impression in flabby ridge may compress the tissue. Ideally, modified open mouth impression technique is used to avoid compression in flabby area which cause denture base displacement. Flat ridge offers little possibility of retention, stability, and the muscle attachments are located near the crest of the residual ridge so there is more dislocating effect to horizontal and vertical movement. Closed mouth functional impression technique may produce a more retentive denture base for flat ridge because it record peripheral seal and denture bearing area with patient's functional. The main problem arises when flat ridge is also accompanied by flabby ridge. Closed mouth functional impression technique in this case cause pressure on the flabby ridge. This case report discusses about the management of the case with modification to functional closed mouth impression technique using wax as a spacer which is covered with metal mesh on the flabby ridge. The function of closed mouth functional impression technique is to obtain optimal muscle trimming and impression with patient's functional pressure and movement, to obtain the extension of the denture base to movable unmovable tissue during function. Modification with wax spacer in flabby area so that non-spacer area act as stopper during functional impression, and flabby ridge is free from pressure. Additional modification with metal mesh above the wax serves as escape holes, as well as scaffold for retention of impression material. Modification in this impression technique produce denture base which does not compress flabby ridge, and also obtain retentive, and stable base for flat ridge case.
Keywords: closed mouth, open mouth, functional impression, flabby ridge, flat ridge

INTRODUCTION

One of the most important factors in obtaining a good full denture is the adequate impression technique, that is useful for obtaining maximum support area and peripheral seal without interfering with functional movement, and accurate adaptation of soft tissue. Adequate impression to all of the support tissue of the denture bearing area will help us in obtaining denture with maximum support, as well as good retention and stability. However, these difficulties will arise when there is a compromise on the quality of the denture bearing areas such as the flabby and flat ridges, so that modifications to impression technique are necessary.[1]

Various kinds of impression techniques that can be done are in the form of open mouth and closed mouth. The open mouth impression technique allows the operator to hold the custom tray and control the pressure exerted during impression. The disadvantage of this impression technique is that the pressure applied is not functional and the base extension is not in accordance with the limit of functional movement of the patient so that the possibility of under extension on the peripheral part of the denture base is possible. In the closed mouth impression technique, the operator does not manipulate the pressure applied to the custom tray, but all pressure and patient movements depend on the functional movement of the patient's mouth. The disadvantage of this technique is that it can not be performed in patients with neuromuscular disorders and the pressure on the denture base support and the extension of the base according to the functional movement of the patient's mouth.[2]

Flabby ridge can also be called fibrous ridge or moving ridge, which are movable tissues that are located on the superficial aspect of the alveolar ridge. Flabby ridge is often found in the anterior maxillary region and are often associated with a combination syndrome.[3] Flabby ridge can cause complications such as pain or loosening of the denture overlying the tissue.[1] This condition can arise due to compression of the flabby area during impression, resulting in a base the resulting compresses the flabby area. The depressed flabby margins will experience a change in shape again, which can cause the denture to become loose.[3] The basic principle needed for impress the flabby ridge is to minimize the mucodisplacive impression on the flabby area so that flabby tissue is not depressed.[4]

The flabby ridge impression technique generally uses the open mouth technique with a modi-

fied custom tray so that two different types of impression materials can be used. Magnusson et al., described an impression technique using two impression materials on a physiological custom tray using zinc oxide and eugenol on normal tissue areas and an impression plaster on the flabby area. Crawford et al., described a two-tray impression technique, the two trays are fabricated and the impression is performed with two different materials. Osborne, describing a "window" impression technique with a custom tray, "window" is created in the flabby ridge area. In this technique, mucocompressive impression is performed on areas of normal tissue with zinc oxide and eugenol on a custom tray. After setting, a low viscosity impression plaster mixture was applied to the flabby tissue through the window. After setting, all the impression are removed from the patient's mouth. Watson, revising Watt and McGregor's technique, they applied an impression compound to a modified custom tray. The thermoplastic properties of the material are then manipulated simultaneously to compress normal tissue, but avoid flabby tissue areas; then the impression is carried out by using wash impression materials and zinc oxide and eugenol.[5,6] The problem that is found in this technique is that there is a difficutly in positioning of two custom tray. The main problem encountered in flabby ridge apart from the above difficulties is that it is not indicated for closed mouth impression technique because it can cause functional pressure on the flabby ridge area.[5-7]

Flat ridges, also called atrophic ridge, can result in them being unable to provide good resistance to vertical or horizontal movement. The main problem that often arises in flat ridges is the unstable and non-retentive dentures that can cause pain and discomfort. This condition is more common in mandibular area due to the smaller denture bearing area and limitation in the anatomical area.[9]

In managing flat ridges, various modifications to the open mouth impression technique that can be done such as admix and green all compound have been suggested to obtain satisfactory functions in denture fabrication. The disadvantage of the following technique is that it can cause discomfort to the patient due to the heat required for manipulation. The advantage of this impression technique is that it can record the functional position of the muscles in one step and it requires a shorter and more economic work time. Closed mouth techniques that can be done are functional and cocktails. The disadvantage of these various techniques is that the operator cannot control the patient's movements, which can cause over or under extension of the denture base. The advantage of this technique is that extension and pressure is obtained according to the patient's functional.[8,10]

In this paper, the management of flat ridge and flabby ridge in one ridge would be discussed. The problem that arises in this case is that for obtaining a retentive denture base and optimal extension of the denture base for flat ridge, we would need a closed mouth impression technique, but this technique is contraindicated for flabby ridge because it will depress the flabby tissue. To solve this problem, the closed mouth functional impression technique was modified so that accurate denture base can be obtained, but also avoid the pressure in the flabby ridge. The modification is using a wax spacer and metal mesh in flabby ridge area so that during the physiologic impression there is no pressure in flabby ridge.

CASE

A 72 years old male patient came to Department of Prosthodontic Dental Hospital of Universitas Sumatera Utara with the chief complaint that his old denture was loose and it could fall out when was used for talking and eating. The patient does not have a history of systemic disease and any bad habits.

Extra oral examination (Fig.1) showed that the patient's face was ovoid and prognathic, the upper and lower lips were thick, long, and provided adequate support. The patient's left and right pupils were normal.

Figure 1A Front face; **B s**ide face

Intra-oral examination (Fig.2) showed that in the maxillary ridge, there was flat and flabby ridge in the anterior part while in the mandibular ridge there was also flat and flabby ridge in anterior part with flat ridge in the posterior margin area. The arch of the jaw was ovoid with Class III relation. The tongue was slightly larger with Wright class III. The frenulum and saliva were normal.

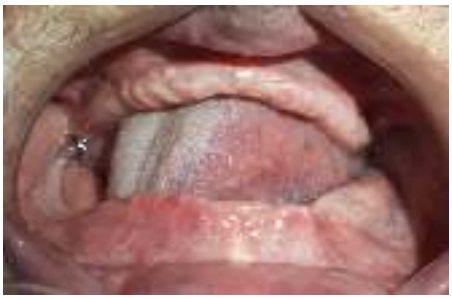

Figure 2 Intraoral examination

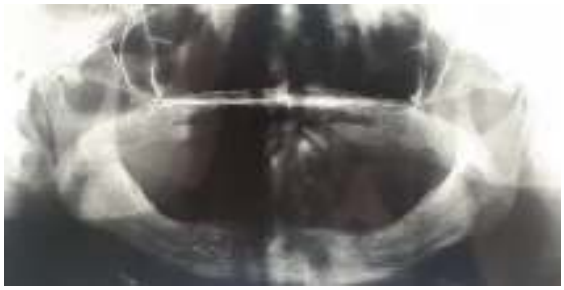

Figure 3 Radiographic examination

Radiography examination showed that there was severe resorption in maxillary and mandibular ridge (Fig.3).

The diagnosis for the maxillary ridge was fully edentulous with flabby ridge in anterior area (canine–canine); for mandibular ridge was fully edentulous with flat ridge, and flabby ridge in anterior area (canine–canine), with Class III skeletal relation.

MANAGEMENT

This case was managed with a functional close mouth impression technique without a spacer with a modified spacer with wax on the flabby areas which were covered with metal mesh.

The procedure for making a custom tray was 1) draw an outline of 2-3 mm above the mucobuccal fold; 2) do a blocking out of the undercut area, as well as adding a 2 mm of wax spacer on the flabby area (Fig.4), and placing the metal mesh over the spacer wax which functions as an escape hole for the light body impression; 3) making custom trays using autopolymerized acrylic resin (Fig.5); 4) followed by making a wax rim on a custom tray and wax pole on the mandibular wax rim; 5) after finishing making custom tray, record the vertical dimension (VD) of the patient; 6) then proceed to border molding and physiologic impression of maxillary ridge first and was followed by mandibular ridge (Fig.6).[11]

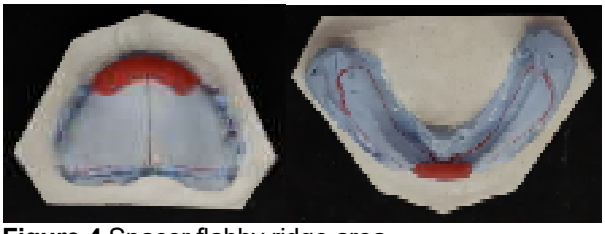

Figure 4 Spacer flabby ridge area

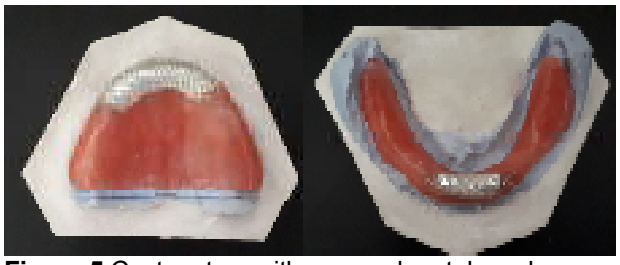

Figure 5 Custom tray with wax and metal mesh

Figure 6 Recording VD for physiologic impression

For maxillary border molding, adhesive agent was applied to the maxillary custom tray, then apply heavy body to the edge of the maxillary custom tray. The border molding material must cover all the edges of custom tray. After that, insert the maxillary custom tray into the patient's mouth, while a cheek retractor prevented border molding material touching the patient's lips. Then, insert the custom mandibular tray into the patient's mouth, instruct patient to cover mouth, pull the upper lip down and pull the buccal mucosa in the left premolar area inferiorly and posteroinferiorly (repeat the procedure on the right side). Instruct the patient to say “woo”, “eee”, and suck on the operator's finger. Finally, remove the custom tray from the patient's mouth and trim the excess area.

Procedure for maxillary physiologic impression were initiated with making an escape hole (metal mesh) in the flabby area (Fig.7A). Apply adhesive to the maxillary custom tray and apply light body material into the tray, then put it into the patient's mouth. Then, insert the mandibular custom tray into the patient's mouth, then repeat the movements made during border molding, and removing of the RA and RB custom trays from the patient's mouth, as well as trim the excess area.

Whereas procedure for mandibular border molding (Fig.7B), apply adhesive to the edge of the custom tray and apply monophase to the retromo-

lar area to minimize deformation, and heavy body to other edges. Then, insert the maxillary and the mandibular custom tray into the patient's mouth, instruct the patient to say "woo", "eee", and instruct the patient to move the tongue to the left and right. While the patient's mouth closed, push slightly behind the tray to impress the floor of the mouth under pressure, which reflects the high contraction of the mylohyoid muscle. After that, instruct the patient to swallow, and make all movements in the oral cavity. Then, remove the mandibular custom tray from the patient's mouth, and trim excess areas on the interior of the custom tray, distal retromolar pad, and retromylohyoid fossa area.

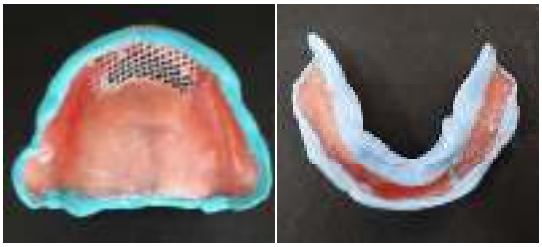

Figure 7A Escape hole in maxillary custom tray after border molding; **B** border molding in mandibular custom tray

Figure 8 Physiologic impression

The procedure for mandibular physiologic impression were make an escape hole, made of metal mesh, in the flabby area; then apply adhesive to the custom mandibular tray and apply light body material into the tray, then put it into the patient's mouth. After that, insert the maxillary custom tray into the patient's mouth, then repeat the movements made during border molding, and remove the maxillary and mandibular custom trays from the patient's mouth (Fig.8).

