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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Modified Suction-Effective denture technique for mandibular flat ridge

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Keywords: Closedmouth impression, Mandibular flat ridge, Suction denture, Suction-effective method

ABSTRACT

Aging is a universal, progressive physiological process affecting all living organisms, leading to the loss of bone, bone mineral density, and muscle in humans. The rate and extent of musculoskeletal decline vary due to factors such as diet, systemic diseases, medications, and clinical interventions. Prolonged denture use can lead to atrophy of the residual alveolar ridge, particularly in cases of a flat mandibular ridge, where achieving adequate denture retention and stabilization is challenging. Proper impression techniques play a crucial role in addressing this challenge. This report aims to describe the management of complete dentures in cases of mandibular flat ridges using a modified suction-effective method. A 70-year-old female presented for a complete denture following the extraction of her last upper left tooth. She had previously used removable partial denture around 3 years ago but has not used them since. Clinical findings revealed significant bone loss in the mandible, sufficient spongy tissue on the sublingual area, and panoramic examination classified the mandibular cortical index and bone density as C2. A centric tray was used to record the vertical dimension to fabricate the bite rim used for closed-mouth impression. Lingualized occlusion scheme was then used during denture fabrication to achieve a more stable denture. The suction-effective denture is an enhanced method for achieving retention and stability in patients with flat mandibular ridge. Creating a good peripheral seal on all borders is crucial to achieve the suction effect, which can be facilitated through proper planning and impression technique. (IJP 2025;6(1):1-5)

Introduction

Tooth loss has always been an issue all over the world, especially on elderly patients. Somehow it is an inevitable phenomenon due to aging, and it can cause several problems such as decrease in the masticatory function, speech, profile and affect social aspect in the individual, which eventually leads to reduction of their quality of life.[1] Anatomic changes on the alveolar ridge will always occur following dental extractions. Once teeth are extracted, the whole distribution is changed. Alveolar bone can only tolerate masticatory load to a certain extent. By time, the long term-effect of denture wearers is the atrophy of the residual alveolar ridge or what so called reduction of residual ridge (RRR).[2] The most common problem in treating edentulous patients, especially in elderly patients, is the highly resorbed mandibular ridge.[3] The rate of resorption is related to anatomic, metabolic, functional and prosthetic factors, which involve the osteoblast and osteoclast, where mandible is twice more prone to resorb compare to maxilla. The lower residual ridge is classified by the amount of remaining alveolar bone:[4]

Class I: Alveolar ridge have an adequate height for denture support and able to resist lateral movement of the denture; Class II : Alveolar ridge has undergone some resorption, but still have enough bone to resist lateral shift of the denture; Class III: Alveolar ridge is almost or completely resorbed, where there is little or no resistance to lateral movement of the denture.

This report aims to describe the management of complete denture in case of mandibular flat ridge using a modified suction-effective method.

Case Report

A 70 years old female patient came to the Prosthodontic Clinic at Universitas Indonesia Dental Hospital to make complete denture. The patient has undergo her last tooth extraction on the upper left and had a history of using partial removable denture around 3 years ago but not been used since. She also has a history of diabetes and osteoarthritis, but are under control with routine medication taken. She wants to make a complete denture on both arch to improve her masticatory and aesthetic function. There were no abnormalities found on the extraoral examination. On the intraoral examination was found a fully edentulous ridge on both arch, with a quite significant bone loss and low ridge on the mandible with sufficient spongy tissue on the sublingual area. As it shown in figure 1, for the upper arch residual ridge was ovoid in every region with a sufficient height on the vestibulum. For the mandibular, the residual ridge was flat on the posterior lower left and right, with an tapering ridge and irregular surface on the anterior area.

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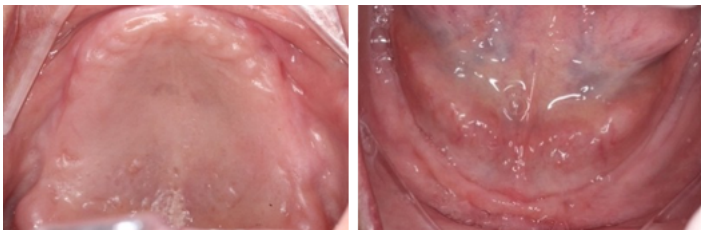

Figure 1. Intraoral condition

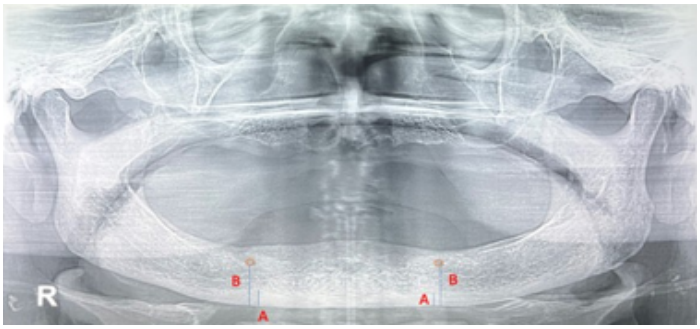

Figure 2. Panoramic radiograph

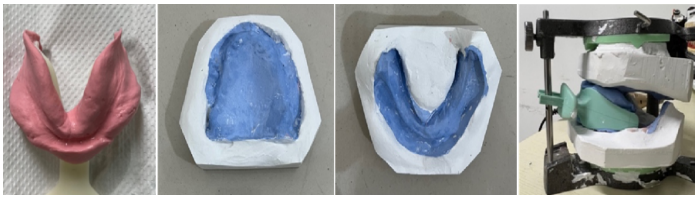

Figure 3. Mandibular ridge preliminary mpression with FCB tray ; study model and mounted on articulator with centric tray

Figure 4. Border moulding and result of result of close mouth impression

Figure 5. Vertical dimension measurement and facebow transfer

From the panoramic examination shown in figure 2, the distance from alveolar ridge to the maxillary sinus is 2mm and the distance from foramen mental to the lower alveolar ridge is 5mm. Mandibular cortical width on the left side was 6mm with PMI score 0.35 while the right side 7mm and PMI score 0.41. In summary, the density of the bone was classified as C2.

The first visit was to get the anatomical impression of the upper and lower arch and the preliminary vertical dimension occlusion (VDO). The preliminary impression of the mandibular ridge was taken with a frame cut back tray (Accutray, Ivoclar USA) and two consistency of alginate, the first one was the low viscous with high water ratio and injected into the mandibular ridge with the help of 10cc syringe, and the normal consistency was applied to the FCB tray. The result of the impression can be seen on Figure 3. Meanwhile for the maxillary ridge was taken with edentulous stock tray and normal alginate consistency. Frame cut back tray was chosen due to the mandibular atrophic ridge condition and can capture the anatomical condition for such case. The preliminary VDO was taken with the help of centric tray (Ivoclar, USA) and putty impression material and then mounted on the non-adjustable articulator (Handy II, Shofu, Japan) prior to fabrication of the custom individual tray figure 3.

On the second visit, the VDO was measured once again to reassure the occlusion vertical dimension. Border moulding was done arch by arch with green stick compound and close mouth technique, with passive and active movement done by the patients and with the help of the operator. Final impression was taken directly for both arch with the close mouth technique and light body polyvinylsiloxane impression material figure 4.

Beading and boxing was done to make sure all the borders can be seen clearly in order to fabricate the second bite rim. The second bite rim was made from the working model and the patient came again for the third visit to measure the correct vertical dimension and to do a facebow transfer figure 5. Midline, canine, and smile line was also marked on the bite rim prior to the tooth arrangement procedure.

Working cast was mounted on the semi-adjustable articulator (Bioart Articulator A7 Plus). Teeth arrangement was done with an occlusal scheme of lingualized occlusion and arranged directly for the anterior and posterior teeth due to patient's condition and limitation. The fourth visit agenda was to try in the teeth arrangement figure 6, record the neutral zone, and taking protrusive and lateral record to adjust the condylar and Bennett angle on the articulator.

For the final step, we do the gum cuffing, making post dam, packing, finishing, and polishing the denture is ready for insertion.

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Figure 6. **Try in teeth arrangement**

Figure 7. **Denture insertion**

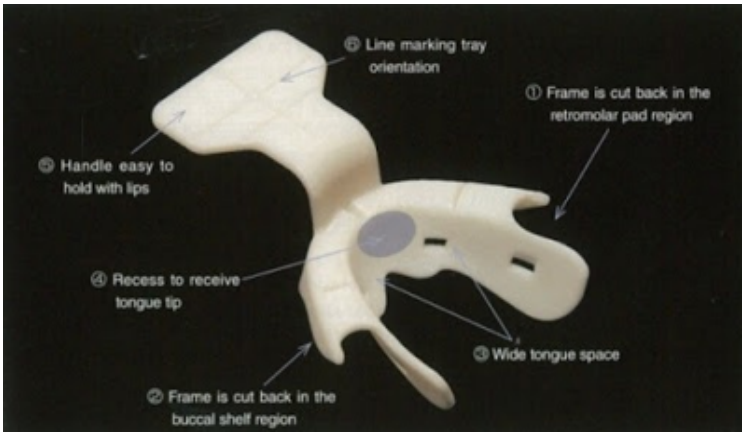

Figure 8. **Frame cut back tray**

Figure 9. **Preliminary VDO with centric tray**

Discussion

Residual ridge resorption is a complex biophysical process following dental extraction. Rapid resorption usually occurs in the first year after tooth extraction and progressively slower by time. Compromised ridges may be broadly classified as atrophic ridges, flabby ridges, knife edge ridges, and abused ridges. Atrophic ridges usually leads to an unstable and non retentive dentures because of its inability to bear the masticatory load.[5] Patient who has flat ridge and wear dentures often felt pain and discomfort due to vertical and horizontal movement.[6] A proper preliminary impression is needed to help fabricate the custom individual tray prior to the mucofunctional impression. It is important to obtain the maximum support area and peripheral seal, especially for such case where the patient have flat or atrophic ridges.[7] Frame cut back tray is a prefabricated tray with a special design used for flat ridge fully edentulous patient. The design itself enables the operator to capture the depth of the retromylohyoid due to its flange extension on the lingual area and the open area on the distal part of the tray helps to capture the retromolar pad under rest position and not deformed figure 8.[8]

There are basically two methods to record the VDO with the centric tray. The first one is by using the free way space method and the second method is to train the patient to blow air from the mouth. Since this is not the final VDO we want, it is determined 2-3mm above the patient's actual VDO to help fabricate the custom individual tray figure 9.[9] The centric tray was originally made by Ivoclar to link with the Stratos semi-adjustable articulator, but in this case we improvised by using the non-adjustable articulator Handy II to make the custom individual tray with wax rim according to the preliminary VDO. The bite rim individual tray was then prepared for the functional impression.

In suction-effective method, it is important to identify anatomical landmark from the diagnostic cast. There are 8 points the operator needs to understand:[9] Identify and mark the retromolar pads; Avoid the sinew string; Draw a line at the most inferior point of the buccal shelf; The line enters the retromylohyoid fossa passing 2-3mm beyond the mylohyoid muscle line; Avoid buccal frenulum; Avoid mentalis muscle attachment; Avoid the median inferior labial frenum; Draw a line on the convexity and avoid lingual frenum.

Sinew string is a mucosal string forms at the buccal root of the retromolar pad, posterior to the second molar, resembling a frenum or wrinkle figure 10.[10] It is somehow visible in only 10-20% of the edentulous patients. Somehow it is believed that the role of this string is to pull the buccal mucosa strongly inward during the swallowing process and it contributes the formation of BTC (buccal-tongue contact) point.[9]

After understanding the key points and anatomical landmark, fabrication of the custom tray should be easier:[9]

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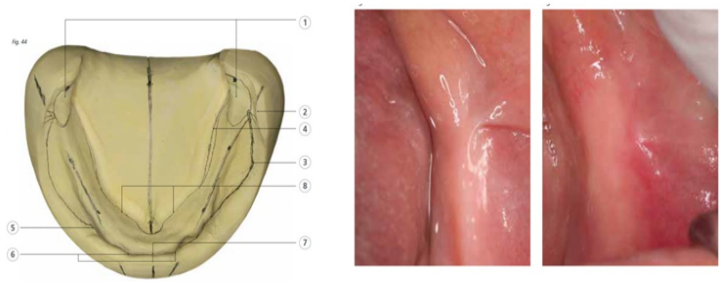

Figure 10. Anatomical landmark and outline ; intra oral image of sinew string

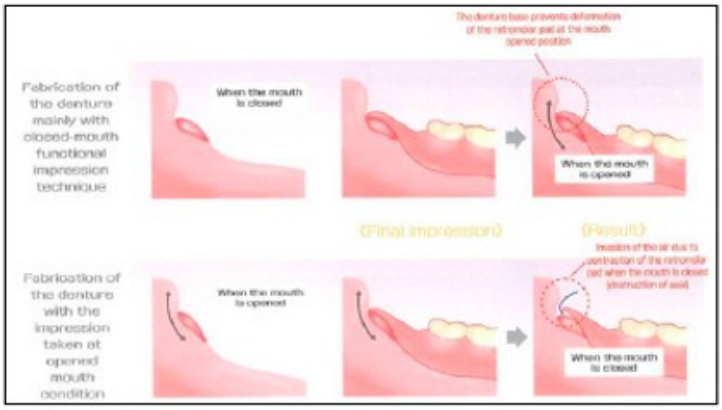

Figure 11. Illustration of the retromolar pad condition when mouth is open and closed

Figure 12. Normal occlusion, A. Lingualized occlusion, B. Lingualized occlusion in lateral movement

Cover the entire retromolar pad with a thin layer of resin; Sinew string must be avoided; Polished surface should be given a concave shape, especially on the second molar to the retromolar pad region; Wax rim should be positioned in the middle of alveolar ridge or in the neutral zone (buccolingually); Lingual polished surface should be shaped in such way to provide adequate space for the tongue; Mandibular anterior polished surface between lateral incisor should be given a concave shape.

The thickness of the tray itself should be sufficient enough especially in the sublingual fold region that can ensure a strong suction effect combined with the spongy tissue of the patient, and the labial region to ensure sufficient lip support.[9]

Basically, different materials can be used to record the border of the denture, such as with low fusing impression compound, waxes, elastomeric materials, acrylic resin, and tissue conditioner.[11] The most common materials used for border moulding are either the heavy body (elastomer material) using the one step or single step technique and the sectional technique with the green stick compound. For the maxillary arch, resistance to upward and forward force of the handle indicates a good posterior peripheral seal (PPS), while the resistance towards the downward, buccal, and lateral force of the handle indicates a good labial border extension and seal. For the mandibular tray, resistance towards the downward and forward indicates a good seal of the posterior area, and resistance of the upward force of the handle indicates a good labial border extension and seal.[12]

Close mouth impression technique is a method that rely only on the patient's movement. Patients need to fully understand and follow the instructions. This technique has advantage the advantage to minimalize the chance of over and under extension of the flange because the impression is done in an occluding position (optimal border moulding) and can record the the ridge in functional pressure. Meanwhile the disadvantage of this technique is it can cause pressure to the underlying structure, that it is contraindicated on flabby tissue.[13] The illustration shown on Figure 11 about the deformities of retromolar pad that can happen in open mouth impression. This method can create a negative pressure that seals the denture border all around.[14,15]

With the help of silicone adhesive and light body impression material, it can be done arch by arch or both arch together while the patient is instructed to say "woo", "eee", and instruct to move the tongue to the left and right. Patient is also instructed to swallow and make all movements while in the close mouth position.[9]

Retention and stability of the denture does not rely solely from the impression technique. The concept of occlusion for complete denture has to give an aesthetic yet a good masticatory efficiency, and the most important thing is the stability of the denture itself while in function.[16] An optimal occlusal scheme is essential to achieve a stable, retentive, and supporting denture. The fully bilateral balanced articulation (FBBA) has been considered as the ideal occlusal scheme for conventional complete denture.[17] As the residual ridge resorb to the point where ridge is classified as flat or atrophic, consideration in occlusal scheme plays an important role. In conventional denture setup, both buccal and lingual cusp of the upper and lower denture contact on the working side in lateral movement. This achieve the goal of bilateral balance occlusion and distributes the bite force as wide as possible to the jaw. On the contrary, lingualized occlusion is an occlusal scheme developed to enhance denture stability in patients with flat ridge. It somehow eliminate the stress of lateral force by eliminating the contact on the buccal cusp.[18,19] This occlusal scheme is developed to maintain the

masticatory mechanical function with the use of anatomic teeth on the upper jaw and semi or non anatomic teeth on the lower teeth.[20]

Lingualized occlusion is indicated in cases where high priority on aesthetic but a non anatomical tooth is needed, severe residual ridge resorption, class II jaw relationship, flabby supporting tissue, and when a complete denture opposes a removable partial denture. Few advantages of lingualized occlusion are figure 12:[19,20] Good cutting efficiency with a combination of anatomic and semi or non anatomic tooth; Limited amount of lateral forces due to small area of contact between maxillary palatal cusp and zero degree of mandibular teeth during lateral movement; Can be used for a variety of residual ridge conditions.

After combining all the technique from preliminary impression to the final tooth arrangement, the delivery of the complete denture results in satisfactory of the patient. The denture have a good retention and stability regarding the severely resorbed mandibular ridge. Few days after the insertion the patient was still adapting to the denture and several adjustment was done on the retromylohyoid flange due to its overextension intentionally made to compensate the complete seal, and patient can fully adapt after seven days of insertion.

Conclusion

Mandibular flat ridge has always been a challenge due to it's improper anatomical condition to maintain a stable and retentive denture. Mandibular suction effective method is a technique developed especially for such cases, differ the conventional method from the preliminary impression until the functional impression. Closed-mouth impression helps in capturing the intraoral condition under rest and functional movement. Modification of this technique such as the use of border moulding material and semi adjustable articulator can be used as long as we understand the basic concept of the technique, from the anatomical landmark to the practical technique that needs to be done. Lingualized occlusal scheme is basically just another concept that can increase the stability of the denture due to it's ability to minimalized the lateral force by using a combination of anatomical and semi or non anatomical teeth. For whatever the occlusal scheme chosen, the main goal is to achieve a retentive and stable denture which can restore both aesthetic and function for patients.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Improving obturator retention in hollow palatal defect using silicone soft-reliner

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Keywords: Hollow bulb, Obturator, Palatum defect, Soft-reliner

ABSTRACT

Defect in the intraoral maxilla or palate resulting from surgical hemimaxillectomy can lead to difficulties in chewing, speaking, swallowing, and may also affect psychological function. One effective rehabilitation method for restoring oral function is the obturator prosthesis. This case report discusses the rehabilitation of a palatal defect following hemimaxillectomy, utilizing a hollow bulb obturator with a silicone-based soft liner and incorporating extracted posterior teeth as immediate dental provisions for relining an interim denture. The patient, a 46-year-old male, presented at Universitas Gadjah Mada Dental Hospital with complaints of discomfort, instability, and inadequate palatal coverage from his prosthetic obturator after undergoing tumor removal in the right maxillary area two years earlier. Examination revealed a significant hollow defect under the palate, exposure of the inferior nasal conchae, and mobility in the first and second premolars on the right side. Panoramic radiographs indicated loss of ridge support around these teeth. To enhance retention and comfort, a silicone-based soft liner was applied to the obturator. The use of extracted teeth proved beneficial for improving occlusal force, strength, and aesthetics. Thus, a hollow ground obturator with a soft reliner is recommended for effective rehabilitation post Class II Aramany hemimaxillectomy. (IJP 2025;6(1):6-9)

Introduction

The oral cavity commonly referred as mouth, a part of digestive system which functioned in speech, mastication, and occlusion in life, is enclosed by lips anteriorly, oropharynx at the posterior side, both hard and soft palate superiorly, tongue as the floor with a lining of buccal mucosa lining, upper and lower teeth, and peridontum.[1,2] The soft tissues of the mouth comprise the tongue, floor of the mouth, buccal mucosa, and the retromolar trigone that extends to the tonsillar region.[3] The oral functions include swallowing, speech, mastication and esthetic aspects of facial features that impact human quality of life. The defect on maxilla that creates nasal and oral cavities communication (oro-nasal defect) will impair oral–maxillofacial functions.[4,5]

Maxillofacial defects are usually complex, involving skin, multiple layers of mucosa, muscle, cartilage, and bone.[6] The ethiology of maxillofacial defect are broadly classified into congengital and acquired. Trauma, radiation burns, surgical intervention, infection, bone osteonecrosis and some pathological disorders fall under the category of acquired maxillar defects.[7,8] Surgery, as an treatment for cancer that not responding to chemoteraphy and radiation, unfortunately could cause wide range of acquired maxillofacial defect. This condition gave rise to concern on understanding the acquired defect to help with the rehabilitation. There were several classification that classify maxillofacial defects, one of them is Aramany's classification that presented in 1987.[9] Based on a cohort of 123 patients' incidence of defect occurrence, Aramany's divided the defects according to defect relations with the abutment teeth in 6 categories.[9,10] This classification might offer guidance in obturator design.[9]

The most common approaches to the reconstruction of maxillary defects have included prosthetic rehabilitation with obturators and microvascular free flap transfers.[8] Obturator helps to separate the oral and nasal cavity, prevent food or liquid regurgitation, improving on speech as well as facial profile, and giving the benefit for easier cancer reccurence detection.[11,12]

In this case repot the author described the utilization of silicone soft-reliner to improve the obturator retention and to provide better defect coverage in order to improve patient quality of life.

Case Report

At Universitas Gadjah Mada Dental Hospital, a 46-years-old male patient, presented with complaints on discomfort, instability, and inadequate palatum covering of his prosthetic obturator after tumor excision on his right maxillary region two years ago.

Upon physical examination, a deep, hollow defect under the palatum figure 1A were discovered as well as an exposed inferior nasal chonchae and the nasal cavity's lateral wall.

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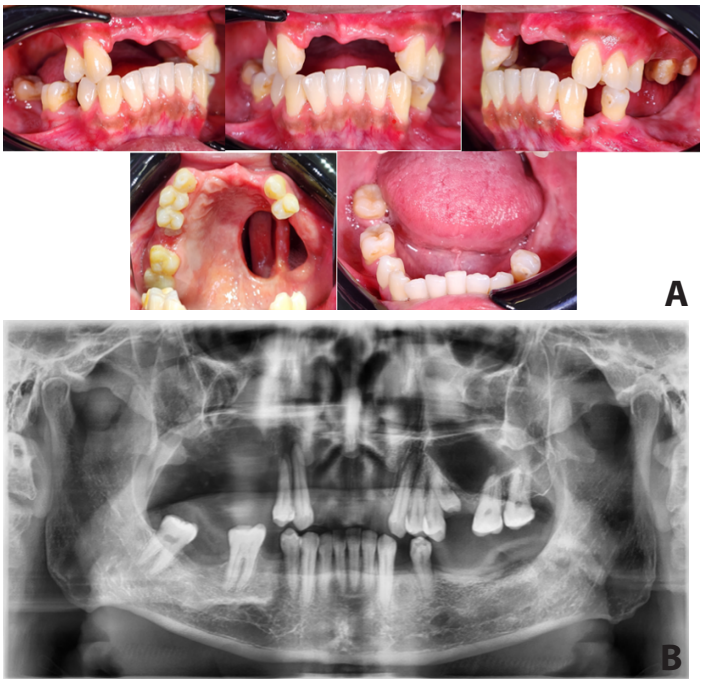

Figure 1. A. Intraoral examination, B. Panoramic radiograph

Figure 2. A. Preparation of making the silicone index, B. The relining process of previous interim denture after tooth 14 and 15 extraction

On the right maxilla, there was third-degree mobility in the first and second premolars. According to the panoramic radiography figure 1B, The first and second premolars on the left maxilla area's ridge support had ceased, and there were additional teeth on the right maxilla region between them. A several tooth loss can be seen 18, 17, 16, 13, 12, 11, 21, 22, 26, 38, 37, 36, 34, 45, 47, and the rest of the remining tooth is still in healthy state.

Due to the tooth's third-degree movement, tooth 14 and 15 had to be extracted as a preliminary treatment. Before that, a silicone index using silicone putty with the patient 's using his previous interim denture was made as a preventative step against the occlusion key lost once the extraction was completed figure 2A.

The extracted tooth served as a natural replacement for the interim denture, and silk'thread was utilized to stitch the extraction site. The teeth were first severed in half, and the pulp was then taken out. Following that, the pulp room was expanded to accommodate the acrylic, and the tooth was disinfected for five minutes in 5% NaOCL. After the cleaning, the tooth was placed into the silicone index along with the temporary denture. The acrylic was poured as a reliner and molded into the mouth. Once the acrylic had hardened. The temporary denture was taken out then any extra acrylic was cut and polished figure 2B.

After a week, an inspection and hecting off were conducted on the surgical wound. To create a final denture, fresh impressions were cast after two months. The prior Kennedy classification changed to Kennedy class 1 as a consequence of the tooth extraction, thus explaining why the RPD was created figure 3A. The laboratory created the metal frame based on the cast, and once the metal frame was returned, the try-in procedure was completed. The maxilla-mandibular relation (MMR) and bite rim making would be performed after the metal frame was correctly positioned figure 3B.

The bite rim was marked with the smile line, canine line, and median line as MMR was carried out. After using bite registration material to record the biting record, the articulator was mounted. Both the second try-in and the positioning of the artificial teeth were completed. Once the layout didn't require any adjustment, the laboratory was utilized to make the acrylic and hollow bulb. The third attempt was made to examine the oral occlusion, pain, ulcer, retention, and stabilization of the completed RPD figure 3C.

An issue regarding RPD retention was found during the inspection. In order to fix the retention problem, silicone reliner was required. After applying primer and silicone to the acrylic hollow bulb, it was molded into the palatum hollow figure 4A. The denture was removed once the silicone had hardened, and the undercut surrounding the hollow bulb was discovered. This undercut could benefit in the hollow bulb retention.

After 3 month after using his new obturator figure 4B the patient was asked about his testimonial. Patient is satisfied with the treatment, the obturator fit perfectly and he feel comfortable using the new obturator, it helps restore the mastication function, and the aesthetic makes him more confident. While eating and drinking, he feel no more choking and he can speak fluently after using hi new obturator.

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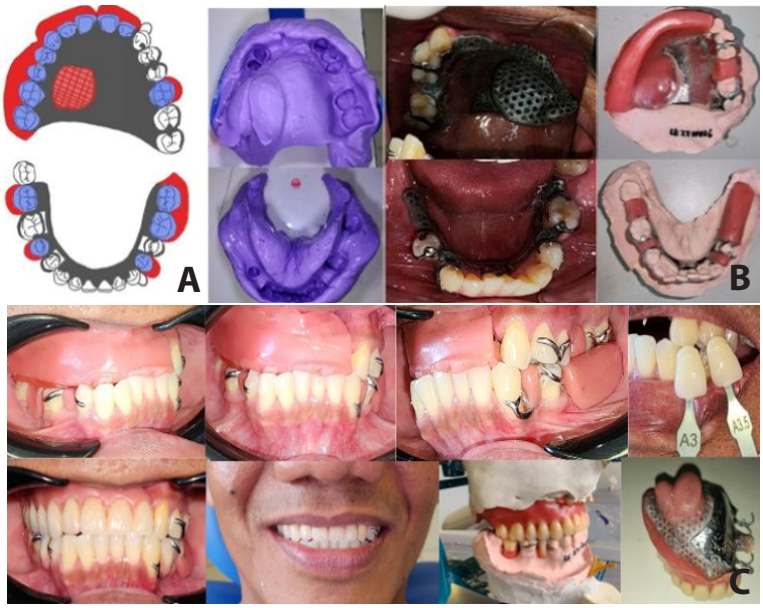

Figure 3. A. RPD design, B. RPD frame fitting, C. MMR and the laboratory process

Figure 4. A. The relining process of the final denture using silicone soft-reliner, B. The result between before and after treatment

Discussion

An obturator prosthesis is essential to a patient's ability to regain oral function following a maxillectomy. The design of the obturator structure may vary depending on the defect classification system.[13] Obtaining proper retention, stability, support for prosthetic treatment, relieving pain and ease of use is the most frequent issues.[14-16] Hence, all removable obturator prosthesis should be designed with basic prosthodontic principles in mind, such as wide stress distribution, cross-arch stability with a rigid major connector, along with stabilizing and retaining components at proper arch locations to effectively reduce dislodging functional forces.[13]

Intraoral examination in this case revealed an Aramany class II maxillary defect in the right maxilla.[3] Speaking, eating, and appearing normal are all made possible with a definitive obturator, which serves as a barrier between the nasal and oral cavities.[17,18] When fabricating a definitive obturator, caution should be exercised to ensure that the site is free from new difficulties. Only after the defect's size is dimensionally stable should the final prosthesis be provided. In this case, the intervention is an end-of-treatment procedure.[18]

A tripodal design was employed in this instance. The prosthesis was supported by the remaining teeth, the palate, and the rest. The left first premolars, second premolars, and canines were prepared for resting, as were the second and third molars in the left quadrant of the maxilla. Optimizing the distribution of the functional load across the tissue was the aim of the entire palate design. To provide retention, double akers are used on the second and third molars as well as the first and second premolars. Stability is provided by the left caninus RPI-bar clasp. However, since the arch is only made of one side, it is unable to adequately support the denture's retention. Consequently, using a soft retainer with a silicone base is required to improve retention.

A recent systematic review found that the masticatory function of denture users was improved when soft silicone reliner was compared to typical acrylic resin materials. Researchers that compared silicone soft reliner to conventional hard acrylic denture relining discovered considerable improvements in patients' overall health and enjoyment of life, as well as their ability to eat and swallow.[19,20]

Conclusion

The application of a soft reliner with a silicone base could improve obturator retention, resulting in enhancing the one sided denture anchorage. On the other hand, it provides better defect coverage which reduces oro-antral interaction and increases comfort while speaking, eating, and drinking. Utilizing the the patient's natural teeth in place of artificial ones may help the patient maintain occlusion caused by tooth extraction as well as provide the benefit of having similar-colored teeth.