DISCUSSION

Modification closed mouth functional impression technique is used to manage of flabby and flat ridge. Closed mouth functional impression technique has an advantage such as the possibility of over and under extension is minimal because border molding is carried out by the patient and impression is done in occlusion position, thereby obtaining extension of the denture base to movable and unmovable tissue during function (optimal border molding) and record the ridge in functional pressure.[12] The disadvantage of this technique is that it will cause a compressibility in all the underlying structure tissue so that it is contraindicated to the flabby tissue.

To overcome this condition, a modification is made to the impression technique by placing a 2 mm wax spacer to the flabby tissue area which functions as a spacer and the area which is not covered with wax act as a stopper. In addition, other modifications are made in the form of adding a mesh coated with tin foil to the wax area, where the tin foil serves to isolate the mesh so that it is not covered with wax from the occlusal rim and the existing mesh functions as a substitute for the escape hole and acts as a scaffold to hold the impression material. From the modification of this impression technique, the selective pressure impression can be obtained, which in flabby area there is no mucofunctional pressure; but in the other tissue, mucofunctional pressure can be obtained.[7,12] With this modification, the problem can be also solved; that is usually found in flabby impression technique such as difficulty in applying impression material in open tray technique because of the gravitational forces, and also concern of controlled application and technique sensitivity in double tray impression for flabby ridge.[13]

The advantages of this modified functional closed mouth impression technique are 1) obtaining an extension of the denture base according to the patient's function and minimalized the likelihood of under or overextension of the denture base, 2) does not require double trays for flabby area impression, 3) single stage impression, and 4) easier fabrication and execution.

From this case, it can be concluded that extension of the denture base according to the patient's functional movement, denture base with functional pressure, but no pressure to flabby tissue can be obtained with modified closed mouth impression technique. It is suggested that during the impression with this technique, it is better to add light body in the muccobuccal fold area where the mesh is located to obtain a better impression.

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Iris positioning technique by using face symmetric measurement tool on the custom ocular prosthesis: a case report

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ABSTRACT
Loss of eye can have a major psychological impact on the patient. To overcome this problem, an ocular prosthetic must have been fabricated similar with the natural eye. Various techniques are documented to determine the symmetrical bilateral iris position; these methods can be subjective and have no measurement guidelines. A 20-year-old male patient came to the Prosthodontic Clinic of Dental Hospital Universitas Sumatera Utara with the diagnosis is post enucleation socket syndrome. Determination of the iris position using the face symmetric measurement-tool by focus to the vertical and horizontal lines of the facial symmetry guide. Confirm the alignment of the vertical lines by connecting the trichion–glabella–subnasal–gnathion guide points so that they vertically divide the two sides of the face, then the two horizontal lines by connecting the left-right cheilon with the mesial-distal canthus of the right and left eyes. This tool is like a face mask with vertical and horizontal guidelines connecting the symmetrical guide points of the face accompanied by centimeters and millimetres making it easy to measure distances and sizes of the iris symmetrically. The use of this tool has given good results in determining the position of the iris because its simplicity and can see facial symmetry.
Keywords: custom ocular prosthesis, iris position, face symmetric measurement tool, face symmetry

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INTRODUCTION

Loss of the eyeball is generally associated with congenital defects, trauma, or pathological abnormalities that may require surgical intervention in removal of the eyeball.[1] Surgical procedures in this case may require some stages such as orbital evisceration, enucleation or extenation.[2] Loss of the eyeball can have a major psychological impact. Patients with maxillofacial defects often withdraw, especially on the eye area, resulting in disabling of functional and social activities. To overcome this problem, an ocular prosthesis can be made that aims to imitate the color, contour, size and orientation of the eye from the existing eye so that it can provide cosmetics eye prostheses.[1-3]

Prosthetic replacement of a missing eye presents many challenges, one of them is determining the accurate size and position of the iris.[3-7] An ocular prostheses must be accurate in terms of size and symmetrical iris position, so will give effects such as natural eye duplication.[2] Various methods, techniques and concepts were documented for determining bilaterally symmetrical iris positions in the fabrication of ocular prostheses.[4] McArthur used a method for positioning the iris using an ocular locator and a fixed caliper with respect to the mediolateral and superior-inferior planes.[2,4] Robert used a pupilometer. Guttal uses a grid graph.[1] Benson suggests a visual assessment because positioning the iris is a sensitive procedure. However, visual assessment and similar techniques are subjective, and neither the grid chart nor the ocular locator technique is well stabilized and cannot be used in patients with facial asymmetry.

Face symmetric measurement tool is a face mask with vertical and horizontal line guides accompanied by a centimeter-millimeter size that can connect several reference points. This instrument can effectively measure iris and pupil size as well as right and left binocular iris distance. The aim of this case report is to describe a simple technique to accurately determine the symmetrical position of the iris in the fabrication of ocular prostheses.

CASE

A 20-year-old male patient came to the Prosthodontics Clinic of the USU General Hospital to have his right ocular prostheses. From the anamnesis, it was known that the etiology of eye losing due to a shot from an air rifle in his eyelids when he was 9 years old by eye surgery at Pirngadi Hospital, the ophthalmologist gave a manufacturer-made ocular and was only instructed not to do too much activity. About 1 month later, the patient lost his ocular prosthese and he has never worn ocular prostheses again due to limited economy.

Objective examination showed that the patient's right eye has been enucleated, healthy orbital

socket mucosa, superior sulcus deepening, ptosis, weakness of lower eyelid closure and sufficient space for ocular prosthesis (Fig.1). This condition was diagnosed as post-enucleation socket syndrome. It was decided to make a custom ocular prosthesis.

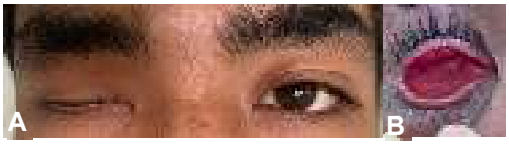

Figure 1A Condition of the eye profile; **B** eye socket

MANAGEMENT

Case management began with anatomical impression of the eye socket using a mold made of self-cured acrylic molded with thumb and index fingers attached to a disposable syringe (Fig.2A). Irreversible hydrocolloid impression material (alginate) was injected with the syringe position perpendicular to the eye socket until the impression material came out slightly through the tray hole (Fig.2B).

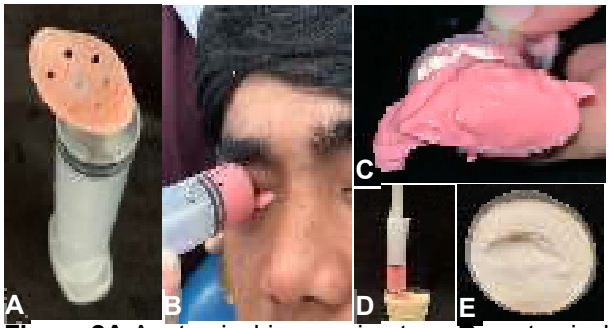

Figure 2A Anatomical impression tray; **B** anatomical impression of the socket; **C** anatomical impression; **D** the anatomical impression was entered in a container of type IV dental stone; **E** anatomical cast of the socket.

The anatomical impression (Fig.2C) was entered in a container containing type IV dental stone in an upright position (Fig.2D) so that an anatomical cast was obtained and marked the mesial, distal, superior and inferior sections (Fig.2E).

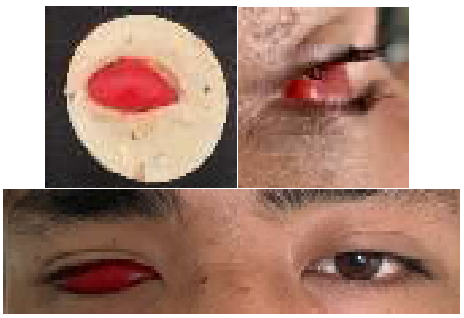

Figure 3A Anatomical scleral wax pattern; **B** passen anatomical scleral wax pattern seen from the side view; **C** from the front view.

Then the anatomical cast was filled with a wax pattern and shaped like a dome with a convex point at the center apex of the anatomical scleral wax pattern (Fig.3A). The wax pattern was tried in the patient by observing the convex point equal to the left eye (Fig. 3B,C). Then the wax pattern is given three signs, namely the convex point, vertical and horizontal lines as a guide for releasing the final impression tray which will later be made a putty index.

The final impression tray is made from a putty index mold with self-cure acrylic material (Fig.4A) and a straw as a connector with the tip of the PVS light body impression material (Fig.4B).

Figure 4A The putty index of the scleral wax convexity; **B** the final impression tray

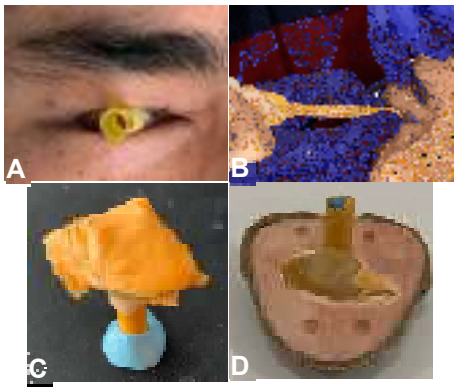

Figure 5A Try in the final impression tray; **B** final impression; **C** results of final impression; **D** entering the mold into the cuvette

The final impression tray was tried in the patient by seeing the straw as a convex top, vertical and horizontal lines are in the middle of the socket while the patient is instructed to activate the eye movement of opening, closing the eyes, looking left, right, up and down to see if the edge of the final impression tray is at the margin intaglio eye socket (Fig.5A). Impression is carried out by injection of the impression material previously then connecting it to a straw until the socket is full, the tip is removed and the patient activates eye movements (Fig.5B).

The surface of the final impression (Fig.5C) was entered in a cuvette containing type IV dental stone and several key holes were made (Fig.5D). After hardening, the surface is coated with vaseline and refilled to cover the entire surface of the mold, wait for it to harden.

The final cast was opened, the impression material was removed (Fig.6A) and filled with liquid wax from the hole formed from the previous straw. Once the wax has hardened, remove it, trim off the excess wax and polish the scleral wax (Fig.6B). Wax scleral was re-tried to the patient to evaluate eye size, convexity, comfort, superior and inferior palpebral support and eye movement.

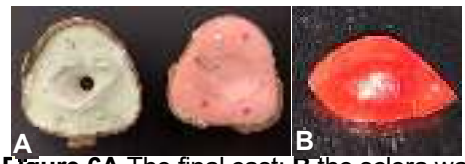

Figure 6A The final cast; **B** the sclera wax

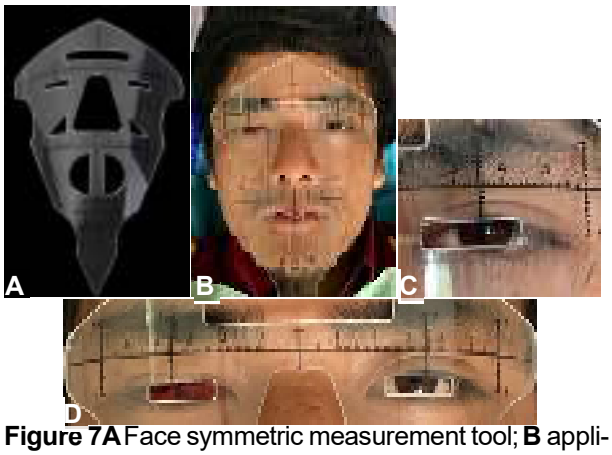

Figure 7A Face symmetric measurement tool; **B** application of the appliance to the patient's face; **C** measurement of iris and pupil diameters; **D** alignment

Determination of the position of the iris and pupil using a face symmetric measurement tool in the form of a face mask with vertical and horizontal line guidelines accompanied by centimeter and millimeter sizes (Fig.7A). The patient was instructed to sit up straight, with sclera wax in the patient's socket eye, applying a face symmetric measurement tool. Ensure the alignment of the vertical lines by connecting the trichion–glabella–subnasal–gnathion points so that they vertically divide the two sides of the face (Fig.7B).

Ensure the alignment of the 2 horizontal lines by connecting the left and right cheilon with the mesial-distal canthus of the right and left eyes. Then instruct the patient to look straight ahead, measure the diameter of the iris and pupil, mark the pupillary point with a permanent black marker on the sclera wax (Fig.7C,D).

Coloring of the iris and sclera of the eye was performed with a camera taken in daylight at around ten o'clock in the morning (Fig.8A). The diameter of the iris is 11 cm which has been measured using a face symmetric measurement tool. Iris staining was carried out with a nylon brush no.01 on a black plastic dick with a diameter of 11 cm with acrylic paint coloring with a mixture of burnt amber and raw amber colors in a 1:1 ratio. Before coloring the eyes, determine the midpoint of the plastic disc and draw a diameter line from the vertical and horizontal. Staining starts from the inner ring out slowly and gently for an embossed effect, repeats after 30 minutes and applies black paint on the edges of the dick for a limbus effect. The plastic disc was left for 24 hours and then a 2-3 mm diameter black plastic disc was attached as a pupil with multipurpose glue (Fig.8B).

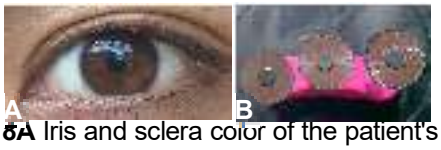

Figure 8A Iris and sclera color of the patient's eye; **B** iris staining on plastic discs.

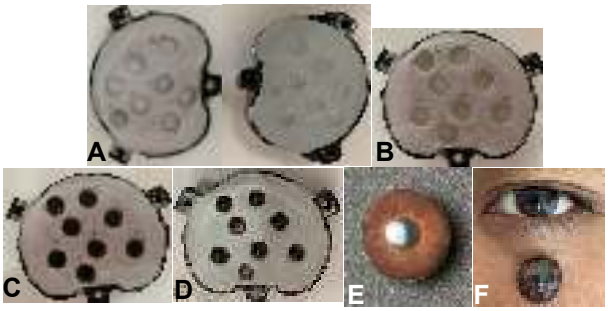

Figure 9A The eye doll mold; **B** self cure clear acrylic on mold base; **C** laying the iris disc on self-cure clear acrylic; **D** the result of boiling the iris button; **E** iris button after finishing and polishing; **F** color of the iris button is similar to the real eye.

The iris button was made by duplicating the doll's eye and entered in a cuvette containing type III dental stone to obtain the iris button mold (Fig. 9A). Before to boiling, the molds were coated with CMS. The base of the mold is filled with self-cure clear acrylic (Fig.9B), wait for it to harden, then the iris is glued on top with multipurpose glue (Fig.9C). Apply heat-cured clear acrylic to the antagonist mold, closing, pressing and boiling. Open the results, do the finishing and polishing (Fig.9D,E,F).

Scleral wax which has been marked with a black point as a pupil, enlarged by 11 mm. Remove the convexity of the eye on the wax sclera to the diameter of the iris to a depth of 2 mm and merge the iris button without any gaps between them (Fig. 10A). Try the scleral iris button in the patient and look at the alignment with the left eye with the use of the face symmetric measurement tool again (Fig. 10C,D). Re-instruct the patient to make eye movements; if the iris button is too convex, the convexity can be removed. Put the scleral wax back into the mold in the previous cuvette and coat with va-

seline. To prevent the iris button from rotating when it is boiled, an acrylic cylindrical stick is attached to the top of the iris button without vaseline (Fig.10B). Open the previous antagonist cuvette model, refill it with type III dental stone.

After dewaxing (Fig.11A), apply CMS, fill in A3 color heatcure white acrylic, pressing and boiling. Open the results, with the stick still in a cuvette, do the finishing and polishing (Fig.11B).

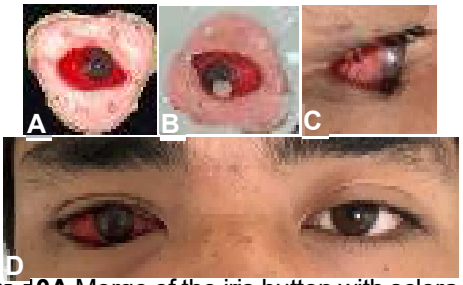

Figure 10A Merge of the iris button with sclera wax; **B** connect the stick with the iris button; **C** insertion of sclera wax and iris button from side view; **D** front view.

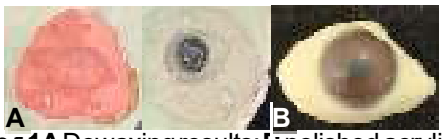

Figure 11A Dewaxing results; **B** polished acrylic sclera.

The putty index (Fig.12A) as an indicator of depth is made by placing the putty at the bottom of the container and making a keyhole. Apply vaseline on the surface, fill the putty on the antagonist cap. Remove the surface of the acrylic sclera to a depth of 2 mm for subsequent clear acrylic application and measured using a putty index whose antagonist cap had been halved (Fig.12B,C). The iris button was finished and polished, except the sclera to application the scleral stain.

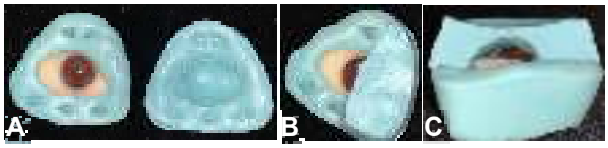

Figure 12A The putty index of 2 mm surface reduction; **B** cap of the putty index antagonist is halved; **C** indicator of scleral surface reduction

The color of the sclera was matched to that of the patient's eye (Fig.13A). The sclera was stained with yellow, brown, and red colored pencils (Fig. 13B). The similarity of blood vessel fibers used red wool thread which was attached with monopoly syrup, waiting to dry (Fig.13C). Place the sclera back into the previous cuvette, apply CMS, apply heat-cured clear acrylic, pressing and boiling (Fig.13D). Open the results, do the finishing and polishing (Fig.13E).

Before to insertion of the ocular prosthesis, the

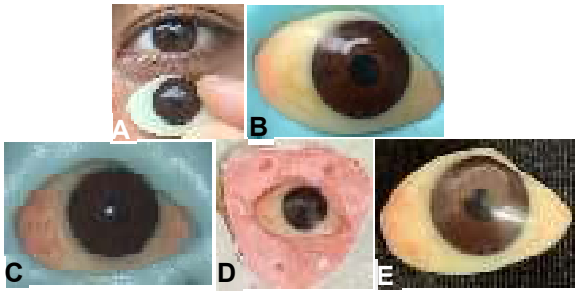

Figure 13A Color matching of the white acrylic sclera with the patient's eye; **B** scleral staining; **C** blood vessel fibers with red wool thread; **D** the acrylic sclera is returned to the cuvette for boiling; **E** ocular prosthesis.

eye socket was cleaned and ophthalmic fluid was applied. An ocular prosthesis was inserted from superior to inferior. Insertion of the ocular prosthesis by evaluating the size, convexity of the eye, comfort, superior and inferior palpebral support and eye movement (Fig.14A,B). If there is still something disturbing, it can be corrected by smoothing using sandpaper. Patient instruction and education on how to put on and take off the ocular prosthesis, how to clean and store it, and check-up visits.

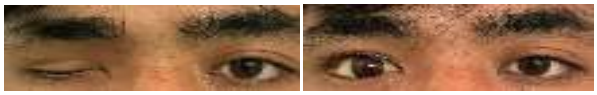

Figure 14 Ocular prostheses **A** before; **B** after

DISCUSSION

Eye defects are maxillofacial deficiencies that interfere with functional and social activities and require prosthetic replacement. A custom ocular prosthesis duplicates the orientation, color, contour, and size of the existing pupil and iris, providing realism and symmetry to the patient's face. The position of the iris is an important step and becomes a challenge in making ocular prostheses because symmetrical eyes provide good aesthetics so that it increases the patient's confidence. The literature shows many techniques for positioning the iris on ocular prostheses such as the use of a pupillometer, plastic strip template, millimeter ruler, ocular locator-fixed caliper, light reflection symmetrical viewing of the eye, inverted anatomic tracings, Boley's gauge, transparent graph grid, computer simulation with optical scanning techniques. and computer-based design.[6]

Bhochhibhoya et al, used pupillary distance (PD) ruler in determining position of the iris which has a weakness in the case of facial asymmetry because this technique only uses the same guiding plane and cannot be used in cases of hypertelorism where both eyes cannot be accommodated in the eye sockets of the PD ruler.[2] Manjita et al, using glasses with added grids that can be continu-

ed to the patient's facial skin has a weakness in preparation, which is the manufacture of custom scale grids which may lead to fabrication errors.[3] Slightly different from Lokhande using photographic assistance printed on self-adhesive glossy vinyl paper sticker attached to the glasses.[6] Shetty et al, using the Hanau wide-view spring bow combined with a ruler also has the disadvantage that clinicians must have a tool that is quite expensive and cannot be used in patients with ear loss.[4] Similar to Ankita, using facebow combination frame with grid graph which has a weakness also in facial symmetry.[7] In this paper, the author uses a face symmetric measurement tool to overcome these weaknesses.

Face symmetric measurement tool is a face mask that is usually used for eyebrow and lip tattoos. This tool has a guide of 1 vertical line and 2 horizontal lines accompanied by a ruler with units of centimeters-millimeters. These lines connect the symmetrical guide points of the face. The vertical line (Fig.15A) on this tool can divide the face symmetrically by drawing the trichion (tr)-glabella (g)–subnasal (sn)–gnation (gn) line.

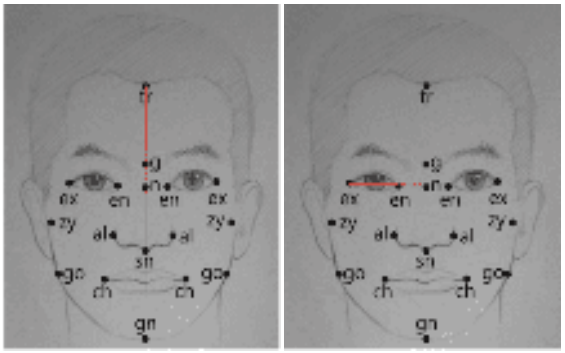

Figure 15A Symmetrical measuring guide points of vertical line faces: trichion (tr)–glabella (g)–subnasal (sn)–gnation (gn); **B** symmetrical measurement guide points of the face of the upper horizontal line: mesial (en)-distal (ex) eye canthus and lower horizontal line: cheilon (ch).[5]

The first horizontal line (Fig.15B) is on the top, connecting the mesial (en)-distal (ex) points of the right and left eye canthus, while the second is on the bottom, connecting the left-right cheilon (ch) points. The first is used to measure the distance between the two pupils, the size and position of the pupil and iris. In this tool there is a rectangular hole in the eye that can easily mark the position of the pupil and iris directly into the sclera wax. This tool has a handle on the bottom that is stable, comfort and easy for clinicians and patients to position it and can assess the iris position adequately.

The advantages of using a face symmetric measurement tool are 1) a standard for measuring facial symmetry by connecting the guide points so that it can be used on asymmetrical faces; 2) simple, economical, easy to use, does not require special skills, thereby reducing clinician's working time; 3) rigid, so it is stable, not easy to move in determining the point and can be used for right, left or both eye loss; 4) point determination can be done directly on the scleral wax because there is a square hole in the eye area; 5) a ruler with units of centimeters and millimeters, making it easy to measure the distance and size of the iris and pupil vertically and horizontally; 6) vertical and horizontal line guides making it easy to divide the face and accurate location of the iris and pupil; 7) the handle under the chin can be held by the patient alone, comfortable without feeling tired or stiff, making it easier for clinicians to work; 8) transparent so you can see the guide points directly.

The weakness of this tool is that this tool only has one size (free size) so that when the patient has a large reasonable width, the square hole in the tool cannot reach the location of the iris or pupil.

It is concluded that the use of the face symmetric measurement tool described here has given good results in terms of aesthetics, acceptability, and patient satisfaction. This tool is easy to use, does not require special skills, is accurate, stable, and can see facial symmetry compared to the techniques used previously.

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Modified impression tray and iris positioning ocular prosthesis of post enucleation socket syndrome: case report

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ABSTRACT
The cosmetic disfigurements which arise due to loss of orbital volume after enucleation of an eye include enophthalmus, superior sulcus deformity, upper eyelid ptosis, and lower eyelid laxity. The treatment can be either conservative or surgical. For patients who does not want to undergo further surgical procedures, the conservative treatment is simple, non-invasive, and appropriate. This case report describes modified impression tray and iris positioning technique of post enucleation socket syndrome to achieve aesthetics and function. A 65-year-old male patient reported to the Dental Hospital Universitas Sumatera Utara with the chief complaint of facial disfigurement due to loss of the right eye. Patient had enucleation 6 months ago and using conformer after surgery. The diagnosis was post enucleation socket syndrome. Clear acrylic sclera as a tray without handgrip will precisely records of the palpebre convexity and specified socket. The use of eyebrow ruler helps accurately determine the symmetrical iris position compared to only visually determining which is subjective with the possibility of interobserver errors. It was concluded that clear acrylic sclera as a tray and eyebrow ruler to determine the position of iris resulting in patient satisfaction due to aesthetics and function.