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CASE REPORT

Prosthodontic rehabilitation of partial edentulism: Fixed-Removable approach

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Keywords:
Cobalt-chrome denture, Dental prostheses, Fixed-removable prostheses, Milled features, Partially edentulous

ABSTRACT

Effective history-taking and comprehensive clinical investigations play a vital role in systematic treatment planning process for a successful treatment outcome. This case report highlights prosthetic rehabilitation utilizing milled featured fixed-removable prostheses taking into account patient concerns to achieve aesthetically pleasing outcome without surgical intervention. A 68-year-old Malay female was unsatisfied with her maxillary partial acrylic denture and requested for a substitute. Several treatment options were discussed to replace the multiple missing teeth on both arches. The implant-retained prosthesis was not considered as an ideal treatment option due to the patient's financial constraint and reluctance for surgical intervention. Combination of fixed-removable prostheses were planned. The maxillary removable partial cobalt-chrome denture was fabricated with milled features of anterior fixed dental prosthesis to enhance the retention, support and stability of the prosthesis. Mandibular partial cobalt-chrome denture with composite build-up on attrited anterior teeth were fabricated as a definitive treatment plan. This prosthodontic management was able to provide satisfactory aesthetic and functional outcome thus achieving a mutually protected occlusion scheme. Regular prostheses maintenance and oral hygiene instructions will enable the patient to perform adequate plaque removal. Ultimately, meticulous case selection is essential to achieve favourable longevity of the prostheses. (IJP 2025;6(1):10-14)

Introduction

A successful treatment outcome relies on effective clinical decision. Clinical decision is facilitated by history-taking, clinical investigation process with several treatment options which leading to a sequential treatment plan based on patient's concern and agreement.[1] Therefore, prosthodontic rehabilitation is essential to restore aesthetic form and function of the patient thus contributing to the health of stomatognathic system.[2] Management of partial edentulism includes various treatment options such as from a provisional removable partial denture, a definitive cast partial denture, a resin bonded prosthesis, fixed partial denture or Osseo integrated implant prosthesis.[3] Fixed-removable approach is applicable in certain cases where fixed prosthodontics is unfavourable to perform due to clinical situations such as long span residual ridge and patient financial constraint for implant supported prosthesis.[4,5] However, analysing the nature of patient's occlusion as well as determining the type of occlusal approach is necessary in the treatment planning process. Generally, there are two types of occlusal approach such as conformative and reorganised approach. Conformative approach is adapted by providing restorations conforming to the patient's existing intercuspal position where there is sufficient space available for fixed or removable prostheses. Reorganised approach may applied either in centric relation or increase vertical dimension forms based on patient condylar position to achieve favourable inter-occlusal space for fabrication of prosthesis.[2,6,7]

The aim of this case report is to highlight the ability to utilize pre-existing oral condition in the process of full-mouth rehabilitation taking patient's perception into account. Milled features partial denture prosthesis has long been considered advantageous in dentistry as it combines fixed and removable prosthodontics in such a way as to enhance aesthetic in removable prosthesis. However, most dental professionals have largely neglected the option in the past for legitimate reasons, due to its complicated technique and high technical demand especially in treatment planning, designing and fabrication. In this case, periodontally stable abutment teeth enabled the clinician to apply the concept of milled featured prosthesis as a retainer to partial cobalt-chrome denture. Periodontal health of abutments and prosthetic factors share a close relationship in determining the success of treatment. Periodontal health reflects the longevity of restorations. Thus, it is crucial to determine the prognosis of individual tooth and overall dentition to develop treatment strategies. In this case, the periodontal stability was assessed based on general and local factors. Generally, patient is well motivated in practicing oral hygiene, no smoking habit or systemic illness which may contribute to periodontal disease. Periodontal pocket depth was examined and the deepest probing depth on all abutment teeth was

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Table 1. Basic Periodontal Examination (BPE)

	2	2	2
	2	2	-

Table 2. Dental charting based on the ICDAS Codes

Tooth	Findings	ICDAS Code
18	Clinically missing	99
17	Amalgam restoration on occlusal surface	40
16-11	Clinically missing	97
21-23	Temporary bridge with composite materials	80
24	Composite restoration on mesio-occlusal surfaces	30
25	Sound tooth surfaces	00
27	Amalgam restoration on occlusal surface	40
28, 38	Clinically missing	99
37-34	Clinically missing	97
33-43	Attrited composite restoration on incisal region	97
44	Attrited composite restoration on disto-occlusal region	30
45	Sound tooth surfaces	00
46	Clinically missing	98
47	Amalgam restoration on occlusal surface	40
48	Clinically missing	99

Table 3. ICDAS Codes based on caries severity, restoration status and missing conditions

Caries severity		Restoration status	
Code	Description	Code	Description
0	Sound tooth surface	0	Unrestored and unsealed
1	First visual change in enamel	1	Partial sealant - a sealant which does not cover all pits and fissures of the both surfaces
2	Distinct visual change in enamel	2	Full sealant
3	Localised enamel breakdown due to caries with no visible dentin	3	Tooth-coloured restoration
4	Underlying dark shadow from dentin (with or without enamel breakdown)	4	Amalgam restoration
5	Distinct cavity with visible dentin	5	Stainless-steel crown
6	Extensive distinct cavity with visible dentin	6	Porcelain, gold or preformed metal crown or veneer
		7	Lost or broken restoration
		8	Temporary restoration
Missing conditions			
97	Permanent tooth missing due to caries		
98	Permanent tooth missing for other reasons		
99	Unerupted tooth		

noted to be 3 mm. This condition is favorable as studies revealed that deep probing depths and alveolar bone resorption may be risk factors for periodontal breakdown in future.[8,9] Inability to access the deepest area for oral hygiene maintenance as well as microbial environment favoring periodontal pathogens due to opportunistic changes may led to periodontal disease. Harmonious relationship between prosthesis and periodontium is also significant in maintaining aesthetics and longevity of prosthesis.[10,11] Therefore, the design and contour of the milled features porcelain-fused to metal (PFM) fixed dental prosthesis was selected in consideration of aesthetic and the health of periodontium.

Case Report

A 68-year-old Malay female was referred from outpatient department to restorative specialist clinic for fabrication of new set of dental prosthesis. She wished to replace her current maxillary acrylic removable partial denture and her temporary bridge due to dissatisfaction with the disproportionate appearance in terms of tooth shape and size. She claimed that she had experienced with long span fixed dental prosthesis which was fabricated by general dental practitioner in private clinic several years ago. However, the abutments of the long span fixed dental prosthesis were sectioned and extracted due to undermined or subgingival caries. Patient presented to our clinic with unsatisfactory maxillary partial acrylic temporary denture with 3-unit temporary bridge from tooth 21 to 23 figure 1. Her medical history revealed that patient has osteoarthritis and was on ibuprofen (non-steroidal anti-inflammatory drugs) 400mg x BD x 1/52 or PRN basis. She has regular follow-up in government medical clinic for her medical illness and she has no history of any allergies. Previous dental history revealed that she was an irregular dental attendee and had undergone scaling, dental filling and extraction without complications. Social and family history were also noted to be unremarkable.

Extraoral examinations revealed no abnormalities. No asymmetry of the face was detected, and the lips were competent. She has a Class I skeletal pattern and the mouth opening was normal (35mm) with no enlargement or tenderness of the lymph nodes. There is no clicking or tenderness in the temporomandibular joint and no deviation upon closing and opening the mouth. Intraoral examination revealed that lips, tongue, oral pharynx, hard and soft palate appeared normal. Saliva was thick with good quality and quantity. Her oral hygiene was fair with localized bleeding on probing on tooth 17 (mesial surface) and 47 (mesial surface). 2mm gingival recession noted at 24 and 25 buccal surfaces. Thin plaque and calculus were noted on the surface of maxillary and mandibular posterior teeth. No deep pocketing, abscess, sinus and teeth mobility noted. Basic Periodontal Examination (BPE) revealed score 2 on all 5's sextant table 1.

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Table 4. Sensibility Test

Tooth	EPT	Cold Test	Findings
25 (c)	6.0	+	Responsive
33 (c)	5.0	+	Responsive
17(t)	8.0	+	Responsive
21(t)	7.0	+	Responsive
23(t)	8.0	+	Responsive
24(t)	11.0	+	Responsive
27(t)	10.0	+	Responsive
44(t)	13.0	+	Responsive
47(t)	9.0	+	Responsive

Figure 1. Intraoral pre-operative photographs; A. Labial retracted view, B. Maxillary anterior view, C. Mandibular occlusal view

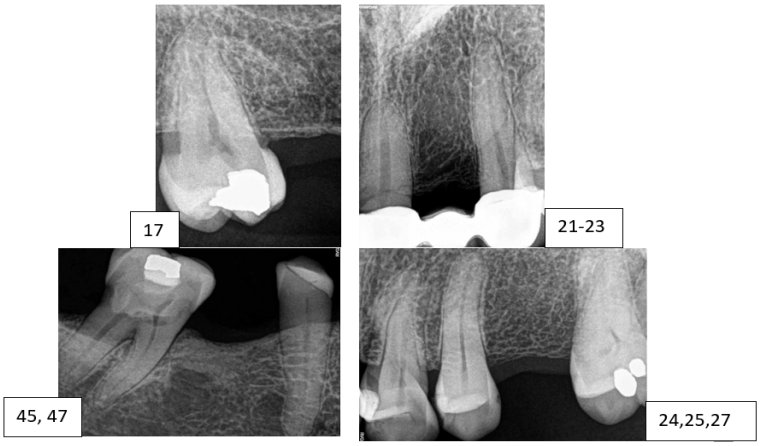

Figure 2. Radiographic assessment of periapical radiographs of maxillary and mandibular teeth

Figure 3. Post-cementation view of 3-unit PFM milled fixed dental prosthesis/bridge

She has maxillary and mandibular partial edentulous dentition with Kennedy Class III Modification II on the maxillary arch and Kennedy Class II Modification II on the mandibular arch figure 2. Full mouth dental charting table 2 was performed based on the International Caries Detection and Assessment System (ICDAS) table 3.

Space analysis and occlusal analysis were performed. The interocclusal space of the edentulous area was sufficient. There is anterior and posterior tooth contact (23 with 33, 17 with 47) and teeth 24, 25 and 27 are not overerupted. Special investigation such as sensibility test (electrical pulp test (EPT), cold test) table 4 and radiographic assessment via periapical radiographs figure 3 were taken. Teeth as control are 25 and 33 whereas teeth as test are 17, 21,23,24,27,44,47. Electrical pulp and cold test revealed positive responses on all control and test teeth.

Several periapical radiographs were taken. There is generalised maxillary and mandibular horizontal alveolar bone loss mostly at 1/3 of the coronal root length. All periodontal ligament (PDL) widening with intact lamina dura. There is no periapical radiolucency detected on all periapical areas of the teeth. Favourable crown-root ratio of all maxillary and mandibular teeth noted within 1:2 and 1:1. Radiopacity noted at crown region on teeth 17, 21-23, 24, 27,44 and 47. Based on the intraoral and radiographic findings, the diagnoses of the case are partially edentulism, normal pulp with normal apical tissues of 17, 21, 23, 24, 27, 44 and 37 based on the endodontic diagnosis by American Association of Endodontists 2013, periodontal health in reduced periodontium (Chapple 2018) and defective composite restorations on 33-44.

Assessment of restorability of the temporary bridge abutments from 21-23 was performed and resulted in favourable prognosis with no caries and pulpal involvement. There was sufficient remaining tooth structure on the abutments on 21 and 23 after temporary bridge removal. Problem lists were identified such as patient was unsatisfied with the appearance of the existing acrylic partial denture as well as maxillary anterior fixed dental prosthesis (bridge) and clinically missing several maxillary and mandibular teeth due to caries and periodontal disease. Therefore, the treatment aims of the patient may focused on prosthodontic rehabilitation. For instance, to replace the clinically missing teeth with fixed and/or removable prosthesis. Secondly, to improve aesthetic of the patient by producing the favourable anterior tooth proportion and smile of the patient. Last but not least, to restore to optimum function and rehabilitation of occlusion and to improve the quality of life (QoL) of the patient.

Several treatment options were discussed with the patients regarding the advantages and disadvantages on each

treatment.

Treatment option 1 (fixed prosthesis): Implant supported fixed dental prosthesis with and/or without bone augmentation (16-14, 13-11), 26, 34-36, 46; Fixed-fixed conventional porcelain fused to metal (PFM) or porcelain fused to zirconia (PFZ) fixed dental prosthesis/bridge from 21 -23; Composite build-up to minimised the space between 32 and 31; Restore and recontour composite restorations on incisal edges from 33-43; Removal of defective composite restoration and placement of new com- posite restoration on 44.

Treatment option 2 (fixed-removable prosthesis):- Fixed-fixed conventional porcelain fused to metal (PFM) or porcelain fused to zirconia (PFZ) fixed dental prosthesis/bridge from 21-23 with milled features; Maxillary and mandibular partial cobalt-chrome partial dentures; Restore and recontour composite restorations on incisal edges from 33-43; Removal of defective composite restoration and placement of new composite restoration on 44; Implant therapy to replace maxillary and mandibular missing teeth may require bone augmentation and/or sinus augmentation. The patient preferred a less invasive treatment prior to implant therapy. Hence, treatment option 2 was chosen. This treatment was considered conservative, less invasive, less costly and able to provide optimum function and aesthetic for the patient. Informed consent was obtained from the patient and explained regarding the procedure. Below are the treatment phases and stages: Phase 1: Prevention. This phase consists of oral hygiene instruction (OHI) and motivation. She was advised to practice good oral hygiene care to prevent any oral diseases in the future and she was advised to brush using fluoridated toothpaste and floss the teeth regularly. She was recommended to use dental floss or super floss to clean the interproximal region; Phase 2: Diagnostic and treatment planning. This phase focused on primary impressions for study models, diagnostic wax-up, porcelain shade selection and prosthesis design for future fixed-removable prosthesis. The porcelain fused to metal fixed prosthesis with 2/3 palatal metal coverage was planned with 3-unit fixed-fixed conventional PFM bridge from 21-23 with milled features (guiding plane on mesial of 21 and palatal ledge on 21 and 23); Phase 3: Interdisciplinary intervention and maintenance. For instance, non-surgical periodontal therapy (scaling and polishing), reviewed periodontal status and reinforced oral hygiene after 2 weeks. Defective composite restoration was removed and replaced with new composite on 44. The attrited mandibular anteriors were restored with composite restorations to re-establish favourable vertical dimension.

Phase 4: Fixed prosthodontic phase involved abutments preparation for fabrication of 3-unit milled featured of PFM fixed dental prosthesis/bridge from 21-23. The triple cord gingival retraction technique was used soaked with ViscoStat™ clear haemostatic gel. The maxillary working impression was taken using the dual-phase impression technique (heavy and light-bodied consistency polyvinyl siloxane (PVS) (Aquasil, Dentsply Sirona, USA) impression materials.

An interocclusal record was taken using polyvinyl siloxane (EXABITE™, GC, USA) at centric occlusion. The working impression, interocclusal record and mandibular study model cast were sent to dental laboratory for construction of the 3-unit milled bridge.

Definitive fixed indirect restoration was tried inside the mouth. Aesthetic, marginal adaptation, occlusion and function were assessed. Surface treatment of air-particle abraded with 50- m alumina oxide of the intaglio surface of restoration was performed prior to cementation. The prosthesis was cemented using resin-based cement (Rely X™ 200, 3M ESPE, USA) following the recommendation of the cementation protocol from the manufacturer. Initial polymerization or tag cure was done for 3 seconds and the excess cement was removed by dental floss and probe. A final cure with LED curing light was performed with 20 seconds for each surfaces. Occlusion was re-assessed after cementation procedures.

Phase 5: Removable prosthodontic phase focused on the construction of maxillary and mandibular removable partial cobalt-chrome dentures. The definitive impression was made using monophase silicone impression material (Aquasil® Dentsply Sirona, USA) and sent to the dental laboratory. The maxillary and mandibular cobalt-chrome framework was tried inside the mouth. The retention, stability, extension and fit of the framework were checked and was found to be excellent. Facebow (Denar® Mark II, Whip Mix, USA) transfer and jaw relationship records were made with interocclusal recording material ((EXABITE™, GC, USA) and the occlusal wax rim. The acrylic tooth shade was determined using an acrylic tooth shade guide, and shade A3 was selected. Issue stage of the dentures involved the assessment of denture's fit, retention and stability figure 4. The occlusion was checked using an articulating paper and the high bite was trimmed accordingly. Mutually protected occlusion achieved with group function upon right and left lateral excursion and shared anterior guidance during protrusion. The fitting surface of the dentures was checked using pressure indicator paste and minor adjustment done. Final polishing of the dentures was done, and post-denture insertion instructions were given to the patient. She was pleased with the new set of dentures and confident with her new appearance.

Phase 6: Review and maintenance phase. The patient was reviewed after 1 week for any signs and symptoms. She was satisfied with the treatment outcome. Good oral hygiene and acceptable soft and hard tissue integrity around the dental restorations were successfully maintained. Overall, prognosis of the treatment is good with all the treatment aims were achieved. The patient was emphasised on denture and oral hygiene maintenance care such as tooth brushing, flossing. She was taught to use super floss to clean the area underneath bridge.

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Discussion

Prosthodontic rehabilitation in achieving aesthetic and functional restorations especially in the anterior region of the maxilla can be particularly challenging. This case involved unfavourable aesthetic outcome of existing fixed dental prosthesis (bridge) and removable partial denture. Anterior dental aesthetics is primarily concerned with the appearance of the maxillary anterior six teeth. It comprises of the concept of macro aesthetic (facial aspect) and micro aesthetic (dental aspect). The concept of micro aesthetic involved tooth dimensions and proportions (white aesthetics) and its correlation with the periodontium (pink aesthetics).[12] Therefore, several studies have been directed towards the size, shape, shade, alignment of the maxillary incisors and canines, their relationship to each other and the antagonist dentition, and the surrounding soft tissues including the gingivae, lips and facial features.[12-15]

Fixed-removable prosthodontic management based on this case was considered a challenging procedure because it involved rehabilitation of existing restorations and patient expectations towards the future final outcome. Patient refused to have osseointegrated implants as it involved high costs and surgical procedure. Therefore, a comprehensive treatment planning was conducted and focusing on fixed and removable prosthesis design. Full mouth rehabilitation aims to achieve harmonious relationship between teeth, periodontal structures, muscle of mastication and temporomandibular joint (TMJ) mechanisms.[16] The success of prosthodontic treatment dependant on the ability to achieve posterior occlusal contacts which contribute to stabilise occlusion.[17] Conformative approach is applicable for this case as there has stable contact on posterior second molars and sufficient interocclusal space for the definitive restorations.[18] This approach allows provisional restoration to be in harmony with the existing jaw relationship.[6] For early adaptation in this situation, combination of maxillary and mandibular interim removable partial dentures and composite build-up was used to establish a stable and functional occlusal vertical dimension. This method is reversible, simple to adjust and stabilises the occlusion.[19] Combination of prosthodontic rehabilitation provide retention, stability and support on both fixed and removable prosthesis. Metal ceramic fixed dental prosthesis/bridge for removable partial cobalt-chrome denture abutments are made with guiding plane, rest and retentive areas to optimize the biomechanics of the denture.[20] Survival rates for porcelain fused to metal fixed dental prosthesis (bridge) was 92% over ten years and 75% over 15 years. One of the contributing factors to success or failure rate of these prosthesis depends on the design of every component of the prosthesis.[21] The size, shape, type and position of the connecter can be determine the restoration's success.[22]

As part of the maintenance phase, regular follow up on oral health and prosthesis maintenance were given attention as periodontal maintenance play a vital role in reducing the occurrence of tooth loss post prosthetic therapy. Routine home care and professional maintenance therapy may provide the best solution in preserving the periodontal health of the patient. This is essential in determining the long-term success of the prosthesis.[10,11]

Conclusion

A combination of fixed and removable prosthesis able to provide favourable clinical outcome for partially edentulism case. Moreover, this treatment approach able to achieve support and stability of fixed restorations with the adaptability and simplicity of removable prosthesis. Ultimately, meticulous case selection is essential to achieve favourable longevity of the prostheses.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Complex aesthetic rehabilitation with lithium disilicate veneers

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Keywords: Cosmetic dentistry, Indirect veneer, Lithium disilicate, Peg-shaped, Primary tooth

ABSTRACT

Currently, demand on society for dental aesthetics has become increase especially dental veneer. Minimal invasive technique is the most advantageous technique in dental veneer due to pulp tissue remained safe and aesthetic aspect fulfilled. In this case is to give detail of aesthetic procedure to correct irregularities anatomical of the teeth using lithium disilicate veneers. A 20-year-old female patient came with a complaint of multiple diastema on anterior upper teeth. Based on objective examination 12 and 22 having peg-shaped and 53 maintain prolonged retention, agenesis and still sufficient. Multiple diastema between 53, 12, 11, 21, 22 and 23. Crown lengthening was performed on 53 to improve inciso-gingival ratio and tooth preparation for this case were using minimal invasive. Six units of lithium disilicate indirect veneer were placed using resin cement. Indirect veneers are placed with overjet and overbite are 3 mm, there is no changing contact maxillary and mandibular prior and following placement indirect veneers. Minimal invasive preparation involves in making the space needed for the restorative material of choice, outlining requirements for aesthetic needs, and outlining requirements that will make fabrication easier and created satisfactory result. After 2 months follow-up, veneers still retained well and stable, the veneers colour resembles natural teeth, tissue adaptation was also performed good and the patient is satisfied with the treatment results. Lithium disilicate veneers can be used as a treatment option for anterior teeth with deformities and primary tooth which still sufficient was performed. (IJP 2025;6(1):15-20)

Introduction

One of the biggest challenges in aesthetic dentistry is the restoration of anterior teeth. This is one of the most important topics in dentistry. To overcome aesthetic problems such as colour, structural abnormalities, and anterior tooth abnormalities, the technique most often chosen is to cover the tooth with a dental crown that covers part of the teeth. The main disadvantages of full-coverage dental crowns are excessive loss of healthy tooth structure and damage to the surrounding soft tissue. The goal of every procedure in dentistry is to provide successful dental treatment with a conservative approach and good aesthetics. Therefore, the use of veneers has increased in recent years due to their better aesthetics and minimal invasiveness.[1]

In recent years, lithium disilicate veneers have been used in dentistry as a more conservative and aesthetic treatment option. Lithium disilicate veneers are minimally invasive because they require very little tooth reduction. This veneer has promising aesthetic results because its properties are similar to enamel. Lithium disilicate material produces the thinnest veneers and has better properties than other materials.[1,2]

Lithium disilicate veneers are also known as "contact lenses", and are capable of providing a very accurate reproduction of natural teeth with good colour stability and also a very conservative treatment approach. Research has shown success rates for over 10 years for veneers. Veneers are also biologically compatible with the periodontium.[3]

This case report aims to explain the management of multiple diastema on upper anterior teeth starting from treatment planning to Lithium disilicate veneer cementation to restore aesthetics and function.

Case Report

A 20-year-old woman came to the RSGM Prof. Soedomo UGM with a complaint of poor shape appearance and gaps on her upper jaw front teeth. The patient came of his own will to improve the condition of his teeth which caused her to lack confidence. The patient admitted that he had never worn dentures before. The patient admitted that he had no history of systemic disease. The patient has no history of allergies, medications, or foods. The patient is not under a doctor's care or taking routine medication.

The results of the extraoral examination showed that there were no abnormalities in the patient's lips, lip and cheek muscles, and lymph nodes figure 1. Intraoral examination showed multiple diastemas between teeth 53, 12, 11, 21, 22 and 23. Teeth 12 and 22 were peg-shaped and tooth 53 had not fallen out and was in good condition. Figure 2.

On radiological examination, it was seen that the alveolar-crest furcation and periapical conditions were within normal

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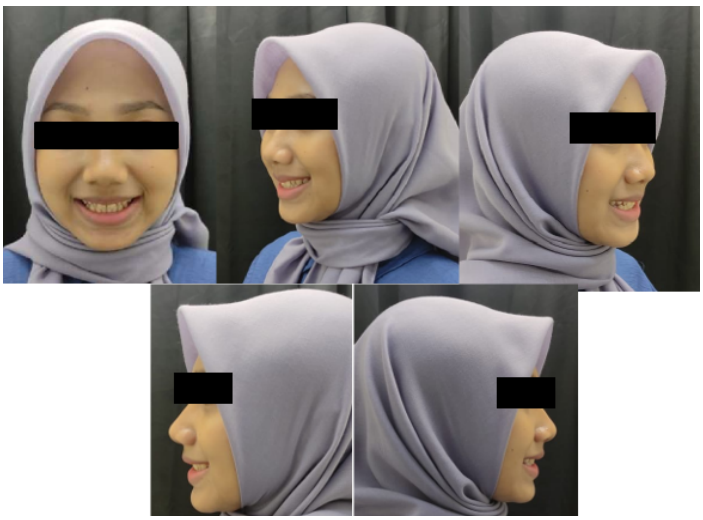

Figure 1. Extraoral photo of patient

Figure 2. Clinical photo of the patient before treatment

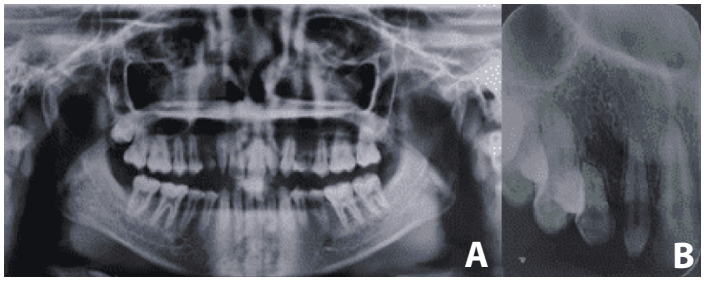

Figure 3. A. Panoramic radiological image, B. Periapical radiological image

Figure 4. Measurements before crown lengthening procedures

limits, and absent of complement of tooth 53. Then a periapical radiology was performed, which confirmed the previous radiology that tooth 52 persisted in the condition of root resorption figure 3.

The patient was diagnosed with Anterior Maxilla Diastemata (peg-shaped on teeth 12 and 22). The patient was given the option of veneer due to its minimally invasive nature and excellent aesthetic qualities, so the decision was made to enhance the appearance using lithium disilicate veneers.

The overall treatment plan is indirect veneers on teeth 12, 11, 21, 22, and 23, crown lengthening on tooth 53 by 1 mm, and direct veneers on tooth 53. Crown lengthening is carried out on tooth 53 to improve the inciso-gingival ratio and tooth preparation, in this case using minimally invasive. Then, we made the impression of the maxilla and mandibula using irreversible hydrocolloid, and the cast was poured using type 3 gypsum.

At the next appointment, crown lengthening was carried out on tooth 53 after anaesthesia using 0.5 cc of lidocaine and epinephrine. Gingival excision is carried out using blade number 15. Then, irrigation and dressing are carried out with a gingival pack. figure 5 The patient was instructed to avoid brushing in the wound area, playing with the tongue, and eating hot foods for 3 days. Patients are prescribed antibiotics, analgesics, and anti-inflammatory drugs. The patient's teeth are matched with the shade guide and produce colour A2 figure 6.

At the third appointment, control of crown lengthening and veneer preparation is carried out figure 7 and figure 8. After that, we made the working with elastomeric impression material and one step technique figure 9. Then, a temporary crown is made figure 10.

The fourth meeting carried out a try-in of veneer and insertion figure 11. During the try-in, adaptation, occlusion, colour, and aesthetics of the veneer are checked. Six units of indirect lithium disilicate veneer were cemented using resin. ement. Indirect veneers were inserted with an overjet and overbite of 3 mm each, there was no change in the contact of the maxilla and mandible before and after the insertion of the indirect veneers. To remove excess of cement resin in interproximal was using dental floss.

After 2 months of follow-up, the veneers were still good and stable, the veneer colour resembled natural teeth, tissue adaptation was also going well and the patient was satisfied with the treatment results. Lithium disilicate veneers can be used as a treatment option for anterior teeth that are deformed and primary teeth that still require adequate care.

Discussion

Multiple diastema of anterior teeth is a malocclusion condition that can disrupt a person's appearance and self-confidence.[4-6] Diastema of maxillary teeth is an aesthetic problem that often occurs compared to mandibular diastema.[4] Treatment of diastema can be done with orthodontic treatment, restorative treatment (direct composite veneers, indirect composite veneers, porcelain laminate veneers, all-ceramic crowns, metal-ceramic crowns), surgical correction, or a multidisciplinary approach depending on the etiology.[4,7,8] Direct and indirect adhesive restorations are a safe, predictable, and recom-

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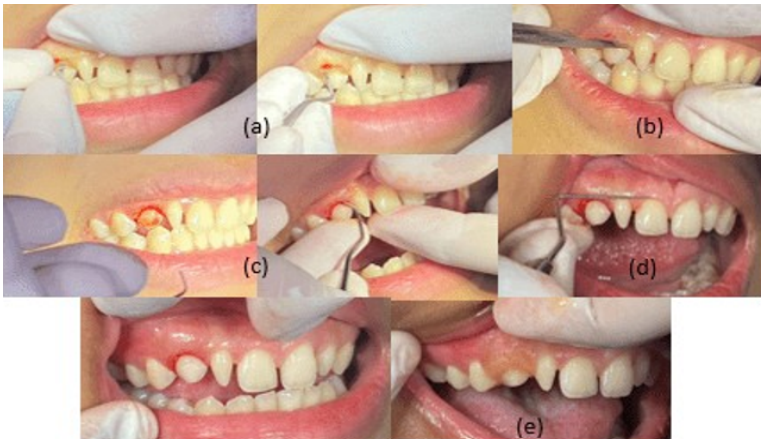

Figure 5. A. Crown lengthening of 53 by 1 mm, B. Cutting with blade number 15, C. Smoothing the cut with a curette, D. Final measurement, E. Application of the periodontal pack and the patient is given antibiotics and anti-inflammatory drugs

Figure 6. Colour matching with shade guide

Figure 7. Post preparation

Figure 8. Crown lengthening control

mended restoration for closing diastema.[4,6,8,9]

Veneers play an important role in smile restoration because of their ability to change the shape of teeth with a conservative approach. A specially made thin shell is bonded to the labial surface of the tooth to treat various aesthetic problems including discoloration, chips, cracks, diastema, and malalignment.[5] Veneers are the most popular method for diastema.[10] Composite resin veneers are veneers that have several advantages including economical, can be used as a temporary restoration during adolescence, can be repaired easily, easy to make, minimally invasive, only carried out in one stage, and takes a short time to carry out.[11-13] However, this material is less resistant to chewing and can also stain the restoration surface, marginal wall leaks, and it can cause disruption of gingival health if oral hygiene is poor.[13] These weaknesses make this material inferior compared to indirect veneers.[11] Treatment for aesthetic cases can involve multidisciplinary knowledge, one of which is using indirect veneers such as ceramics laminate veneers.[4,7,10]

Various ceramic materials have been widely used, such as lithium disilicate and zirconium oxide.[4] Veneers made from lithium silicate have increased strength and also provide high aesthetic results.[11,12] The material selection uses lithium disilicate not only because of its mechanical properties but also its good optical properties because it is in the anterior region.[4]

Peg-shaped teeth are defined as undersized, tapered maxillary lateral incisors and are associated with other dental abnormalities such as transposition of canine teeth or over-retained deciduous teeth.[13-15] Due to their reduced size and irregular tooth shape, this shape of the lateral incisor can cause the formation of another diastema in the anterior region and cause aesthetic problems.[5,15,17] Currently various techniques are available to treat this situation, such as orthodontic treatment, crowns, laminate veneers, and direct resin composite restorations.[14,15] Currently, ceramic veneers have been used widely and effectively in treating diastema with high aesthetic results.[17]

A variety of tooth-coloured materials are widely used especially silicate ceramics.[17] Lithium disilicate ceramics are superior to polymer-based materials in terms of abrasion resistance, flexural strength, and marginal color change of the material.