Keywords: post enucleation socket syndrome, impression tray, iris position, eyebrow ruler

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INTRODUCTION

The loss of an eye can have physical, social, and psychological impacts on the affected person. Physical flaw due to an ocular defect compromises appearance and function, which prevents an individual from leading a normal life and usually prompt the individual to seek treatment that will reinstate acceptable normalcy. The combined efforts of the ophthalmologist, plastic surgeon, the maxillofacial prosthodontist and dental technicians are needed to provide a satisfactory ocular prosthesis.[1] The enucleation of the eye globe is undertaken by an ophthalmic surgeon only when all other eye treatments are ineffective, inappropriate or undesirable. It is the final measure taken most frequently when a patient has intra-ocular malignancy, trauma, and a blind, painful eye. Following enucleateon, the orbital tissues that once supported and protected the natural eye no longer serve a useful purpose and tend to shrink leading to loss of orbital volume. The cosmetic disfigurements which arise due to loss of orbital volume after enucleation of an eye include enophthalmos, ptosis of the upper eyelid, deepening of the superior sulcus, backward tilt of the ocular prosthesis, and drooping of the lower eyelid i.e. ectropion. These symptoms, summarized in 'the postenucleation socket syndrome,' may arise separately or in combination and vary in severity.[2,3]

Enucleation or evisceration causes constriction of the tissues around the ocular cavity. A temporary conformer to prevent tissue contraction will maintain proper contours. The fabrication of a definitive ocular prosthesis should begin as soon as the socket has healed. An ocular prosthesis is a maxillofacial prosthesis that artificially replaces an eye missing as a result of trauma, surgery, or congenital prosthesis does not replace missing adjacent skin, mucosa or muscle.[4]

Ocular prosthesis can be classified as stock shell 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.[4]

This article describes a technique for fabricating a custom-made ocular prosthesis using conventional technique. The technique described in this article provides a cost-effective choice for optimal anophthalmic socket rehabilitation.

CASE

A 65-year-old male patient was referred by an ophthalmologist at the Sumatra Eye Center Medan to the Dental Hospital Universitas Sumatera Utara for an eye prosthesis. The patient felt discomfort in his right eye because there was an object (hair), then the patient tried to remove it by hand and bleeding occurred in his eye. Enucleation surgery was performed in 2019 and a conformer was attached to the patient's right eye. After six months of using the conformer, the patient felt insecure in his activities and wanted to make an eye prosthesis.

On clinical examination of intraocular tissue, there was a conformer (Fig.1A) in the eye that had never been removed and cleaned by the patient since postoperative because there were no instructions given by the ophthalmologist. After the conformer was removed and cleaned, the eye condition was good, there were threads and the depth of the eye socket on the superior and inferior eyelids was deep enough, there was eye excretion in it and then cleaned (Fig.1B). The diagnose was post enucleation socket syndrome.

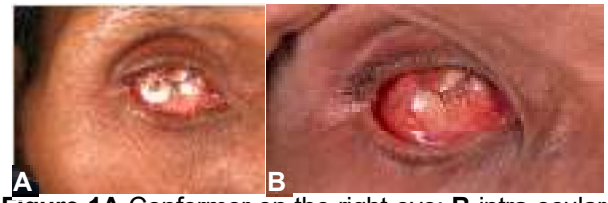

Figure 1A Conformer on the right eye; **B** intra-ocular examination

Figure 2 Customized impression tray

MANAGEMENT

Case management began with anatomical impression performed using a customized impression tray of self-polymerized acrylic resin which was connected to a syringe (Fig.2) by try in first into the eye socket.

Furthermore, vaseline was applied to the eyelashes to prevent from sticking to the impression material so that they are easy to clean. Alginate impression material was inserted into the syringe, the impression tray was placed into the socket, and then injected. The patient was seated in an upright position and instructed to move the eyeball to the right, to the left, up and down without moving the head to get the proper depth and width of the socket (Fig.3A). After the material was set, the tray was removed and the remaining impression material was cleaned from the socket (Fig.3B).

Figure 3A Anatomical impression with alginate; **B** the anatomical impression

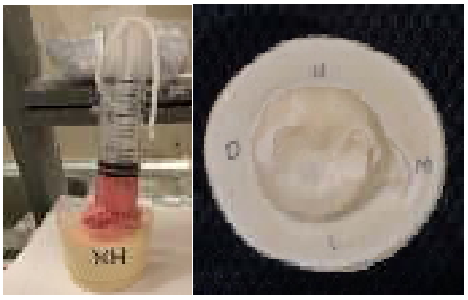

Figure 4 Mold making

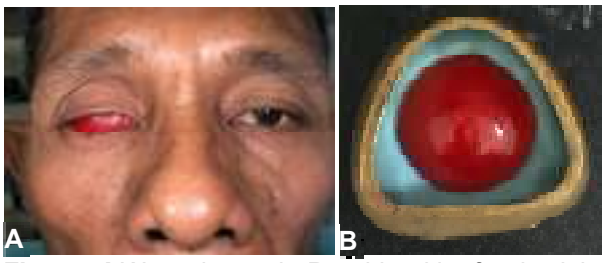

Figure 5A Wax sclera try in; **B** mold making for physiological impression tray

The anatomical intaglio surface was implanted in a small plastic cup containing type III dental stone on the non-anatomical surface and the top (anatomical surface) was filled with type IV plaster (fuji rock) to obtain maximum detail (Fig.4)

Making a scleral wax pattern by pouring. The surface of the mold was moistened with water and the molten wax was poured into the mold. When the wax begins to set the surface was pressed with a finger to reduce shrinkage of the wax. The wax pattern was shaped by the natural convexity of the eye with the highest part of the convexity located in the pupillary area. Trials on patients to get the shape of the eyeball that best fits the natural eye. After everything was matched, the surface of the wax pattern was smoothed (Fig.5A).

Making a physiological impression tray by making a mold first, implanted a scleral wax pattern in-

to a cuvette filled with putty with the anterior surface facing up, after the putty was set the surface was given vaseline and then inserts the putty into the opposite cuvette. After the putty was set the cuvette was opened and the wax pattern was removed (Fig.5B). Vaseline was applied to the mold, then the self-polymerized clear acrylic resin was poured on the cuvette and then pressed. After setting, the sclera, was polished and try in into the patient's eye. The intaglio surface and the outer surface were reduced by 1 mm for the physiological impression material (Fig.6A).

Physiological impression was done with light body impression material by first injecting the impression material into the eye socket, then inserting a self-polymerized clear acrylic resin scleral pattern into the eye socket and the patient was instructed to move the eyeball to the right, left, up and down and close the eye socket, to record the depth, width and convexity of the eyes (Fig.6B).

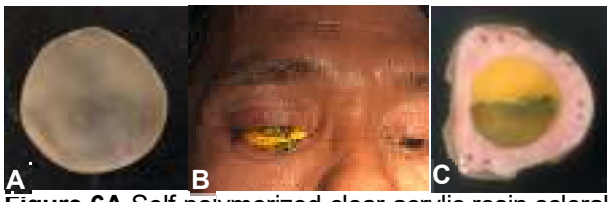

Figure 6A Self-polymerized clear acrylic resin scleral pattern as physiological impression tray; **B** physiological impression; **C** physiological mold making

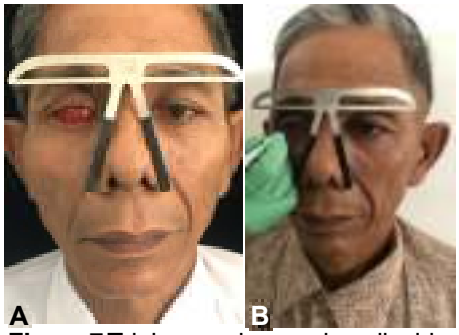

Figure 7 Trial wax sclera and pupil midpoint determination

The filling of the physiological mold was carried out by implanting it in a cuvette containing type IV dental stone. After setting, vaseline was applied to the entire surface of the dental stone and physiological impressions, then the antagonist of the cuvette was closed and filled with type IV dental stone to obtain a mold (Fig.6C).

Making a scleral wax pattern by pouring. The wax pattern was adjusted and trial in the patient's eyes. After that, the center of the pupil was determined using the eyebrow ruler and marked with a marker and adjusted to the position of the middle point of the pupil of the left eye. In this patient the distance from the guide point of the eyebrow ruler to the midpoint of the original pupil is 2.5 cm. Determination of the diameter of the iris (11.5 mm) using a compass and then the circle is colored with a marker on the entire iris (Fig.7).

The iris coloring uses a paper iris disk technique with modifications, the paper material was replaced with a black disk of the doll's eye, using acrylic paint with a mixture of brown and black colors adjusted to the color of the iris of the other eye, then clear acrylic was boiled to get the iris button (Fig.8)

Figure 8 Iris button making

The marked wax sclera was perforated from the front and the iris button was inserted into it adjusted to the convexity of the patient's eyes, then trial on the patient (Fig.9A).

The surface of the mold was applied with cold mold seal (CMS) as a separation medium, before using acrylic resin (Heat cure shade 3). The acrylic was stirred and then filled in the bottom of mold, covered with cellophane plastic. The top cuvette was reassembled and then slowly pressed, the excess acrylic was removed. Apply pressure again, lock the cuvette in a depressed state, then do the boiling. The sclera was trimmed and polished and trial on the patient's eyes (Fig.9B)

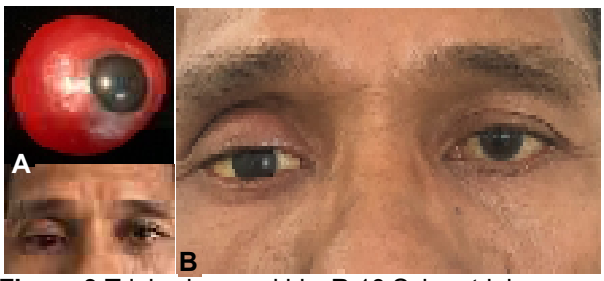

Figure 9 Trial sclera and iris; **B** 10 Sclera trial

Clear acrylic filling (Meliodent, heat cure denture bases material, color 01, clear) was performed by returning the sclera to the implanted cuvette, the surface of the cuvette was applied with cold mold seal. For clear acrylic applying, boiling, finishing and polishing were carried out (Fig.10A). The finished prosthesis was fitted with attention to appearance, comfort and function (Fig.10B). The pa-

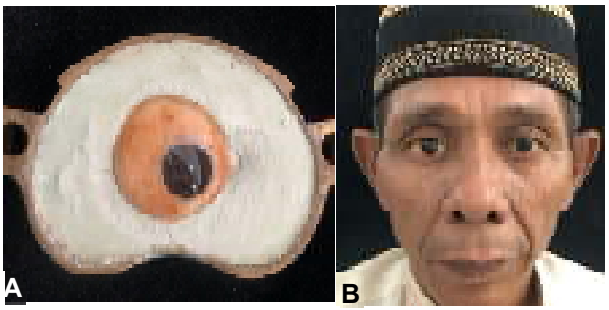

Figure 10A Clear acrylic applying; **B** the patient was wearing a right ocular prosthesis

patient was given instructions on how to put on and remove the prosthesis, care at home should be done with care and clean hands, the prosthesis is removed only when cleaning. Control was carried out on day 7 post-insertion.

The first control after one week of insertion the patient complained of a lot of tears and dirt in the eyes. There is no pain and the eyes do not come off when activity. There was an overextended and pressing edge in the median canthus area and it was reduced with a fine stone bur and re-polished.

DISCUSSION

The challenge in restoring an ocular defect is replacing a mobile sense organ with a static prosthesis. An ocular prosthesis should maintain its orientation when the patient is looking straight ahead. It should restore the normal opening of the eye, support the eyelids, restore a degree of movement, must be adequately retained and esthetically pleasing. The use of a stock prosthesis is usually advocated when time is limited, and cost is a consideration. Fabrication of a custom ocular prosthesis allows several variations during construction. The close adaptation to tissue bed uses the full potential to produce movement. Voids that collect mucus and debris and irritate mucosa and act as a potential source of infection are minimized. Optimum cosmetic and functional results enhance the patient's rehabilitation to a normal lifestyle.[1,5-7]

A properly fitted and acceptable custom ocular prosthesis has the following characteristics such as retains the shape of the defect socket, prevents collapse or loss of shape of the lids, provide proper muscular action of the lids, prevents accumulation of fluid in the cavity, maintains palpebral opening similar to the natural eye, mimics the colorations and proportions of the natural eye, and has a gaze similar to the natural eye.[8]

During the postoperative period, it is important for the patient to wear a conformer. The use of a conformer will help maintain the eye socket. Custom conformer fabrication may be indicated when the definitive ocular prosthesis will be delayed due to slow patient recovery, medical complications or patient preference.[9]

The effectiveness of various impression techniques depends on various factors such as the type of patient, space for the prosthesis, available tools and materials, operator experiences and patient psychology.[10] Impression techniques are performed very well and satisfactorily in the rehabilitation of anophthalmic patients. This technique also aids in the proper adaptation of the ocular prosthesis and in close contact with the substructure of the eyeball, and the remaining muscle tissue, which in turn helps reduce the risk of microorganisms and secretions accumulating in the defect.