Restorations with resin composites in the literature showed higher levels of abrasion and
higher levels of discoloration compared to ceramic lithium disilicate restorations.[17]

Lithium disilicate veneers are made with a thickness of 0.3-0.5 mm.[17,19] Lithium disilicate veneers exhibit high wear resistance and optimal optical properties. This material requires minimally invasive preparation but provides optimal aesthetic results.[18] The finished line of the palatal veneer must be 1 mm palatal to the papilla as recommended by the rules assuming there is 1 mm between the roots of the teeth. If 2 mm is at the root, then the finished line must be 2 mm from the palatal to the contact point.[8] Lithium disilicate ceramic is used for single-unit

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Figure 9. **Making impression with elastomer**

Figure 10. **Making temporary restoration**

Figure 11. **Try in of veneer**

Figure 12. **Clinical photo after insertion**

crowns. In the literature, it is stated that its use as a material for bridge dentures has not been very successful.[19]

Selecting the right ceramic material can produce stable aesthetic quality while maintaining biocompatibility, abrasion resistance, good transparency, stable colour, and contour. Plaque deposition on ceramic veneers is lower so it can reduce gingival irritation.[20] The success of ceramic veneers is very dependent on the strength and durability of the bond formed between the 3 components of the bonding complex: tooth surface, ceramic, and luting resin composite. The ceramic used for laminate veneers is feldspathic ceramic which has the advantage of being able to imitate the appearance of natural teeth because of its high transparency and increased durability after being adhesively bonded to the teeth.[21]

Partial anodontia can occur for various reasons, the most common being agenesis of the permanent tooth replacement. Treatment for partial anodontia varies and depends on the condition of the root and crown, when the roots and crowns are in good condition, the teeth can be maintained and if aesthetic improvements are needed, the primary teeth can be reshaped.[22] Primary teeth in the smile zone cause patient dissatisfaction due to the size, alignment, and/or colour, as well as misalignment of the others teeth.[23] Ceramic crowns and veneers are valid treatment options for healthy teeth with improper shape or size. Although more expensive than direct restorations, indirect restorations lithium disilicate can be bonded to conservative tooth preparations to achieve high aesthetic quality and a natural appearance.[22,23] In this case, partial anodontia occurred on tooth 53 which did not have a permanent tooth germ for tooth 13 (the right canine on the maxilla).

A combined periodontal and restorative approach is sometimes necessary to analyze and solve aesthetic problems. So, initial intervention requires crown lengthening apically with periodontal surgery, towards the incisals with the addition of restorative material, or with a combination procedure to maintain ideal tooth proportion and alignment.[18] Crown lengthening is a surgical procedure carried out clinically before the restoration procedure which will create space for the supra-crestal fibers to reform.[24] Crown lengthening can be done only by reducing the soft tissue through gingivectomy or by reducing the soft tissue and alveolar bone. If the supracrestal tissue measurement (bone crest to gingival margin) is greater than 3 mm and attached gingiva of at least 2 mm will remain after surgery, then it is indicated for soft tissue reduction only.[24] The indication for crown lengthening is for subgingival caries or fractures. Crown length inadequate clinics for retention, gingival height that is not aesthetic.[25] Without a crown lengthening procedure, the teeth will appear short and unaesthetic. Crown lengthening on the remaining teeth can be done for functional and aesthetic reasons. The main function of this procedure is to increase retention and resistance to the tooth where the crown will be placed and change the proportions of the tooth.[18] In this case, due to deciduous tooth for 53 for restoration having unsimilar gingival height in order to manage inadequate axial height for restorative retention, cervical root resorption without alveolar crest reduction due biological width greater than 3 mm, functional crown lengthening may be necessary.[29]

In primary teeth that experience resistance, minimal preparation for veneers using lithium disilicate ceramic material must be carried out to prevent the possibility of root resorption caused by trauma and to obtain the benefits of enamel adhesion. Root resorption is a pathological condition characterized by the resorption of hard tissue (cementum and dentin) and can be caused, among other things, by mechanical or thermal trauma, such as by preparation using burs. The greater the amount of enamel, the better the adhesion and prognosis of the restorative treatment.[22]

In addition to selecting an adequate restorative approach, gingival health must also be achieved. Indirect restorations such as ceramic crowns and veneers will maintain proper

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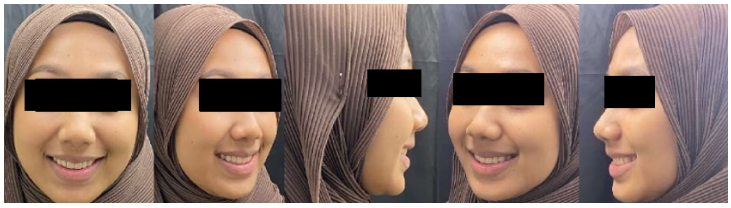

Figure 13. Extraoral photos after insertion

Figure 14. Extraoral photos of patient after 2 months follow-up

Figure 15. Profile photo of Veneer follow-up in 5th appointment

gingival margins and emergent profiles, reducing plaque retention which will contribute to the maintenance of periodontal health.[22] Several factors that play a role in the lack of aesthetics in the appearance of teeth are lack of aesthetic alignment of teeth, level of gingival tissue, smile lines, and periodontal morphology. The balance of the gingival architecture is very important in determining the shape and contour of the teeth. So interdisciplinary therapy is needed to establish harmony between tooth and gingival parameters.[6] The crown lengthening technique will provide satisfactory results if the patient has excessive gingival tissue and does not require bone remodeling intervention. This procedure is carried out by removing excess gingival tissue so the enamel covered by the gingiva can be seen.[6,18]

Deciduous teeth can be veneered with lithium disilicate. Lithium disilicate is a ceramic material with high torsional strength and high translucency which allows good aesthetic results. When applying veneers with lithium disilicate, it should be noted that this material has a special property called the "Umbrella effect" which allows light to pass through the material and be partially highlighted.[26] Lithium silicate ceramic combines superior mechanical properties with a high level of transparency and very good aesthetics.

This material is pressed to a thickness of 0.3 mm and will provide a strength of 400 MPa. This material is widely indicated to improve tooth shape and produce long-lasting aesthetic results, providing longer color stability than direct restorations.

The use of ceramic veneers makes it possible to condition the gingival tissue for papilla formation with a non-surgical procedure in which soft tissue topography is guided prosthetically. This requires the establishment of a gingival architecture based on the concept of cervical contour and contact points. Intrasulcular placement of the cervicoproximal margin is necessary to increase the emergence profile so it can cause gradual and natural closure of the diastema or black triangle.[16] Treatment of the black triangle with veneer restoration requires an appropriate crown height ratio between the connector and the incisors.[27] Reduction of anterior teeth enamel in the cervical area ranges from 0.4 mm and thickens towards the incisal 0.5-0.7 mm.[28]

Conclusion

An interdisciplinary approach is required to achieve an aesthetic smile and functional results. Aesthetic restorations must have an accurate contour match and be in harmony with the natural shape of the tooth and the surrounding gingival margin to obtain a good boundary between the restoration and the gingiva, preventing the build-up of food plaque which can cause gingival irritation. Lithium disilicate ceramic veneers are considered one of the most popular restorative materials in aesthetic dentistry because they provide good results so they can improve the patient's smile

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Ocular prosthetic of patient with shallow socket: Different impression technique

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Keywords: Impression technique, Ocular prosthesis, Shallow eye socket

ABSTRACT

The loss of an eyeball can be caused by trauma, surgery, or defects in the ocular area. Missing this part of the body can result in loss of vision and a decrease in self-confidence for the patient. Through our clinical report, a custom-made ocular prosthesis was made using acrylic resin materials which aims to provide rehabilitative care and restore patient self-confidence. A 27-year-old patient came to RSGM Prof. Soedomo for an ocular prosthesis after losing her eyeball due to an infection. Clinical examination revealed that the patient's ocular profile is convex while her eye sockets are shallow. This makes it challenging to create an ocular prosthesis. In this case report, the impression of work model uses two methods to determine the best way to make an impression of shallow eye sockets. Using an individual tray, one impression uses putty and light body, and the other uses light body only. Better results were obtained when the impression was made using the light body only in this case. The patient expressed satisfaction with her new custom-made ocular prosthetic. When compared to manufactured ocular prosthesis, custom-made prostheses offer superior fitting, comfort, and aesthetics, as they closely resemble the contralateral patient's natural eye. (IJP 2025;6(1):21-25)

Introduction

Loss of an eyeball is a condition that can affect the function of surrounding organs, disturb the aesthetics of the face, and even a person's psychological state. Eyeball loss can be caused by congenital eye diseases, eye damage due to blunt and sharp trauma, traffic accidents, sports accidents and severe eye infections.[1] Surgery for eyeball removal is divided into enucleation and evisceration. During an evisceration treatment, the sclera and extraocular muscles are preserved. This procedure is mostly considered cosmetic. In contrast, during an enucleation procedure, the entire eyeball is removed.[2] The orbital tissues that formerly supported and shielded the natural eye become useless after surgery and have a tendency to shrink, resulting in the loss of orbital volume.[3] Ocular defects are a significant maxillofacial weakness that requires replacement of prosthetics. Stock ocular prosthesis, modified stock ocular prosthesis, and customized ocular prosthesis are some of the techniques that have been implemented.[4]

The most common techniques for ocular prostheses are stock ocular prosthesis and customized ocular prosthesis. Stock ocular prosthesis have the advantage of being minimally made since they do not require laboratory manufacturing procedures. There are three sizes and three iris colours available for manufactured ocular prostheses. The ocular prosthesis has a drawback due to the size mismatch between the eyeball and its socket, which can cause pain and infection. This is caused by a water sac that serves as bacterial breeding ground. Additionally, the mismatched iris colours can lead to unsightly issues. On the other hand, the customized ocular prosthesis has an advantage over the contralateral eye in terms of size and colour likeness. By preserving the equilibrium of pressure surrounding the eye socket, this can lessen the probability of lacerations and ulcerations on the conjunctiva. Because the iris and sclera of the personalized ocular prosthesis are made to order and painted, the results are more aesthetically pleasing. The main disadvantage of custom-made ocular prosthetics is that they take longer to make.[3-5]

Ocular impressions are typically made using alginate, silicone, or polyether materials. The choice of material depends on various factors including patient sensitivity, socket condition, and the ocularist's preference. Alginate is a popular choice due to its ease of use, although it must be used immediately due to its rapid setting time and tendency to shrink upon drying. Silicone materials, while more expensive, provide a more accurate and stable impression.[6]

Through our clinical report, a custom-made ocular prosthesis was made using acrylic resin materials, which aims to provide rehabilitative care and restore patient self-confidence. In this case, patient's eye has a shallow socket, which is complicated by the fact that the patient's eye profile tends to be convex. In this case, two types of impression techniques were performed to see which technique was better.

Case Report

A 27-year-old patient came to RSGM Prof. Soedomo UGM, on her . own initiative to have a suitable right ocular prosthesis made to improve her appearance because the patient was not confident.

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Figure 1. Initial patient profile

Figure 2. Initial impression making

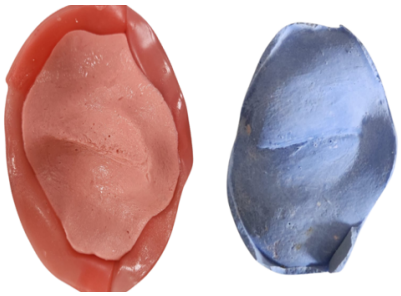

Figure 3. Initial impression and study model

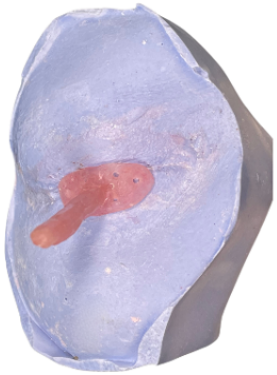

Figure 4. Individual tray

According to her medical history, the patient lost her right eyeball due to an infection of the retina in early 2023. The patient had undergone surgery to remove the eyeball (enucleation). The patient had previously used a fabricated ocular prosthesis after surgery, but the prosthesis didn't fit well and was uncomfortable.

At the first visit, anamnesis was taken of the patient, the patient's profile was photographed figure 1, and an impression of the study model was made using irreversible hydrocolloid or alginate impression material figure 2. Figure 3 shows the initial impression and study model.

Subsequently, individual tray was made using acrylic resin. Try-in the individual tray on the patient's eye socket, making sure there are absence of sharp parts. The eye impression is taken using a rubber-based impression 'material. The patient is seated upright, looking straight ahead, and is instructed to relax and cover the skin of the impression area with Vaseline. The impression for work model were taken two times with different technique. Polyvinyl siloxane was the material that used in this case. The first one was using putty and light body and the second one using light body only.

On the second visit, a working model is made using 2 different impression methods. Before the impression making, first try-in the individual tray figure 5A. The individual tray should not be sharp as it may cause pain to the patient. The impression was then taken using two methods. The first method was using putty and a light body figure 5B and figure 5C. The putty material is placed on the individual tray first. The light body material was injected into the eye socket until it was full, then the individual tray containing the putty material was inserted back into the eye socket. Wait until it sets. The impression was checked, as are the eye sockets, to ensure that no impression material was left in the eye sockets. In the second impression technique, the impression material used was a light body figure 5D, which is directly injected into the eye socket, and then the individual tray is inserted 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 are obtained figure 6A and figure 6B.[7]

The next stage was making a mould to make the wax model figure 7. The mould was filled in three parts, the first part of the mould was filled with hard gypsum until the widest part of the socket base mould, the excess hard gypsum is smoothed out. Before the setting time ends, two or three indentations are made on the surface of the hard gypsum which will later function as keys. The hard cast was then coated with vaseline and the second and third part was divided by wax and part of the mould was filled with hard gypsum. After the working model hardens, the impression material and individual tray were removed from the working model. The working model can be separated into three parts. Next, the working model was trimmed with a plaster knife.