From this case, it is concluded that clear acrylic sclera as an impression tray without handgrip will precisely record the convexity and support of the eye, make it easier to determine the position of the iris with an eyebrow ruler and result in patient satisfaction because maximum esthetics and function are obtained. Delayed fabrication of an ocular prosthesis after enucleation will require many steps in the fabrication of the prosthesis due to changes in the size and shape of the anophthalmic socket. Although patient cannot see with an ocular prosthesis, it can restore the patient's confidence. The use of ocular prostheses has changed the social life of patients to a significant degree and increased self-confidence.

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Novel approach in iris shade matching: mobile photography and custom ocular shade guide

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ABSTRACT
Introduction: Custom ocular prosthesis have several advantages such as even distribution of pressure on the eye socket, highly esthetic iris, better comfort and eyelid movements, but this prosthesis requires a long fabrication time. The fabrication step that spent time the most is the iris shade matching. **Case**: A 19 years-old woman with a defect in her left eye reported to Dental Hospital Universitas Sumatera Utara. The patient revealed history of infection of the left eye due to measles leading to surgical enucleation when she was one year old. Clinical examination shows healthy conjuctiva with no sign of infection or inflammation covering the posterior wall of the anopthalmic socket. **Management**: The iris shade matching was done using mobile photography and custom ocular shade guide, allowing the fabrication of iris button in the same day with shade matching appointment. The mobile photography eliminated the need for the operator painting skill and save the fabrication time significantly. The custom occular shade guide compensated the color biased during the photo taking procedure. **Conclusion**: The novel approach using mobile photography and custom ocular shade guide simplified the iris shade matching, provide highly esthetic results, eliminate the needs for operator painting skills, and save a significant amount of time in fabrication.
Keywords: custom ocular prosthesis, custom ocular shade guide, enucleation, anopthalmic.

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INTRODUCTION

Loss of an eye can cause a significant psychological and emotional disturbance to any patient, because eyes are generally the first features of the face to be noted.[1] Congenital defect, pathology or accidental trauma to eyes can lead to surgical intervention resulting in the removal of the eyeball. The surgical management ranges from evisceration, enucleation to exenteration depending upon the case and its severity. Evisceration is the removal of the contents of the globe while leaving the sclera and extraocular muscles intact. Enucleation is the removal of the eye from the orbit while preserving all other orbital structures. Exenteration is the most radical of the three procedures and it involves removal of the eye and part of the bony orbit.[1,2]

The disfigurement caused by the loss of an eye can be treated with an ocular prosthesis. An ocular prosthesis which restores and replaces the natural eye aims to improve the patient's esthetics, restore and maintain the health of the remaining structures and consequently provide physical and mental well-being for the patient.[2] There are two types of ocular prosthesis; stock ocular prosthesis (ready-made) or custom ocular prosthesis. Stock ocular prosthesis possess disadvantages such as ill-fitting and improper shade matching with the natural eyes, meanwhile the custom ocular prosthesis increases the adaptiveness, better esthetic and movement of the eye ball, and exactly matches the iris position as that of the adjacent natural eye, but it requires more time in the fabrication process.[3]

The most consuming time in the ocular prosthesis fabrication is in the iris shade matching process. The conventional methods using paint to recreate the patient iris, depends on the clinician painting skills to produce an esthetic iris, it also requires days of waiting for the paint to dry before we can use it to make iris button or to attach it to the acrylic sclera. Nowadays, mobile photography grows rapidy in terms of sensor quality, resolution and lens sophistication. Some new mobile phone cameras have dual and even triple cameras setups including macro lenses which allow the smart phone to take picture of small object with great details. The smart phone camera is also lightweight, low cost and easy to operate.[4] Using the right methods mobile photography can be used to recreate the patient iris with great details in short amount of time, decreasing the time and visits that require in the custom ocular prosthesis fabrication significantly.[4] This case report describe a novel approach in iris shade matching using mobile photography and a custom ocular shade guide.

CASE

A 19 years-old woman with a defect in the left

eye reported to Dental Hospital Universitas Sumatera Utara. The patient revealed a history of infection of the left eye due to measles leading to surgical enucleation when she was one year old. Clinical examination shows healthy conjuctiva with no sign of infection or inflammation covering the posterior wall of the anopthalmic socket. According to the treatment-based classification system given by Himanshi *et al.*, the patient was categorized under Class 4 phthisis bulbi (severe enophthalmos with disfigured sclera and loss of orbital fat).[5] This case (Fig.1) was managed using a custom ocular prosthesis.

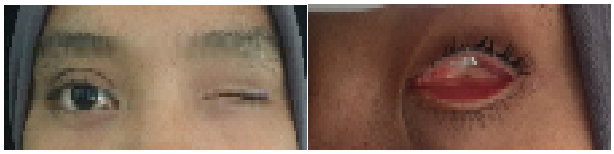

Figure 1 Enucleated left eye

MANAGEMENT

First, glycerine application was done onto the eyelashes and the lining of anopthalmic socket. A custom tray was fabricated with autopolymerizing polymethyl methacrylate. The tray was finished, polished, and tried in the patient to check for extensions. An impression of the anopthalmic socket was made. Cast was made from type II gypsum on which a special tray was fabricated using self-cure acrylic. A syringe was attached to the special tray through a perforation made at the centre of it. Impression of the defect was recorded using polyvinyl siloxane light viscosity material. The material was injected into the socket, while the patient was instructed to make various eye movements as the material was injected so that the impression was recorded in the functional form. After the material had set, impression was retrieved from the socket and checked to ensure that all the surfaces were recorded. A two-piece type IV dental stone cast was poured to immerse the lower part of the impression (Fig.2). 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 impression. The wax was properly contoured and carved to give it a simulation of the lost eye. The wax pattern was tried in patient's socket and checked for size, comfort, support, fullness, and retention by performing the functional movements. Iris positioning was performed using face symetris measurement tool.

Figure 2 *Wax Sclera Try-in*

Iris fabrication was done using mobile photography. The photo was taken in a dark room, a white flashlight positioned 45^0 from the patient eye was used as light source. The smart phone with built in macro features was positioned in front of the patient eye (Fig.3).

Figure 3 Mobile photography result

The photo was edited with photo editing software (Adobe Photoshop CC 2015) to eliminate the white flash light reflection from the eye, using the same software (Fig.4), a custom ocular shade guide was made with a saturation and lightness gradation to compensate the biased effect from the light source. The custom ocular shade guide was printed and ready to use (Fig.5).

After the iris matching was done, the selected iris was cut with a curved scissors and coated with cyanoacrylate adhesive. The iris button was fabricated with a *custom cuvette.* A layer of self-cured transparant polymethyl-methacrylate was placed on the custom cuvette, then the iris photo was attached on top of it with an adhesive. A hot cured transparant polymethyl-metacrylate was placed on top of the iris photo. and the second part of the custom cuvette was placed and both of it was pres-

sed with a press machine. The excess material was removed and the custom cuvette was put into a hot water. After the hot cure polymethyl-methacrylate sets, the custom cuvette was opened and the iris button was polished.

Figure 4 Photo editing result

Figure 5 Custom ocular shade guide

Figure 6 Iris button fabrication.

Figure 7 Iris button

After the iris button fabrication (Fig.6) process completed, the iris button (Fig.7) was attached into the wax sclera and the final try-in was done in the patient (Fig.8). The wax sclera with iris button attached was invested in a cuvette (Fig.9). Dewaxing was done and continued with sclera fabrication using hot cured transparent polymethyl-methacrylate mixed with acrylic paint matching the patient sclera color.

Figure 8 Final try-in

Figure 9 Wax sclera

After deflasking, a 2 mm reduction with stone bur was done on the surface of the ocular prosthesis, characterization was done using a color pencil and a red wool filament mimicking the patient eye. The prosthesis was placed into the cuvette and a transparent hot cured polymethyl-methacrylate was placed on top of it. After the curing process completed the ocular prosthesis was deflasked and polished (Fig.10). The ocular prosthesis was inserted into the patient socket (Fig.11) and the patient was instructed to return for control.

Figure 10 Final ocular prosthesis

Figure 11 Final result

DISCUSSION

Custom ocular prosthesis is the best treatment option in prosthetic eye replacement. It provides better adaptation, esthetic, and eye movement. It also preserves the remaining tissue post enucleation.[1,2] When it comes to the ocular prosthesis esthetics, many clinicians have concluded that iris color is the most important consideration. The common techniques for the fabrication of custom-made prosthesis are paper iris disk and blank iris disk technique. However, painting the iris disk involves both artistic skills and science of color. This method of iris shade matching is also time consuming, because the time it takes for the paint to dry completely. One of the alternatives to overcome the disadvantages of the conventional painting technique is digital photography.[6]

Nowadays, digital photography has evolved, so has colour calibration technology and ink quality. The ability to print an exact colour replica of what was taken in camera has become much simpler. Digital photography arguably provides a more scientifically robust method of production that can be standardised, measured, and effectively reproduced. The disadvantages of digital photography are the requirement of expertise in photography and the cost of the photography equipment.[7]

Mobile photography using smart phones have come a long way in digital photography due to the fact that those cameras have some interesting features and characteristics that are beneficial, such as 1) very small aperture due to the small size of the camera and its diaphragm. Therefore, a very high depth of field is achieved on a regular basis; 2) good ISO settings adding more light sensitivity to the camera with low noise; rather good resolution to show small details; 3) large display to preview and view the images, especially when using smart phones with large screens; 4) battery autonomy that allows working for many hours; 5) the white balance, exposure, focus, ISO, metering and the shutter speed can be modified manually in some cameras; 6) smart phones are light and easy to operate.[4]

This benefits, combine with the right technique will allow us to reproduce the patient iris esthetically in a short amount of time. Mobile photography also eliminates the needs for operator skills and experience in painting and mixing color which is required in the conventional methods.[8-10]

The usage of custom occular shade guide will compensate the color biased that might happen during the photo taking or editing process, therefore increasing the precision of the iris color during iris shade matching. Even though this technique provides us with many advantages, it requires the operator skills in using the photo editing software such as adobe photoshop to reproduce a natural and highly esthetic iris.

It is concluded that the novel approach using the mobile photography and custom ocular shade guide simplified the iris shade matching, provide highly esthetic results, eliminate the needs for operator painting skills, and save significant amount of time in fabrication.