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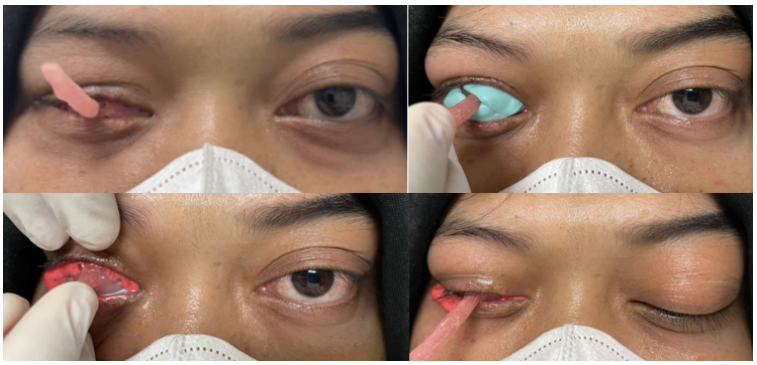

Figure 5. A. Individual tray try-in, B. Putty impression making, C. Lightbody impression making after putty, D. Light body only impression making

Figure 6. A. Putty and light body impression, B. Light body only impression

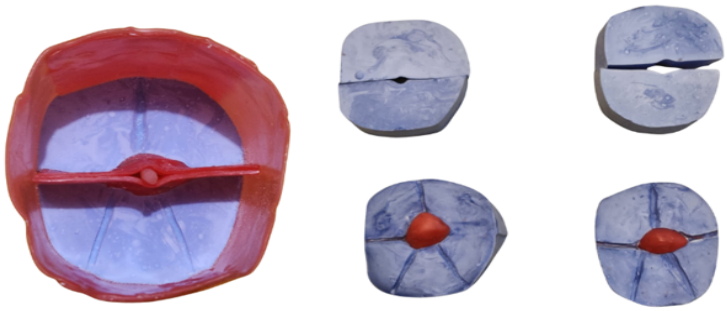

Figure 7. Mould and wax model making

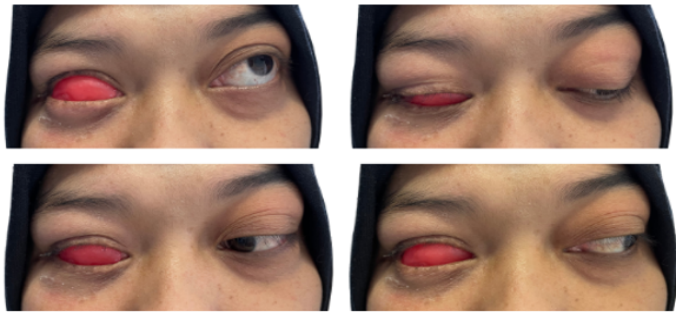

Figure 8. Try-in the wax model by instructing the patient to look up and down, left and right

Using modelling wax and the working model impression as a guide, the sclera model was created. Wax scleral model try-in. After telling the patient to sit up straight and unwind, the scleral model was placed into the socket. The patient was asked to look left and right, and up and down to ensure the model did not fall out of the socket figure 8. Apart from that, check the edge area to see if there are empty gaps or parts that don't fit properly. Since an accurate impression technique may reliably capture the interior tissue surface and fornixes of the socket, most authors concur that a critical step in assessing fit is a wax trial ocular prosthesis try-in.[8] In this third visit, a shade guide was used to determine the scleral colour figure 9. The results of the scleral model and colour determination photograph were sent to the laboratory for the fabrication of the acrylic sclera. Try-in the wax model by instructing the patient to perform physiological eye movements.

On the fourth visit, try-in the scleral acrylic to the socket. The upper eyelid was lifted and the upper edge of the sclera was inserted. The lower eyelid was then retracted slightly to allow the lower border of the acrylic sclera to be included. The acrylic sclera should be comfortable and there should be no complaints of pain. The sclera must be symmetrical to the opposite eye. The patient was again asked to look left and right, and up and down to ensure the model does not fall out of the socket. At this visit, the location and diameter of the iris as well as the central pupil markings were made based on the opposite eye. The center of the pupil was marked with a pencil or marker. The patient's iris diameter was found to be 11 mm. Iris diameter was confirmed by direct measurement using a sliding calliper figure 10.

The center of the pupil and the diameter of iris were identified and marked on the blank acrylic sclera with the help of sliding calliper. After drawing the outline, the prosthesis was sent to the dental laboratories to draw the iris based on the patient's eye photograph.

The following appointment was for the insertion of the ocular prosthesis figure 11. During the insertion, it is important to check the following: Retention: the ocular prosthesis remains in place when worn and does not detach from the eye socket; Stabilization: when wearing an ocular prosthesis, there should be no pain, and the colour and symmetry should match the existing eye or protrusion of the eyeball; Comfort: the patient reports feeling comfortable while wearing their ocular prosthesis.

The patient was instructed to maintain cleanliness around the eye and to remove the ocular prosthesis at night for cleaning using cotton wool. A follow-up appointment was scheduled for 1 week later to monitor progress. During the appointment, the patient reported experiencing continuous tears at the beginning of use, but eventually adjusted and returned to normal. Apart from that, the patient reports feeling

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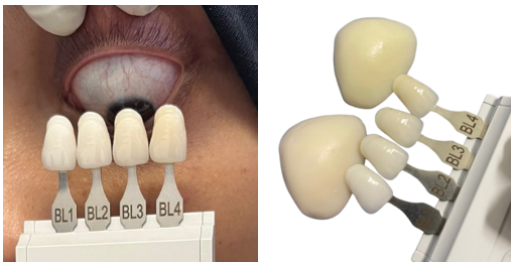

Figure 9. Determination of scleral colour with a dental shade guide

Figure 10. Determination of the central point of the pupil and pupil diameter

Figure 11. Before and after using ocular prosthesis

comfortable with the prosthesis and not experiencing any pain. The patient's appearance was nearly normal following the successful, effective, and aesthetically acceptable rehabilitation of the ocular defect, as evidenced by the results of the post-operative examinations.

Discussion

Eyes are one of the most specialized and developed sensory organs of the body. The loss of an eye has a deep effect on the psyche of a patient. In the present case report, the surgery and the loss of an eye had a significant psychological impact on the patient.[9] When compared to a stock ocular prosthesis, prosthetic rehabilitation with a custom-made ocular prosthesis can result in better and more gratifying outcomes for the patient on both an aesthetic and psychological level.[10] Acrylic is the material most frequently used due to its versatility, which benefits tissue, appearance, durability, resistance to colour fading, capacity to be sculpted to fit a socket, affordability, and ease of manipulation.[11]

Dental putty, which serves as the heavier, more stable base of the impression, is prepared according to the manufacturer's instructions. This putty is then inserted into the eye socket. The putty is chosen for its thicker consistency, which helps to create a stable base for the lighter, more detailed-impression material. Light body silicone impression material is known for its flowable consistency and ability to capture fine details. It is then applied over the putty or directly into the eye socket over the putty. Patients may be asked to close their eyelids or move their eyes in certain directions to ensure that the light body material spreads evenly and captures the intricate details of the socket. The advantages of using putty and light body silicone should be detail accuracy and comfort. The light body silicone captures fine details of the socket, while the putty provides a stable base. Both materials are generally well-tolerated by patients and do not cause discomfort when used correctly.[12-14]

In the impression results, it appears that the method using a light body showed better results compared to using putty and light body. According to Turner "Light body impression materials have good biocompatibility and good dimensional stability so that they are very accurate in eye impression".[15]

The patient's eye was then used to test the fit, comfort, and bulkiness of the wax design. Corneal prominence was checked for by standing behind the patient. This will affect the retention of the ocular prosthesis. When there is too prominence ocular prosthesis in the case of a shallow socket it will reduce retention.[16] Wax model should fit in eye properly and should not come out while moving eye in all directions.[17]

Conclusion

For shallow eye sockets, an impression technique utilizing only light body silicone is recommended. This method's fluid viscosity enables it to cover a larger area and capture finer details, resulting in a more accurate and comfortable fit for the ocular prosthesis.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Metal frame overdenture retained with metal medium coping and magnet

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Keywords: Magnet, Medium coping, Metal frame overdenture

ABSTRACT

Overdenture is a removable denture that replaces partial or complete tooth loss and rests on remaining natural teeth or implants. The overdenture concept of avoiding bone resorption can be used as a continuation of root canal treatment so that the alveolar bone remains well preserved. This case report describes prosthodontic rehabilitation with coping and magnet overdentures to increase retention, stability, and reduce bone resorption that will occur due to tooth extraction. A 65-year-old female patient wanted to have new dentures because the old dentures were loose and unaesthetic. Overdentures with metal medium coping and a magnet were made to increase retention for the new upper denture. A metal medium coping with a length of 3–4 mm on the second upper molar can increase retention by the friction force between the coping and the denture. A fabricated magnet, 3.6 mm in diameter with an attractive force of 700±50 gf, was mounted on the denture base, and the keeper was cemented to the second upper premolar as a supporting tooth. The metal frame overdentures provided excellent retention, stability, functionally, and aesthetics. Metal frame overdentures can be treatment of choice to increase the retention and stabilization of dentures. (IJP 2025;6(1):26-30)

Introduction

The success of a treatment is inseparable from adequate planning in managing edentulous patients so that the results obtained can satisfy the patient aesthetically and functionally.[1] Overdentures are removable dentures that replace missing teeth partially or completely, where the denture is supported by one or more natural teeth, tooth roots, and/or dental implants.[2,3] Broadly, overdentures consist of two types: tooth-supported overdentures and implant-supported overdentures.[2,4,5] Implant-supported overdentures depend on the alveolar bone anatomy, the patient's financial status, and the patient's systemic condition which may hinder the patient from choosing this treatment option.[3,6,7] Meanwhile, tooth-supported overdentures are more preventive, simpler, and more cost-effective.[8] The concept of overdentures is to prevent alveolar bone resorption and is performed as a continuation of root canal treatment to ensure the alveolar bone remains well-preserved.[5,6] Overdentures are commonly used today because periodontal treatment, endodontic treatment, and caries control techniques can be relied upon.[7] The benefits of maintaining natural teeth and/or their roots include increased stability and retention of dentures, improved chewing efficiency, preservation of the periodontium which acts as a shock absorber, maintaining the elastic modulus of teeth near the bone and preserving bone, preserving alveolar bone and muscle patterns, as well as maintaining sensory stimulation and vertical dimension.[9,10] Overdentures can be the best treatment alternative because they can provide additional support to the denture, prevent alveolar bone resorption, and maintain the proprioceptive ability of the periodontal tissues. This case report describes prosthodontic rehabilitation with metal medium coping and magnet overdentures to increase retention, stability, and reduce bone resorption that will occur due to tooth extraction.

Figure 1. Intra oral examination

Case Report

A 64-year-old woman came to the Prosthodontics Department at RSGM Prof. Soedomo wanted to have dentures because many of her teeth were missing, and the existing dentures (thermoplastic nylon) were uncomfortable, leading to a decrease in appearance and difficulty chewing food. Multiple teeth had been extracted, affecting both aesthetics and function. Intraoral examination revealed missing teeth in the upper jaw (18, 16, 14, 13, 12, 11, 21, 22, 23, 24, 25, 26, 27, 28) and lower jaw (48, 47, 46, 45, 34, 36, 37, 38) figure 1.

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Figure 2. Pre-treatment extraoral examination

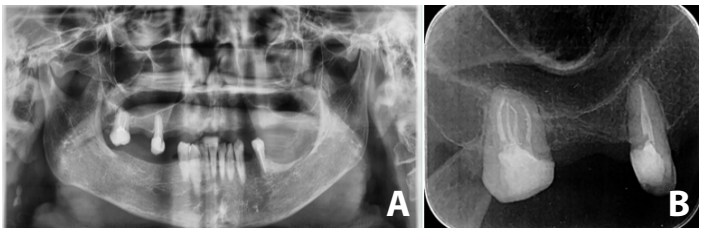

Figure 3. A. Panoramic radiograph, B. Periapical radiograph

Figure 4. The impressions to fabricate study model

Figure 5. The tooth color with shade giude

Figure 6. Try in keeper magnet

The patient's general condition was normal, with no history of systemic diseases or allergies. Patient was not under medical care or taking medication regularly. The patient had undergone root canal treatment (endodontics) on 17 and 15. Teeth 15 and 17 extruded of approximately ± 2 mm. Extraoral examination, the patient exhibited a symmetrical and normal facial appearance figure 2.

Radiographic examinations (panoramic radiograph figure 3A and periapical radiograph figure 3B revealed that the periodontal tissues around teeth 15 and 17 were in good condition, with hermetic root canal treatment. In this case, the patient had previously worn upper dentures but rarely used lower dentures, resulting in extrusion of the remaining upper teeth due to the loss of many antagonistic teeth. The prognosis for this treatment is good, as the remaining teeth will be utilized as support for the overdenture, thereby enhancing retention and stability of the prosthetic teeth. The treatment plan involved providing a single complete overdenture supported by teeth in the upper jaw (magnet on 15 and medium metal coping on 17) and a metal frame removable partial denture incorporates a lingual bar major connector, with RPY clasp applied to teeth 33, akers clasp with mesial occlusal rest applied to teeth 44, and mesio-distal clasp on teeth 45 in the lower jaw. The patient had agreed to undergo the treatment.

During the first treatment visit, a study model was created using a stock tray no. 2 and alginate impression material for the maxilla and mandible figure 4. The tooth color was determined to be A3.5 Ivoclar shade guide figure 5.

The second visit, crown cutting was performed on teeth 15 and 17 to create an overdenture magnet on tooth 15 and an overdenture short-medium coping on tooth 17. Gutta-percha removal from tooth 15 was done using a peeso reamer, along the length of the keeper to be used. The root preparation process involves reaming until a red band is reached, at a depth of approximately 7mm, to accommodate the root keeper, followed by a trial placement of the keeper and reclosure using temporary filling material figure 6. Crown preparation was performed on tooth 17 to fabricated an overdenture coping, leaving approximately ± 3 mm of the tooth crown. Gingival retraction with retraction cord and adrenaline was then followed by the impression of the working model using a perforated stock tray and polyvinyl siloxane impression material for the fabrication of the metal coping figure 7.

The third visit, after the overdenture coping was ready, a trial placement was done on tooth 17, and the accuracy of the coping's edge was checked. The coping was cemented onto tooth 17 using glass ionomer cement luting figure 8A. Impression was taken using Hydrophilic Vinyl Polysiloxane Impression material (monophase) with a custom individual impression tray previously made for the fabrication of the metal framework overdenture base for the maxilla figure 8B and the removable partial denture with metal framework for the mandible.

During the fourth visit, after the metal framework base plate and the bite rim were ready figure 9, recording of the maxillomandibular relationship (MMR) was performed by measuring the patient's vertical dimension and determining the centric relation

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Figure 7. The impressions to fabricate metal medium coping

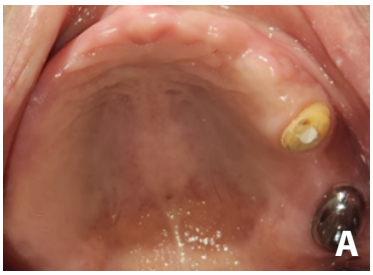

Figure 8. A. Metal medium coping cementation, B. The impressions to fabricate work model

Figure 9. Metal Framework Base plate and bite rim Maxilla and Mandible

Figure 11. A. Camper's line with oclusal guide plane, B. Trying the bit rimes and recording MMR, C. Fixation

figure 10A and figure 10B. Subsequently, the midline (by drawing a line from the philtrum to determine the midline), canine line (to determine the mesiodistal width of the anterior teeth), and smile line (created at 2/3 length of the anterior teeth/upper incisors) were established. After the correct bite and VDO recorded by the bite rim, fixation was applied to both sides of the bite figure 10C, and then the correct bite was removed from the patient's mouth. Next, tooth arrangement were done on the articulator based on our bite rim record figure 11A.