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Modified functional ocular impression of post-enucleation socket: A case report

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ABSTRACT
Introduction: The disfigurement associated with the loss of an eye can cause significant physical and psychological problems. Therefore, a good ocular prosthesis is needed to restore the patient's quality of life. One of the factors that determine the quality of an ocular prosthesis is accurately impression. In the case of enucleation where the eyes socket has a soft and movable tissue bad will result inaccurate impression. The difficulty of post enuclation impression in such case is the compression of the tissue eyes socket. This case report will discuss the modification in functional impression technique using a modified custom tray. **Case**: A 39-year-old male patient came to Dental Hospital Universitas Sumatera Utara with chief complaint an unaesthetic and loose left stock eye that had been used for 10 years. Clinical examination shows moderate depth eye socket with soft and movable tissue. **Management**: The functional impression technique was modified using a self-curing clear acrylic sclera without handle as a custom tray with 2 mm reduction on the intaglio surface and light body polyvinyl siloxane as impression material. **Discussion**: The aim of this modification is to avoid the tendency of the eye socket to compress during impression taking and to achieve a natural contour of the eyelid convexity because of the absence of the tray handle so the patient can close their eyes. **Conclusion**: This technique produces an ocular prosthesis that has a good retention with excellent aesthetic result.
Keyword: enucleation, modified functional impression, ocular prosthesis

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

INTRODUCTION

The special sensory organs play significant role in daily lives. The most tragic and most commonly occurring loss of one of these sensory organs is that of eye. The disfigurement associated with the loss of an eye can cause significant physical and psychological problems. Thus, the replacement of the lost eye is necessary to promote physical and psychological healing for the patient and to improve social appearance.[1,2]

Loss of the eyeball can be caused by congenital anomalies, trauma and tumors. Surgical procedures in making ocular prosthesis are classified into 3 categories: evisceration, enucleation and exenteration. Evisceration is involved the removal of the contents of the globe leaving in place the sclera and sometimes the cornea. The prosthesis best suited for the evisceration defect is the custom cover shell or the scleral cover shell prosthesis. Enucleation is the removal of the entire globe after the extra ocular muscles and the optic nerve have been transected. The prosthesis best suited for the defect is conventional or implant supported ocular prosthesis. Exenteration is the removal of the entire contents of the orbit (entire eye and surrounding structures). This procedure is usually performed due to some form of malignant disease.[1-3]

Rehabilitation for the loss of eye is divided into two types: implants and ocular prostheses. Ocular prostheses are divided into stock eyes and custom ocular prostheses. In the case of enucleation if there is sufficient space for ocular prosthesis, the latest advance treatment is implant because it can provide retention and good appearance. Although implants are the best option, these treatments are expensive and cannot be afforded by everyone. Another best treatment alternative is a custom eye prosthesis because it can duplicate the anatomy of the eye defect properly and affordable.[4,5]

One of the successes in making ocular prosthesis is the accurate impression of the anatomical area of the eye defect. Numerous impression techniques have been described in the literature. Smith uses an existing custom eye as impression tray using the relain technique. The advantage of this technique compared to other techniques such as stock ocular eyes is that the eye contour is already formed in both the intaglio and anterior regions so it can produce accurate eye impressions.[6]

CASE

A 39-year-old male patient came to dental hospital Universitas Sumatera Utara with chief complaint an unaesthetic and loose left stock eye that

had been used for 10 years. The patient experienced sharp trauma to his left eye when he was 29 years old and the entire eyeball was removed at the Zainal Abidin General Hospital in Banda Aceh and after recovering the patient used stock eyes.

On clinical examination of the intraocular tissue (Fig.1), the orbital socket mucosa was in good health, the depth of the eye socket was deep, especially in the superior palpebral area, there was ptosis, lower eyelid laxity, and excessive mucus (the patient rarely opened and cleaned the stock eyes).

Figure 1 Extra and intra ocular examination

MANAGEMENT

The primary impression is done with a tray that made using self-cured acrylic which is shaped in such a way using the thumb and adjusted to the contour and size of the eye socket. After the acrylic setting time is complete, then a handle tray and holes are made for retention. The tray is smoothed and polished (Fig. 2).

Figure 2 Primary tray

Figure 3 primary impression

The tray is tested on the patient. The hydrocolloid irreversible impression material (Alginate) is inserted into the syringe, the tray is placed into the socket and then injected. The patient was seated in an upright position and 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.3). After the material set, the tray is removed and the remaining impression material is cleaned from the socket.

The surface of the intaglio tray impression is planted in a small mold containing half of the dental stone to the anterior posterior edge of the mold and allowed to be harden. After the dental stone hardens, make key holes in the medial and lateral canthus. Apply vaseline on the upper surface and then pour back the dental stone as the antagonist and allow it to harden, make a key hole on the top surface of the antagonist model, a hole is made as an entrance for the melted wax (Fig.4).

Figure 4 Mold making

Figure 5 Clear acrilyc sclera

Making scleral wax; the surface of the mold is moistened with water and then the molten wax is poured into the mold. Then wax pattern is shaped by the natural convexity of the eye with the highest part of the convexity located in the pupillary area. Trial on patients to get the shape of the eyeball that best fit the natural eye. After everything have been matched, the surface of the wax pattern is smoothed.

To make temporary sclera with clear acrylic material, place half of the sclera wax in the lower flask which has been filled with putty impression material, wait till set and make a key hole then cup upper flask and fill it with putty impression material then close and press until the material sets. Remove the sclera wax and fill it with clear acrylic material then press and wait for it to set. Remove excess on the sclera and polish and perform a trial on the patient. Note the convexity and retention of the transient scelera (Fig.5).

Modified functional ocular impression used clear acrylic scelera. After try in the acrylic sclera

on the patient, the intaglio surface of the sclera is reduced by 2 mm then apply adhesive tray material and then using light body impression material on the acrylic sclera and insert it back into the eye socket. Instruct the patient to perform physiological eye movements such as moving the eyes to the right, left, up, down, closing and opening the eyes. With this technique, an accurate impression of the anatomical part of the defect area and natural eye convexity is obtained (Fig.6).

Figure 6 Functional ocular impression

Then the sclera was planted in mold the same as before to get a definitive mold for making sclera wax. The final sclera wax is put to try on the patient. The patient's eye convexity, eye movement and retention was evaluated.

Figure 7 Pupil midpoint determination

Determination of the position of the midpoint of the pupil using the interpupillary distance (IPD) ruler (Fig.7). First, determine the midpoint between the medial canthus of the left and right eyes as the guide point for the IPD ruler, marked with a marker, then the position of the midpoint of the right pupil is adjusted to the position of the midpoint of the pupil of the left eye. In this patient, the distance from the IPD ruler guide point to the midpoint of the original pupil was 3.1 cm. The diameter of the iris was determined (11.5 mm), then the circle is colored with a marker on the entire iris.

The iris coloring uses a paper iris disk technique with modifications (the paper material is replaced with a black disk of the doll's eye) using acrylic paint with a mixture of brown and black colors adjusted to the color of the iris of the other eye, and then planted in the mold and then packaged using heat cure clear acrylic to get the iris button. Then the iris button is inserted in the scelera wax according to the midpoint obtained and a trial is performed on the patient (Fig.8)

Figure 8 Trial sclera and iris

Figure 9 The ocular prosthesis

Making the sclera of the eye by replanting the sclera wax that already has the iris button back into antagonist of the cuvet (in the iris button, plus the acrylic rod, so that the iris button does not rotate when boiling) then cup the top of the flask and fill it with type IV dental stone, close and press. Evaluate convexity, eye movement and retention of the scelera. When it has been adequate, the anterior surface can be reduced by 1 mm for clear acrylic and blood vessels. Then, the sclera was flasked and packed using white acrylic (Fig. 9)

The final prosthesis was fitted with full attention to appearance, comfortable and function (Fig. 10). The patient was given instructions on how to put on and remove the ocular prosthesis, care at home should be done with care and clean hands, the ocular prosthesis was removed at night and immersed in water. antibacterial solution. Recall were performed on days 1, 3, 7 post-insertion.

DISCUSSION

The disfigurement associated with the loss of an eye can cause significant physical and psychological problems. The loss of eye has a serious impact not only for patient but also on family members and the society. Most patient experience severe stress, especially when adapting to functional disability caused by eye loss and reactions from society. Therefore, restore the patient's quality of life depends on a good eye prosthesis.[1,2]

The main goals in performing maxillofacial rehabilitation are 1) restore aesthetics and cosmetics,

2) restore function (which is still acceptable), 3) protecting existing tissue, 4) the prosthesis provides therapeutic or healing effects, and 5) the prothesis provide psychological effects.[2]

Figure 10 The patient used his ocular prosthesis

At every stage of making an ocular prosthesis presented in this case, all of the objectives have been fulfilled. Protheses were made well and planned by maintaining orientation of functional move of the patient eyes. With the development of new materials and modifications of ocular impression techniques, the eye sockets can be recorded in detail, resulting in acrylic ocular prostheses that can be made with accurate fit and aesthetics.

A retentive ocular prosthesis is obtained from a detailed impression that can record anatomical of eye defects and eye convexity accurately so it can result ocular prostheses that are both functionally and aesthetically pleasing. In the enucleation procedure, after healing the eye socket will be found a soft tissue and easy to move. This situation will make the impression difficult because there is a tendency for this tissue to be compressed so that it will produce inaccurate printing.[1,2,7]

Smith in 1995 described the relaining procedure on existing ophthalmic prostheses using Korecta wax no. 4 and performing functional impressions and concluded that the functional reline impression technique resulted in retentive prosthesis adaptation and improved patient appearance and psychology.[6] With the development of impression materials such as flexible impression materials, it will be advantageous when the defect extends beyond the orbital region and can overcome with moving mucosal tissue. According to Turne, "light body printing materials have good biocompatibility and good dimensional stability so that they are very accurate in eye printing compared to alginate."[1,7]

Based on the impression technique described by Smith and the latest developments in printing materials, this paper modifies the impression technique with a functional method using self-curing clear acrylic sclera which acts as a tray with a 2 mm reduction in the intaglio portion and using light body impression material as an impression material.

Compared to stock eyes, custom eye prostheses provide the best compatibility with ocular tissues because provide good adaptation, thereby reducing irritation, infection or fluid accumulation at the prosthesis-tissue interface. Due to the tight adaptation to the underlying tissue, it can result in better mobility of the prosthesis, uniform pressure distribution and reduced incidence of conjunctival abrasion and ulceration compared to the stock prostheses. Control over the orientation, color, contour, and size of different parts of the eye, resulting in facial symmetry and superior aesthetics.[3,9,10]

It is concluded that the functional imprinting technique that has been modified in this case allows the eye prosthesis to move simultaneously following the patient's original eye without being separated by this movement due to the close contact between the eye prosthesis and the eye socket thereby improving the appearance of the eye. Because there is no handle of tray on the anterior aspect ensures that the outer eye contour resembles that of the adjacent normal eye. This results in excellent aesthetics and functionality. This technique has given good results from both the patient.

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Prosthodontic and comprehensive treatment of temporomandibular disorders

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ABSTRACT
Temporomandibular disorder (TMD) is the common term used to describe a range of disorder affecting the temporomandibular joint (TMJ). Facial pain is a common symptom that patients present to their dentist, and TMDs represent a significant proportion of the non-dental causes of this pain. These disorders can have a profound effect on a patient's quality of life. The management goals for the prosthodontist are patient comfortable, occlusal stability and the complex restoration of the teeth.
Keywords: temporomandibular joint, temporomandibular disorder, TMD treatment, occlusal appliance

INTRODUCTION

Temporomandibular disorder (TMD) is a general term used to explain various disorders that affect the temporomandibular joint (TMJ). Facial pain is the most common symptom that often occurs in patients when patients come to the clinic, and pain in TMJ disorders is caused by non-dental. This disorder can have a considerable effect on the quality of life of patients.[1]

Patients who have TMD can present with a range of different symptoms; these include diffuse pain–typically intermittent in nature and often reported in several areas of the head and neck; tenderness or pain in muscles of mastication; limited mouth opening and locking of the jaw; painful of teeth (wear facets may be noted on tooth surfaces); and clicking or crepitus sounds when TMJ is in function.[1]

Therapeutic approaches to the TMJ disorders must be directed to reduce the main signs and symptoms of the condition. In the majority, patients who have disorders in the TMJ must be encouraged to be able to carry out early self-management that can help control symptoms and limit functional disorders. However, pain is the main cause of this pathological state, and this is the main reason patients seek medical treatment.[1,2]

Conservative treatments for TMD include medication, physiotherapy, occlusal splints, self-management strategies, and interventions based on cognitive behavioral approach. At present, a conservative treatment approach prevails over surgery, given it is less aggressive and usually result in satisfactory clinical outcomes in the mild-moderate TMD. In fact, the evidence for the greatest effectiveness of surgical versus conservative intervention to reduce short-term pain in arthrogenic TMD is controversial and inconclusive.[2]

Treatment of TMD begins with anamnesis and a thorough examination. Signs and symptoms in TMD can generally be directly identified; however, it is important to pay attention to other diagnoses that can resemble or occur simultaneously. There are certain signs & symptoms that are categorized into "red flag".[3]

Certain signs and symptoms that are categorized into "red flag" need to be considered and if found, they must be all the way to refer to more competent practitioners. It must be noted that the symptoms which are a red flag category have a special type of examination and a different treatment than generally. When the signs and symptoms found are not categorized into red flag, treatment can be done conservatively.[3]

Majority of patients with TMD need to be given non-invasive handling that can relieve symptoms rather than patients. TMD almost resemble rheumatological disorders; and it is still unknown to the cause rather than TMD so that the signs and symptoms can be more severe. So, it is necessary to be given direct handling to avoid invasive and irreversible treatments.[4]

So, it is very urgent to understand prosthodontic and comprehensive treatment of temporomandibular disorders.