The fifth visit, the trial placement of tooth arrangement was performed on the patient figure 11B. The anterior tooth arrangement on the articulator was then tried on the patient. Overjet, overbite, midline, canine line, smile line, and phonetics were good and patient was satisfied. Subsequently, the arrangement of posterior teeth was continued and tried on the patient, followed by checking occlusion, retention, stability, phonetics, and aesthetics. The procedure was then continued with laboratory packing and processing, culminating in a polished and refined the denture.

During the sixth visit, the metal framework overdenture for the maxilla and the removable partial denture with metal framework for the mandibular teeth were inserted. The magnet keeper was attached to tooth 15 using resin cement figure 12A, and the magnet was embedded in the base plate using self-cured acrylic figure 12B. The magnet was a fabricated magnet (Magteeth™ RK 700), 3.6 mm in diameter with an attractive force of 700±50 gf. Following this, the keeper and magnet surfaces are sandblasted to improve bonding. Monobond primer (Monobond®, Ivoclar) is then applied onto the root keeper, and specific bonding agents are used on the tooth root canal surface. During the cementation process, it's crucial to ensure that the keeper's surface remains free from contamination. This is achieved by attaching the magnet along with the keeper, thereby preventing any obstruction to magnetic attraction. Checks on retention, stability, occlusion, phonetics, aesthetics, and patient comfort while wearing the dentures were. Grinding was performed in areas experiencing traumatic occlusion.

The patient did not have any complaints after the overdenture placement figure 13. The patient reported no issues with retention, stability, occlusion, phonetics, and aesthetics while using the dentures. The patient expressed satisfaction with the treatment outcome. Instructions were given to the patient to remove the dentures, maintain denture hygiene, remove the dentures before sleeping and soak them in clean water in a covered container, promptly contact the dentist if there are any complaints or pain, and attend scheduled check-ups. The patient was also instructed on how to wear and remove the dentures.

The follow-up appointment was scheduled for the seventh visit or 1 week after insertion. During the subjective examination, there were no complaints, and the patient

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Figure 11. A. Arranging the Anterior and Posterior teeth, B. Try in

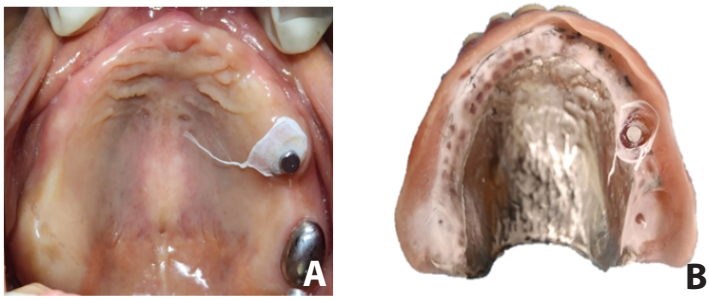

Figure 12. A. Magnet keeper was attached, B. Magnet was embedded in the base plate

Figure 13. Denture Insertion

Figure 14. Post-treatment extraoral examination on control day

expressed satisfaction with the new dentures in terms of retention, stability, and aesthetics. In the objective examination, there were no signs of inflammation in the gingiva, no food impaction, and good retention, stability, and occlusion. The patient was instructed to continue maintaining oral hygiene and to attend regular check-ups.

One month after the insertion, a follow-up appointment was scheduled. The patient had no complaints and was satisfied with the results of the dentures. The surrounding tissues of the dentures were healthy, and the patient's oral hygiene was maintained. The patient was instructed to visit the dentist regularly every six months.

Discussion

The incorrect treatment plan resulted in errors in determining the type and material of the denture for the patient.[11] Errors in the material or type of denture can lead to resorption of the alveolar bone.[11,12] This continuous resorption has the potential to cause major prosthodontic issues and challenges for both the patient and the dentist.[13,14] Maintaining the natural teeth that are still present has a positive impact on denture durability and retention.[2,6] Additionally, this metal framework overdenture can increase the stability of the prosthetic teeth, thus reducing the risk of resorption of the underlying alveolar bone.[1,15] The fabrication of overdentures is an effective approach to preserving the patient's remaining teeth, thus preventing tooth loss.[9,10] This is done to prevent alveolar ridge resorption, maintain proprioceptive abilities of the periodontal tissues, and enhance support for the dentures.[3,6,7]

The patient's dental condition serves as the basis for selecting magnet overdentures. The remaining teeth in the upper jaw, specifically teeth 15 and 17, have experienced extrusion, making them the primary consideration for retention teeth in the overdenture.[11,16] These teeth meet the criteria for magnet overdenture retainers or copings, as they are in good health, have minimal mobility, normal sulcus depth, well-attached gingiva, and healthy periodontal tissues.[10,17,18]

The magnet used in this case is a combination of stainless steel and neodymium magnets, forming a magnetic circuit between the magnet, keeper, and housing, thereby enhancing the attraction force.[9,11] Stainless steel is soldered using micro-laser methods to ensure the magnet's resistance to corrosion.[12] The magnet design employed for overdentures in this case is a closed-field system to ensure that the level of magnetic leakage at the gingival margin remains within normal limits.[11] The magnet is embedded only in the denture base facing the keeper, while the keeper is made of ferromagnetic material.[15] The surface of the keeper is coated with chromium to protect it from oxidation during the casting process. The magnet support has an elliptical shape to withstand rotational forces and is fixed onto the denture base.[19,20] The magnet is embedded in the denture base using self-cured acrylic material.[11,21]

The Magteeth™ keeper and magnet system employs an innovative manufacturing process that contributes to increased magnetic retention force, greatly improving the functionality of dentures and the comfort of patients. Through advanced manufacturing techniques, strong retentive force, and self-reseating capabilities, this attachment ensures stable support

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during chewing and oral movements.[12] Its resistance to displacement, decreased risk of seal breakage, and long-term durability address common issues encountered by denture wearers. By offering consistent retention and seamlessly adapting to denture movement, the attachment improves chewing efficiency, speech, and overall oral function, ultimately enhancing the quality of life and satisfaction of patients with their prosthetic solution.[19]

The benefits of magnetic attachments include their shorter length compared to mechanical counterparts, making them suitable for situations where there's limited inter-arch space.[12] Additionally, they can accommodate moderately nonparallel abutments as they don't require a specific insertion path.[15] Unlike castings, fabricated magnetic attachments eliminate the need for certain laboratory procedures.[12] Furthermore, they offer increased flexibility and enable unrestricted movement of the prosthesis.[5,22]

In this case, an overdenture is fabricated with a medium metal coping on the right maxillary molars. Reducing the height of tooth 17 by 3 mm above the gingival margin increases the crown-to-root ratio, reduces pressure on the tooth, and provides space for the overdenture. As a result, the patient can effectively use the denture for chewing and speaking.[2] The medium metal coping provides additional support and enhances retention.[1,17] Moreover, this design reduces horizontal torque and allows for proper load distribution along the ridge.[9,22]

The fabrication of this overdenture includes adding a cobalt-chromium metal framework to the base. This is done to provide better stability to the denture.[2,13] Additionally, overdenture fractures often occur in regions where there are copings.[1,8] To prevent fractures in the denture base, a reinforcement with an additional metal framework is added. Moreover, this metal framework overdenture can enhance the stability of the denture, reducing the risk of alveolar bone resorption underneath.[7,16] One crucial requirement for the success of overdentures is that the patient understands the importance of maintaining oral hygiene for both the retained teeth and the denture.[16,17] This includes using fluoride-containing toothpaste and regular dental visits every six months.[18] The success of overdenture treatment also depends on the patient's awareness of maintaining oral hygiene and the patient's ability to maintain dentures.[18,22]

Conclusion

The use of magnet and metal medium coping with a tooth-supported overdenture is an easy and affordable alternative therapy. Metal frame overdentures retained with metal medium coping and magnet provides additional support to the denture to increase retention, stability, and reduce bone resorption that will occur due to tooth extraction.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Tooth-Supported overdenture retained with bareroot, coping and magnetic attachment

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Keywords: Bareroot, Copping, Magnetic attachment, Overdenture

ABSTRACT

Overdenture is removable denture used to replace missing teeth and cover or rest on one or more remaining natural teeth in the mouth. Types of overdentures are non-copping abutment, abutment with copping (long, medium, short) and abutment with Attachment. Abutment with attachment overdenture can provide good retention and stabilization. The purpose of the case study is the assessment of retention improvement of overdenture dentures with coping and magnetic abutments in complete denture in the upper jaw and bareroot in complete denture in the lower jaw. A 59-year-old woman reported having the chief complaint of difficulty in chewing food and speaking due to missing teeth in the upper and lower arch. Intraoral examination revealed the remaining teeth were 17, 23, 24, 43, and had been extruded. Tooth 23 was done to support magnetic overdenture, tooth 24 supported coping overdenture in the full maxillary denture and 43 supported bareroot overdenture in the full mandibular denture. Magnetic and coping retained overdenture enhance the retention in the full maxillary denture and bareroot improves the stability of the mandibular complete denture. (IJP 2025;6(1):31-34)

Introduction

Tooth-supported overdentures constitute an important concept in preventive prosthodontics. Overdenture is a removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants. It is also known as overlay prosthesis, overlay denture, and superimposed prosthesis. In tooth-supported overdentures, the teeth are maintained as part of the residual ridge as it provides psychological benefit to the patients.[1] Alveolar bone resorbs at a faster rate without the support of natural dentition.[2]

The presence of some remaining natural teeth serves as a constant stimulus to the alveolar bone and thus minimizes bone resorption. There is better retention and stability when compared to the conventional complete dentures and also eliminate the need for implant supported overdentures which have more of financial, anatomical and medical constraints and can also be time consuming. Tooth sopported overdenture can reduced stress to the oral mucosa, maintenance of proprioception, bone preservation, increased of masticatory efficiency and reduced of psychological distress due to complete edentulism.[3]

Overdenture is indicated in patients with few remaining retainable teeth that are periodontally healthy or with potentially reversible periodontal disease, patients with malrelated ridge cases, patients with oral conditions such as xerostomia, patients who need a single denture; patients with unfavorable tongue position, muscle attachments, and high palate make it difficult to stabilize and maintain dentures.[4,5] Overdentures are contraindicated in patients with questionable oral prophylaxis, systemic complications, inadequate inter-arch distance,[5] inadequate attached gingiva and patients who cannot be motivated to develop the desired level of oral hygiene.[6]

Overdentures can be classified based on the preparation of the abutment teeth: non-copping abutment, abutment with copping – long, medium, short, and abutment with Attachment. Non-coping abutments are also called bare root overdentures. The advantages are that they are low cost, can be retreated or modified if necessary, and make it easier for the operator to make a treatment plan. In abutment with copping overdenture, a dome-shaped coping is made from metal and cemented to the abutment tooth. The choice of abutment with coping is that the abutment tooth has healthy periodontal tissue, does not have mobility of more than 1 mm, and has good bone support. Abutment with attachment overdenture can provide good retention and stabilization. One type of attachment is a magnetic overdenture.[7]

The magnetic attachment includes the magnetic assembly and the keeper. The magnetic part is the main part of the magnetic attachment and includes the magnet and its coating. The keeper is a metal part molded onto the root cap and attracted by a magnetic assembly. It should be noted that magnets increase the retention of partial or complete dentures and overdentures, regardless of the route of insertion. Magnets are easy to use alone or together with any type of retainer.[8] The case study aims to examine the increase in retention and stability of overdenture dentures with coping and magnetic

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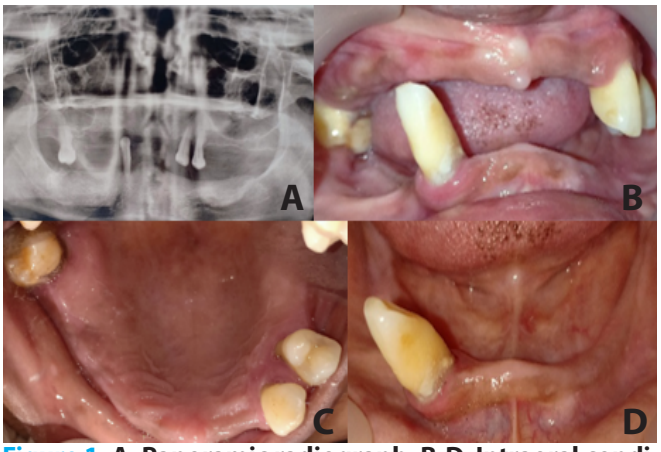

Figure 1. A. Panoramic radiograph, B-D. Intraoral condition

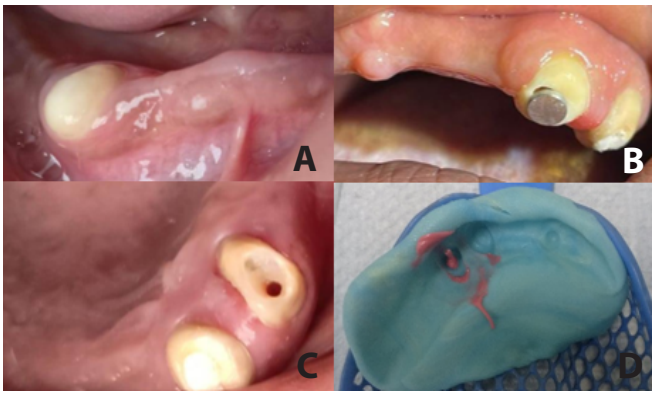

Figure 2. A. Bareroot preparation, B. Try-in keeper, C. Coping and postspace preparation, D. Coping and canal impression

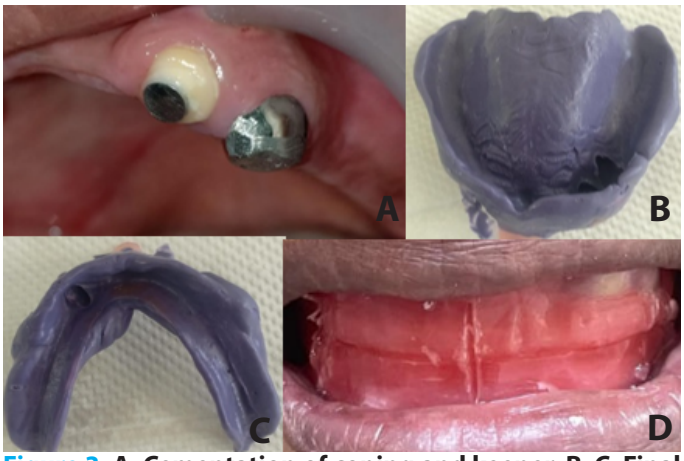

Figure 3. A. Cementation of coping and keeper, B, C. Final impression, D. Recording Maxilla Mandibular Relationship (MMR) and centric relation

abutments in the upper jaw and bareroots in complete dentures in the lower jaw.