CONSIDERATIONS IN THE TMD

Accurately diagnosing and treating TMDs can be a difficult and confusing task. This is often true primarily because patient's symptoms do not always fit into one classification. All the treatment methods being used for TMDs can be categorized generally into one of two types, namely definitive treatment or supportive therapy. Definitive treat-

ment refers to those methods that are directed toward controlling or eliminating the etiologic factors that have created the disorder. Supportive therapy refers to treatment methods that are directed toward altering patient symptoms but often do not affect the etiology.[5] Definitive therapy is aimed directly toward the elimination or alteration of the etiologic factors that are responsible for the disorder. Definitive treatment for an anterior displacement of the articular disc will reestablish the proper condyle-disc relationship. Since it is directed toward the etiology, an accurate diagnosis is essential. An improper diagnosis leads to improper treatment selection.[5]

Supportive therapy is directed toward altering the patient's symptoms and often has no effect on the etiology of the disorder. A simple example is giving a patient aspirin for a headache that is caused by hunger. The patient may feel relief from the headache, but there is no change in the etiologic factor (hunger) that created the symptom. Supportive therapy is directed toward the reduction of pain and dysfunction. The two general types of supportive therapies; they are pharmacologic therapy and physical therapy.[5]

Durham et al categorize some signs and symptoms in orophacic pain, which can resemble TMD. This category is referred to as "red flag" covers 1) previous history of malignancy-could indicate new primary, recurrence, or metastases; 2) persistent or unexplained neck lump or cervical lymphadenopathy–may indicate a neoplastic, infective, or autoimmune cause; 3) neurological symptoms, for example, headache or cranial nerve abnormalities with sensory or motor function change-may indicate an intracranial cause, or malignancy affecting cranial nerve peripheral branches; 4) facial asymmetry, facial swelling, or profound trismus-may indicate a neoplastic, infective, or inflammatory cause; 5) recurrent epistaxis, purulent nasal discharge, persistent anosmia, or reduced hearing on the ipsilateral side-may indicate nasopharyngeal carcinoma; 6) unexplained fever or weight loss–may indicate malignancy, immunosuppression, or other infective causes, for example, septic arthritis; 7) new-onset unilateral headache or scalp tenderness, jaw claudication, and general malaise, if the person is more than 50 years of age-may indicate giant cell arteritis; and 8) occlusal changes-may indicate neoplasia rheumatoid arthritis, trauma, or bone growth around the TMJ, for example, acromegaly.[1]

Signs and symptoms categorized into "red flag" need to be considered and if found, they must be all the way to refer to more competent practitioners. It must be noted that these red flag symptoms in isolation should prompt their own line of enquiry and management. When red flags have been considered and confidently excluded, the mainstay of treatment for majority of people is conservative.[3]

Treatment for TMD is categorized into two types namely definitive care and supportive care. But it must always be remembered that this supportive treatment is only symptomatic and not a substitute for definitive care. The etiological factors need to be addressed and eliminated so that long-term care success will be achieved.[5]

TREATMENT OF TMD

The main goals of treatment for TMD are to reduce or eliminate pain and or joint noises, and to restore normal mandibular function, that is best achieved when other contributing factors such as stress, depression and oral parafunctional habits (ie., bruxism) are addressed and incorporated into the overall treatment strategy. It is essential for the clinician to establish whether the fundamental problem is physical or psychogenic, as this will dictate treatment.[6]

Explanation and reassurance

The initial step in the management of TMD is to explain to patients the causes and nature of the disorders they faced, then convince them of the benign nature of the situation. It must be explained to patients that this disorder is not life-threatening for the patient, not like cancer, and but this disorder can be chronic in nature. Then explain to patients this TMD can be treated.[6]

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Education and selfcare

The next step is to formulate a self-care routine which should include the following; limitation of mandibular function, habit awareness and modification, a home exercises program and avoiding stress. Voluntary limitation of mandibular function (i.e., avoid excessive chewing and talking) is encouraged to promote rest or the immobilisation of muscular and articular structures, much the same

as an athlete would rest an injured joint. Hence, the patient is advised to maintain a soft diet and avoid foods where a considerable amount of chewing is involved;[6] 1) soft diet: existing pain in the mastication system often limits functional range of mandibular movements. Therefore, if possible, painful movements should be avoided. In addition, this should be avoided because it can improve symptoms of the disorder through the effects of central excitatory and cyclic muscle pain. Patients are given instructions to move their mandible in a range that does not provide pain. It means that the type of food must be changed. Patients are encouraged to eat softer diet, bite less, and generally chew slowly (Fig.1);[5] 2) jaw rest (especially in long dental


BREAKFAST IDEAS
Egg (cooked any way)
Cottage cheese
LUNCH OR DINNER IDEAS
Cottage cheese, yogurt
Soft vegetables
Soup, any kind
Pasta
Macaroni and cheese
Chinese food
DESSERTS IDEAS
Ice cream
Jell-O
Anything blended
Pudding
Baby food
Smoothies, milkshakes
FOODS TO AVOID
Gum
Carrots (any crisp vegetables)
Chewy pizza crusts and breads
Bagels
Nuts
Crisp, crunchy crackers
Nuts, peanuts, corn nuts, grape nuts
Tortillas and other dried fruits
Popcorn, crunchy chips

Figure 1 Suggested patient education form for instructtions on a soft food diet.[5]

treatments): after checking hard tissue and initial handling, soft tissue in the joints also needs to be evaluated. Treatment in soft tissue will increase according to the severity of the symptoms. If there is no significant change in the range of movements and slight pain, the patient is asked to reduce use, start a soft diet and generally rest the jaw for two weeks. Patients should be reminded not to chew gum and if possible, reduce parafunctional activity. Patients are instructed to return to clinic if there is an increase in pain and an appointment is made for re-evaluation within 2 weeks;[5] 3) avoid excessive jaw movements: Patients must also be instructed not to evaporate widely, sing, chew gum, and other activities that can improve the function of lower jaw movements;[5] 4) topical heat and coolant therapy: The modality of physical therapy must be done carefully because manipulation of therapy can increase pain. Sometimes stimulation of hot sensations can help. In some patients, cold sensations are more helpful. Patients themselves can know which is better at reducing their pain. Like warm therapy, cold therapy has proven to be a simple and often effective method for reducing pain. Being subjected to a cold sensation can relax the muscles that are spasms, thereby reducing pain. Application is carried out directly into the pain area and transferred by a circular motion without emphasis. When numb starts to feel, stop immediately and do not leave on the tissue for more than 5 to 7 minutes. After a period of heating and cooling, a second application may be needed (Fig.2);[5] 5)avoid

Figure 2 Heat and coolant therapy.[5]

stress and anxiety: Some TMD are etiologically related to certain emotional states. The emotional stress is certainly one of several psychological factors that need attention. Increased levels of emotional stress can affect muscle function by increasing rest activity (protective co-contracting), increasing bruxism or both. Increased emotional stress also activates the sympathetic nervous system, which itself can be a source of muscle pain. One anxiety disorder that might be considered the most difficult by clinicians is obsessive compulsive disorder. This disorder has been shown to increase TMD in patients.[5]

Medicament

Anti-inflammatory can be used when clinicians suspect tissue inflammation such as with capsulitis, retrodiscitis, or osteoarthritis. This type can suppress the body's overall response to irritation. Anti-inflammatory can be given orally or by injection. The main class of oral anti-inflammatory drugs is nonsteroidal anti-inflammatory drugs (NSAIDs). This drug is effective for mild to moderate inflammatory conditions and postoperative acute pain (Fig.3).[5]

When high levels of emotional stress are considered to contribute to TMD, anxiolytic agents (antianxiety) can help in managing symptoms. Remember that the anxiolytic agents do not relieve

stress but only change the patient's perception or reaction to stress. Therefore, the use of anxiolytic agents is a supportive treatment. The commonly used anxiolytics group is benzodiazepines. Can be prescribed every day but, there is a possibility for dependency, it should not be used for more than 7 consecutive days (Fig.4).[5]

Muscle relaxants have been prescribed to patients with TMD for years although most clinicians agree that their effectiveness is minimal. Most of the muscle relaxants have a central effect, which soothes the patient. Perhaps this sedation is the main explanation of the positive response for some patients.[5]

Although tricyclic antidepressants were originally developed for depression management, the latest developments from selective serotonin reuptake inhibitors (SSRIs) have proven to be far more effective.[5]

Jaw physiotherapy

Massage and stretching; deep massage can be more useful than gentle massage in restoring normal muscle function. However, this deep massage must be carried out by a physical therapist. Deep massage itself can help mobilize tissue, increase blood flow to the area, and eliminate trigger points. To increase the effectiveness of deep massage, patients should be given heat stimulation 10-15 minutes before starting the massage. Deep massage tends to relax muscle tissue, and reduce pain (Fig.5A).[5]

Figure 5A Massage therapy; **B** TENS therapy.[5]

Transcutaneous electrical nerve stimulation (TENS), produced by continuous stimulus from the nerve fibers at mild pain levels. When TENS units are placed in areas of painful tissue, electrical activity reduces pain perception. TENS uses low voltage, low ampheres, biphasic currents with varying frequencies and is designed primarily for sensory counter stimulation of painful disturbances (Fig.5B).[5]

Type of Antiinflammatory	Generic Name	Trade Name	Average Daily Dose	Maximum Daily Dose
Paracetamol	acetaminophen	Tylenol	325–1000 mg q4h	1 g/dose 4 g/day
Salicylates	acetylsalicylic	Aspirin	325–650 mg q4h	4 g/day
	diflunisal	Dolobid	250–500 mg bid	1500 mg/day
Propionic acid derivatives	ibuprofen	Motrin, Advil	400–800 mg tid or bid	3200 mg/day
	naproxen	Naprosyn	250–500 mg bid	1500 mg/day of 3–5 days
	naproxen sodium	Anaprox	275–550 mg bid	1650 mg/day of 3–5 days
	ketoprofen	Orudis	50–100 mg tid,	300 mg/day for 2 weeks
	oxaprozin	Daypro	600–1200 mg /day	1800 mg/day
	meloxicam	Mobic	7.5–15 mg /day	15 mg/day
	etodolac	Lodine	300–500 mg bid	1000 mg/day
	diclofenac	Voltaren	25–50 mg tid	200 mg/day
Cyclooxygenase-2 inhibitors	celecoxib	Celebrex	100–200 mg qid or bid	400 mg/day
Corticosteroid	methylprednisolone	Medrol Dosepak	4 mg for 6 days	Each day the dose is decreased
NSAID	ketorolac tromethamine	Toradol	10 mg q 4–6 h	40 mg/day No more than 5 days

bid: twice a day; g: grams; h: hours; mg: milligrams; tid: three times a day

Figure 3 Common anti-inflammatory medications used for TMD.[5]

Generic Name	Trade Name	Average Daily Dose	Maximum Daily Dose
cyclobenzaprine	Flexeril	10 mg tid	60 mg/day
metaxalone	Skelaxin	800 mg 3–4 times a day	2400 mg/day
methocarbamol	Robaxin	1000 mg qid	8000 mg/day
baclofen	Lioresal	5mg tid, gradual increase to reach efficacy	80 mg/day (withdrawal slowly)
cerisoprodol	Soma	250 mg tid	1400 mg/day max 2–3 weeks
chlorzoxazone	Paraflex Forte DSC	250–500 mg tid	1500 mg/day (750 mg max single dose)

mg: milligrams; tid: three times a day; qid: four times a day

Figure 4 Common muscle relaxants used for temporomandibular disease.[5]

Low-level laser therapy (LLLT)

Among the various physical therapy modalities, LLLT has recently been put under the spotlight because of its easy application, short treatment time, and few contraindications. Many prospective clinical trials have been performed to evaluate the efficacy of LLLT. In addition, LLLT can also improve functionality rather than TMJ.[7]

The use of LLLT has been considered as a complement to treatment options in handling TMD which is maintained to provide responses that resemble analgesics, anti-inflammatory, and regenerative effects, without any side effects being reported and can be well received by patients.[7]

During TMD treatment with LLLT, laser type variability, frequency, dosage, exposure time, application area, number of laser sessions, and duration of therapy can increase the heterogeneity of the treatment effect. However, research is needed to look at different laser parameters of type, treatment regimen, evaluation time, and outcome measures so that they can be used better. This treatment is maintained as noninvasive, safe, easy to use, and inexpensive.[7]

Occlusal appliance therapy

Occlusal appliance can also help in reducing certain etiological factors. When malocclusion is suspected as a cause of TMD, occlusal appliance therapy can quickly and reversibly produce more desirable occlusal conditions. If it does not affect the symptoms, malocclusion is most likely not an etiological factor and of course the need for irreversible occlusal therapy must be questioned. The success or failure of occlusal appliance therapy depends on the selection, fabrication, and adjustment of the patient's tools and cooperation.[5]

The reversible occlusal therapy temporarily changes the patient's occlusal condition and is best done with occlusal appliance. An acrylic device used on teeth in one of the jaws to create and change position of the mandible and tooth contact patterns. The exact position and occlusion of the mandible will depend on the etiology of the disorder. If you want to treat parafunctional activity, the appliance will provide mandible and occlusion positions that meet the criteria for optimal occlussal relations. So, when the appliance is being used, the occlusal contact patterns are in harmony with the optimal condyle-discus-fossa relationship for the patient. Therefore, this appliance provides orthopedic stability. This tool has been used to reduce symptoms associated with various TMD as well as reduce parafunctional activity.[5]

Irreversible occlusal therapy is a permanent treatment in changing occlusal conditions and or mandible positions, for examples selective gritting of teeth and restorative procedures that change occlusal conditions. Appliance designed to permanently change mandibular growth or repositioning is also considered irreversible occlusal therapy. When treating patients, one must always pay attention to complexity rather than TMD. Therefore, reversible therapy is always indicated as an initial treatment for TMD patients. The success or failure of this treatment can help determine the need for irreversible occlusal therapy. If the patient successfully responds to reversible occlusal therapy (stabilization tool), there seems to be an indication that irreversible occlusal therapy can also help.[5]

Types of occlusal plane

Stabilizing splint is one of the most-commonly-used splints. Also called *Michigan splint*, muscle relaxation appliance or gnathologic splint and it's usually made for upper arch. This splint has least adverse effect.[8]

This stabilization can take the form of wearing full arch nighttime occlusal protective devices for patients who have grinding, clenching, or bruxism habits that erode teeth or imperil prosthetic restorations.[9] Outcome of stabilizing splint also depends on certain factors among which only continuous use of this splint can cause reduction in symptoms of TMD. As concluded by results wearing splint for 24 hours per day results in occlusal stabilization.[8]

Stabilization appliance can help minimize forces to damaged tissues and permitting more efficient healing. These are the following steps in making this appliance, a) impression used alginate. Impression should be free of bubbles and voids on the teeth and palate. It should be poured immediately with die stone gypsum. When the stone is set, cast is withdrawn from the impression and should be free of bubbles and voids; b) excess stone on labial portion is trimmed to the depth of the vestibule. With a pressure or vacuum adapter, a 2-mm-thick, hard, clear acrylic resin sheet is adapted to the cast. Some products offer a dual-sided acrylic resin sheet with a soft side for the teeth and a hard side on which to develop the occlusion. This 2.5 mm thick should be considered since it offers good retention and comfort during treatment; 3) the outline of the appliance is cut off the cast with separating disk. The cut is made at the level of the interdental papilla on the buccal and labial surface of the teeth. The posterior pa-

latal area is cut along a straight line connecting the distal aspects of each second molar; d) appliance is then removed from the cast. Hard rubber wheel can be used to eliminate excess acrylic in the palatal area; e) the lingual border is extended 10-12 mm from the gingival border of the teeth. A large acrylic bur is used to smooth rough edges. The labial border is terminated between the incisal and middle thirds of the anterior teeth. (The border around the posterior teeth may be slightly longer). It is safer to leave the border a little longer because if the appliance does not completely seat intraorally, the borders can be shortened until the appliance is fit; f) a small amount of clear self-curing acrylic resin is added to the occlusal surface of the anterior portion. This acrylic will act as the anterior stop, with the size approximately 4 mm wide and should extend to the region where a mandibular anterior central incisor will contact; g) evaluation is done intraorally. Appliance should fit, offering adequate retention and stability. Lip and tongue movement should not dislodge it. When pressure applied, it should not cause tipping or loosening. If the borders of the appliance have been maintained near the junction of the middle and incisal thirds on the facial surfaces of the teeth, adequate retention will be achieved; h) if it does not seat completely, it can be manipulated by heating it extra orally with a hair dryer and reseated on the teeth. This will help achieve a well-fitting appliance. Care must be taken not to overheat the plastic or all shape may be lost.[5]

For the stabilization appliance to be effective optimally, condyles must be located on their most musculoskeletally stable position, which is centric relation (CR).[5] Two techniques have become widely used for finding CR, namely 1) bilateral manual manipulation technique. The bilateral manipulation suggested by Peter Dawson in 1974, is the method that has been largely utilized by those who adhere to functionally generated path techniques. They have suggested that the condyles do not always move superiorly, but sometimes, in response to posterior guidance from the operators, they move inferiorly. They emphasized the importance of superior placement of the condyles in the fossa when attempting to record CR.[10]

The bimanual manipulation technique was performed by placing both operator's hands under the subject's mandible. Slight superior pressure was applied at the gonial angle and inferior pressure at the mandibular symphysis, little effort is utilized in gaining a posterior placement. An attempt is made to obtain an arcing motion of the mandible in its most superior position guiding the mandible into registration material. This registration material was allowed to harden and removed from the subject's mouth.[10,11]

2) by placing a stopper on the anterior region of the appliance and the muscles are used to locate the musculoskeletally stable position of the condyles. This point is achieved by placing an occlusal stop in the anterior of the mouth and asking the patient to attempt to close on the posterior teeth. Without posterior tooth contacts, the elevator muscles will allow the condyles to be place into their musculoskeletally stable positions and it can be accomplished with a leaf gauge. The concept behind leaf gauge is when only the anterior teeth occlude (disengaging the posterior teeth) the directional force provided by the elevator muscles (temporalis, masseter, medial pterygoid) seats the condyles in a superoanterior position within the fossae.[5]

The anterior stop provided by the leaf gauge acts as a fulcrum, allowing the condyles to be pivoted to musculoskeletal position in the fossae. Leaf gauge must be used carefully so the condyle will not be deflected away from CR. If the leaf gauge is too rigid, it may provide a posterior slope deflecting the mandible posteriorly as the elevator muscles contract. Another mistakes may result if patient attempts to bite on the leaf gauge in a slightly forward position as this will lead to protruding of the mandible from the CR position.[5]

Anterior positioning appliance

The anterior positioning appliance is an interocclusal device that encourages the mandible to assume a position more anterior to the intercuspal position. It may be useful for the management of certain disc derangement disorders since anterior positioning of the condyle may help provide a better condyle-disc relationship, thus allowing better opportunity for tissue adaptation or repair. This appliance is used to temporarily position the condyles more anterior then their musculoskeletally stable position to relieve the existing symptoms.[5,12]

Like the stabilization appliance, the anterior positioning appliance is a full-arch hard acrylic device that can be used in either arch. However, maxillary arch is preferred because a guiding ramp can be more easily fabricated to direct the mandible into the desired forward position. The steps in fabricating anterior positioning appliance are a) the appliance does not extend onto the labial surfaces of the teeth and hence is more esthetic than the stabilization appliance; b) the key to suc-

cessful construction of the appliance is in locating the correct anterior stop. It is made on the anterior part of the appliance by asking the patient to protrude his mandible and finding the position in which the clicking and the joint pain is relieved; c) sometimes, stoppage of the clicking alone does not indicate that the mandible is positioned anterior to the retrodiscal tissue. So, if symptoms fail to resolve, more advanced methods like arthroscopy and MRI may be used to ascertain the position of the mandible.[5,12]

Anterior bite plane

The anterior bite plane is a hard acrylic appliance worn over the maxillary teeth providing contact with only the mandibular anterior teeth. This appliance is intended to disengage the posterior teeth and thus eliminate their influence on the function of the masticatory system. Bite plane therapy should be used when there's a muscle disorder caused because of excessive loading of the musculature and hyper occlusion; this bite plate allow muscle to relax. It is suggested mostly in patients having muscle pain which could be acute/chronic. The appliance has been suggested for the treatment of muscle disorders related to orthopedic instability or an acute change in the occlusal condition. Parafunctional activity may also be treated with this but only for short periods of time.[5,8]

Posterior bite plane

It is a hard acrylic appliance, which covers the posterior mandibular teeth and is usually fabricated for mandibular teeth and connected by a cast lingual bar. The objective of this appliance is to bring about changes in the vertical dimension and the mandibular positioning. This appliance has been advocated in cases of severe loss of vertical dimension or when there is a need to make major changes in anterior positioning of the mandible. The use of this device may be helpful for certain disc derangement disorders, although it has not been studied well for this condition.[5,12]

Pivoting appliance

The pivoting device is fabricated with hard acrylic resin that covers the maxillary or mandibular arch with a single posterior occlusal contact, placed as far posteriorly as possible, in each quadrant. When superior force is applied under the chin, the tendency is to push the anterior teeth close together and pivot the condyles downward around the posterior pivoting point. This appliance was originally developed with the idea that it would reduce interarticular pressure and thus unload the articular surfaces of the joint. This was thought to be possible when the anterior teeth moved closer together, creating a fulcrum around the second molar, pivoting the condyle downward and backward away from the fossa. This appliance was suggested for patients with internal derangements or with osteoarthritis. Unfortunately, a potential adverse effect with the use of this modified appliance may cause occlusal changes as a posterior open bite in pivot area.[5,13]

Soft or resilient appliance

It is fabricated from resilient material and is usually adapted to the maxillary teeth. The main aim is to achieve even and simultaneous contact with the opposing teeth. This appliance is worn during nighttime only. They can provide relief within 6 weeks. The goal of this treatment is to achieve even and simultaneous contact with the opposing teeth. In many cases, this is difficult to accomplish since most of the soft materials are difficult to precisely adjust. The most common indication is as a protective device for persons likely to receive trauma to their dental arches. Protective athletic splints decrease the likelihood of damage to the oral structures when trauma is received. Soft appliances have also been recommended for patients who exhibit high levels of clenching and bruxism.[5,14]

Cognitive behavioral therapy

Patients with chronic TMD usually present associated psychological factors that should be managed with specific interventions. This therapy is one of the treatments proposed to manage patients' thoughts, behaviours, and or feelings that might exacerbate pain symptoms. It is a non-invasive therapy and unlikely to have adverse effects. This can be in the form of lifestyle counseling, relaxation therapy, hypnosis, and biofeedback.[2,6]

Psychotherapy

Occasionally TMD may be the somatic expression of an underlying psychological or psychiatric disorder such as depression or a conversion disorder. Clues to this possibility are when strange symptoms are reported, the patient demonstrates odd behavior, or the patient's suffering appears to be excessive or persistent beyond what would normally be expected of the condition itself. In these cases, psychiatric referral is a mandatory part of the overall management strategy.[6]

Absolute indications
1 Ankylosis – eg. Fibrous or osseous joint fusion
2 Neoplasia – eg. Osteochondroma of the condyle
3 Dislocation – ie. Recurrent or chronic
4 Developmental disorders – eg. Condylar hyperplasia
Relative indications
1 Internal derangement
2 Osteoarthrosis
3 Trauma
A General indications
i Disorder not responding to non-surgical therapy
ii Where the TMJ is the source of pain and dysfunction
a Pain localised to the TMJ
b Pain on functional loading and movement of the TMJ
c Mechanical interference with TMJ function
B Specific indications
i Chronic severe limited mouth opening
ii Advanced degenerative joint disease with intolerable symptoms of pain and joint dysfunction
iii Confirmation of severe joint disease on CT scan or MRI

Figure 5 Indications for surgical treatment of the TMJ. The types of surgical procedures that can be performed on TMD are **a**) closed procedures; namely TMJ arthrocentesis and TMJ arthroscopy, and **b**) open procedures; namely TMJ arthrotomy/arthroplasty and TMJ joint replacements.

Other

Acupuncture, botox injections, chiropractic/ osteopath jaw manipulation and other treatments have been tried in the management of TMD but have not been accepted in general practice due to lack of evidence in the effectiveness of these therapies. Stimulation of specific areas (or acupuncture points) causes the release of endogenous opioids (endorphins and enkephalins), which reduce pain sensation by flooding afferent interneurons with subthreshold stimulation. This effectively blocks the transmission of noxious impulses and thus reduces the sensation of pain. Intermittent stimulation of about two pulses per second appears to be effective in reducing discomfort associated with masticatory dysfunction.[3,6]

TMJ surgery

Specific indications for TMJ surgery include severe and chronic limited mouth opening and severe mechanical disturbances such as painful clicks and crepitus that fail to respond to nonsurgical measures.[5]

Treatment for TMD is categorized into two types, namely definitive care and supportive care. The main goals of treatment for TMD are to reduce or eliminate pain and or joint noises, and to restore normal mandibular function. Dentist must learn to correctly diagnosis and properly treat the acute orofacial pain condition with practical and evidence-based approach. Acute pain management is necessary to prevent an acute condi-tion from becoming a chronic pain disorder in the future.

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