Case Report

figure 1

A 59-year-old woman came to the Prosthodontics Department of RSGM UGM Prof. Soedomo wanted to have dentures because she had difficulty chewing food and speaking due to missing teeth in the upper and lower arch. The patient had no history of systemic disease and allergies. Intraoral examination revealed the loss of several teeth in the upper jaw and lower jaw figure 1. The remaining teeth (17, 23, 24, 43) have been extruded and mobility was found in the remaining right lower canine. There was calculus, gingival recession, and pocket formation along in the remaining teeth. The radiographs revealed general bone resorption in the upper and lower jaw. The patient was planned to construct a tooth-supported maxillary and mandibular overdenture. The patient agreed to get the treatment. The classical treatment plan consists of Phase I: oral health education, scaling and root planing, and extraction of 17 due to over-extrusion. Phase II: intentional root canal treatment (RCT). Phase III: fabrication of teeth supported Complete overdenture in the maxillary and mandibular arch. Phase IV: Follow-up and post-insertion care.

Procedure: At the first meeting, make an impression of maxilla and mandibula to make a study model (to design the denture) and match the tooth color with a shade guide. Next step, after the intentional root canal treatment of all their teeth, they were prepared with tapered round end diamond bur with a chamfer finish line. 43 were prepared to bareroot and restored with Glass Ionomer Cement (GIC) like a dome shape figure 2A. 23 was prepared and the gutta-percha was removed using a Peeso reamer according to the length of the keeper and then tried-in figure 2B. 24 were prepared and leaving ± 2-3 mm height from gingival margin and gutta-percha was removed to facilitate the placement of coping within the canal space figure 2C. Then postspace impression was obtained using gutta percha and light body and upper pickup impression was obtained using putty and light body figure 2D.

Metal coping was fabricated and evaluated for the fit and was inserted into the canal to evaluate the fit and its parallelism. After the trial fit, coping and keeper were cemented in the prepared root canal space with GIC figure 3A. The primary impressions were obtained with irreversible hydrocolloid material and custom trays were fabricated using auto-polymerizing resin. Final impressions for the maxillary and mandibular arches were made with monophase impression material figure 3B and figure 3C. Master casts were prepared by pouring the impressions in Type III dental stone (to make the overdenture baseplate). The overdenture base plates were retentive and stable when tried-in and the bite rim was made by wax on base plates. Trying in the bite rims to the patient and recording Maxilla Mandibular Relationship (MMR) and centric relations. Creating the median line, the canine lines, and the laugh line figure 3D. Doing fixation of both bite rims then taking out the bite rims from

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Figure 4. A. Arrangement of teeth, B. Tissue surface of maxillary denture with magnet, C. Insertion

Figure 5. A. Pre-operative view, B. Post-operative view

the patient's mouth and transferring to the articulator. Arranging the anterior teeth and the posterior teeth in the articulator figure 4A and then trying into the patient. Retention, stabilization, occlusion, phonetics, and aesthetics were appropriate and good after trying into the patient. The next step was processing the denture in the laboratory. Subjective and objective examinations must be done after a magnet is installed on the baseplate maxillary arch using auto-polymerizing resin and overdenture insertion figure 4B and figure 4C. The patient was satisfied with the treatment outcome figure 5A and figure 5B. Instructions post-insertion to the patient regarding denture maintenance and oral hygiene were given to the patient, and follow-up was arranged every three months. The patient had no complaints on the control day.

Discussion

Various studies have reported that there is a continuous resorption of the residual alveolar ridge in completely edentulous patients with complete dentures and this continuous resorption may lead to serious prosthodontic problems and difficulties both for the patient and the dentist.[9] Preserving the remaining natural teeth has an excellent effect on the retention and stability of dentures. Tooth-supported overdenture accomplishes three important goals. It maintains the abutment as a part of the residual ridge, providing more support than a conventional complete denture. When teeth are retained, the integrity of the alveolar bone is maintained because they support the alveolar bone. With the preservation of the teeth, there is also preservation of the periodontal membrane.[10]

In the following case, for mandibular using complete overdenture with bare root on 43. The bareroot abutment usually prepared to correct the crown-root ratio is compromised.[11] The root canal orifices are restored with an glass ionomer cement. It is recommended to restore the root canal orifice under dental dam isolation before reducing the crown height to the gingival level, which can avoid abutment isolation problems and increase the success rate of restoration and endodontic treatment.[4] Bareroot is expected can improve support and denture stability, increase the abutment teeth life expectancies, and inhibit resorption of the residual ridge of the mandible. For maxillary using a complete denture with magnet attachment on 23 and the short metal copping on 24.

Overdenture with magnetic retention has the advantage of being able to increase retention, overcoming the lateral forces of the abutment tooth, and easy application. Magnets are small in size but have great attraction and are placed on the bottom of the denture so that do not disturb the aesthetics, especially when it comes to anterior teeth.[12] That ninety-seven percent of patients were satisfied with the retention and stability of their overdenture with magnetic attachments after 5-years follow-up and no corrosion of magnet was observed during this period.[13] A systematic review and meta-analysis study reported that the survival rate of magnetic attachment was approximately 90%-92% after 3-years follow-up period.[14]

The short coping design showed the least amount of stress than any of the other designs. This design minimizes horizontal torque on the roots and provides easy maintenance of oral hygiene.[15] The use of copings on relatively porous dentin surfaces can protect abutment teeth from the penetration of

microorganisms.[16] A case series reported that all roots and copings remained in good condition, there were no reports of fractures of the denture base, loss of retention and stability and the patient was reported to be very satisfied with the treatment after 5-years follow-up. The use of short-copings reduces the risk of denture base fracture and the stress distribution to the remaining teeth is lower, especially with non-axial forces.[17]

Overdenture has advantages including preservation of residual ridge, maintenance of proprioception, improved retention and stability of dentures, it can be easily converted to a conventional complete denture by relining if abutment fails and psychological gain of not having lost all the natural teeth.[18] The patients restored with tooth supported overdenture showed higher masticatory efficiency than those restored with conventional complete dentures.[19] Disadvantages of overdenture include the need for increased oral hygiene to prevent caries and periodontitis. Dentures tend to be overly contoured to the position of natural teeth, increasing the risk of fractures if the thickness of the acrylic layer is insufficient and the appropriate amount of tooth grinding is not performed.[20]

Overdenture is an outstanding treatment modality as compared to conventional dentures. the success of the overdenture treatment depends on proper patient selection and motivation, basic prosthodontic principles, maintenance of oral hygiene, appropriate homecare, recall visits and radiographic examinations at regular intervals.[21] Brushing techniques, using fluoride toothpaste, and massaging the gum tissues were taught to patients for successful long-term overdenture treatment.[22]

Conclusion

Overdentures have proven many advantages and applications compared to conventional complete dentures. It is one of the best and most comfortable treatment alternatives for edentulous patients with few remaining teeth. Abutment with metal copping and magnet attachment can provide good retention, stability, support, and masticatory efficiency for the patient. While bareroot can improve support and denture stability of the mandibular complete denture. Regular follow-up is essential for the longevity of the prosthesis and for the preservation of the health of the remaining teeth.

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CASE REPORT

Ocular prosthesis modification with permanent soft liner in anopthalmic socket post evisceration

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Keywords: Custom ocular prosthesis, Evisceration, Permanent soft liner

ABSTRACT

Enucleation and eviseration are surgical procedures often used for the removal of the eye. Some post-eviserated patients have complaints of discomfort when using conformer or ocular prosthesis. Ocular prosthesis modified with permanent soft liner (PSL) on the intaglio surface is an alternative to reduce the discomfort. This case report aims to explain the use of PSL in the manufacture of custom ocular prostheses in post-eviscerated patient. A 72-year-old male patient came to RSGM USU complaining of difficulty to socialize because he lost his eye and wanted to make a prosthetic. The patient had evisceration 4 months ago and was given a silicone surgical conformer. Tearing was the common complaint, followed by itchiness, soreness and uncomfortable when the conformer is fitted. Custom ocular prosthesis is modified using PSL on the intaglio surface. The use of PSL provides comfort to patients because it acts as a shock absorber and shock distributor that can distribute pressure more evenly so that the tissue in the eye socket receives less impact force. Fabrication of new ocular prosthesis with PSL is a novel way to minimize trauma to underlying supporting tissues so it can reduce the discomfort of the patient. (IJP 2025;6(1):35-39)

Introduction

The eyes play an important role as one of the six senses in human. Loss of an eye in an individual will cause functional disability and discomfort that will affect physical, social and emotional aspects. The cause of eye loss can be due to trauma, damage from birth or surgical disposal. The surgical approach is carried out depending on the severity of the case, namely eviction, enucleation and exenteration.[1] Evisceration has gained popularity in recent decades. It is based on the perception that exertion provides superior functional and cosmetic results compared to enucleation.[2,3]

Evisceration is a surgical approach in which the removal of the globe (cornea, iris, lens, vitreous and retina) is removed but leaves the sclera and extraocular muscles. The optic nerve is also not removed or cut in this procedure.[1,4] The nerves and soft tissues that are still left behind in surgical procedures are sometimes compressed or experience excessive trauma, causing several problems when patients are made custom ocular prostheses such as pain, irritation, pressure sensations and watery eyes. Custom ocular prosthesis with permanent soft liner is a new way to minimize trauma to the underlying support tissue.[5-8]

Permanent soft liner is a soft, resilient and elastic material that can form all or part of the surface of the prosthesis. Permanent soft liners distribute strength more evenly and can absorb energy. It provides comfort to the tissue under the prosthesis by providing a cushioning effect.[9] Today, most patients are rehabilitated with ocular prostheses that are conventional and made of hot polymerized acrylic resin. However, some patients are maladaptive in their ability to tolerate conventional ocular prostheses, especially older patients with more sensitive eye tissue. In patients with anophthalmic sockets, the blinking reflex and tears do not function normally leading to problems such as discomfort, irritation, bacterial infection and mucus deposition which all make the prosthesis uncomfortable. Permanent soft liners are used to minimize direct pressure to soft tissues and as an even distribution of pressure. Permanent soft liner materials are processed in dental laboratories in a similar way to hot polymerized acrylic resin materials.[6]

The purpose of writing this case report is to explain the use of permanent soft liner on custom ocular prosthesis to provide better comfort and function for patients with post-eviserated anopthalmic socket.

Case Report

A 73-year-old male patient came to USU General Hospital in October 2022 complaining of embarrassment and difficulty socializing because he lost his left eye and wanted to make a prosthetic eye. The patient came to RSGM USU after surgery on his eye 4 months ago. The patient said that the patient's eye surgery was caused because his eyes hurt, sore and could not shed tears anymore since 2 years ago. Patients hope that with the presence of prosthetic eyes, patients can be more confident and carry out activities as usual. Figure 1.

The patient undergoes surgery or eviseration in Penang, Malaysia on July 4, 2023. Additional advice and advice from the

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Figure 1. Patient's look before treatment

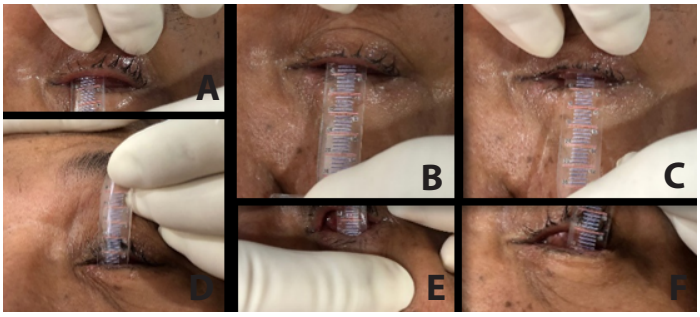

Figure 2. A-B. Measuring superior fornix palpebral depth with FDM, D-F. Measuring inferior fornix palpebral depth with Fornix Depth Measurer (FDM)

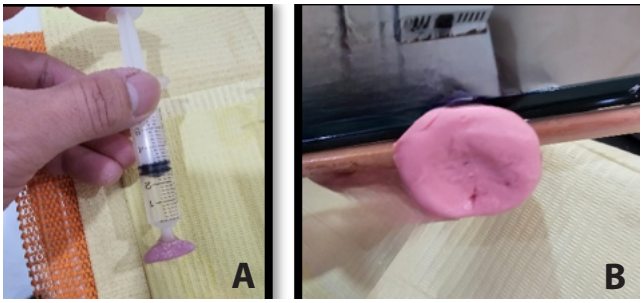

Figure 3. A. Anatomically tray that has been fixed on a syringe tip, B. Result of anatomical impression

Figure 4. Anatomical wax sclera

patient's ophthalmologist is to perform eyelid removal surgery to improve the patient's eye condition before making a custom occular prosthesis. The patient refused the operation because the patient's health condition did not allow him to go abroad repeatedly so the patient chose to make a custom occular prosthesis without surgery. The condition of the patient's eye socket and the depth of the fornix are adequate, so it was decided that the patient can immediately make a custom ocular prosthesis. The depth of the fornix is measured using the fornix depth measurer (FDM). Figure 2 Anatomical tray are made using a tray that has been adjusted to the size of the patient's eye socket using self-cured acrylic material by perforating the center of the tray so that the syringe tip from the alginate printing material can be fixed properly. Figure 3 The patient's eyelashes are smeared with vaseline then anatomicál impression is performed, the patient is instructed to move his eyes in all directions to get the border of the edge of the eye area on the printing sat.

The result of anatomical impression was casting using stone type IV to obtain molds used in making anatomical wax sclera which will later be used as a guide in making physiological tray. Figure 4.

The anatomical wax sclera is then tested into the patient's eye socket and adjusted according to the size and contour of the patient's original eye profile and the results will guide the creation of a physiological tray. Figure 5.

Then make a physiological tray from polyethylene sheet material to obtain a physiological mold using the size guide and convex contour of the anatomical wax sclera where the center of the tray is perforated for fixation of the mixing tip of the polyvinyl siloxane light body impression material and a few additional holes on the tray for retention of the impression material. The patient is instructed to move his eyes to obtain accurate edges of the eye. Figure 6.

The physiological molds will be made a working model with the split cast technique, namely by planting the intaglio surface in a type IV cast using a plastic cup and and key holes are made on the superior and inferior sides before the cast hardens. From the results of anatomical impression, a mold will be obtained for the manufacture of physiological wax sclera which will later become a custom ocular prosthesis. Figure 7.

On the next visit, try-in physiological sclera wax experiments and sclera color matching were carried out using shade guides and taking photos with smartphones in sunlight. Then the results of the photo are used as a guide or control for staining of the patient's sclera.

After that, a try-in sclera was carried out accompanied by iris positioning using a pupillary distance ruler and caliper.[10] The patient is instructed to look forward at one point, then measure the distance of the patient's glabela to the midline of the patient's normal iris, then match the size to the patient's left eye for which a custom occular prosthesis will be made. Measurement of the diameter of the patient's iris using the help of a caliper. The patient's normal iris is measured using a caliper and then the size is used as a guide in determining the iris diameter in the patient's custom occular

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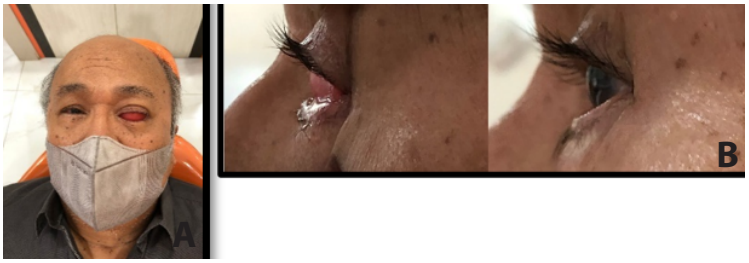

Figure 5. A. Try-in anatomical wax sclera-front view, B. Try-in anatomical wax sclera-side view

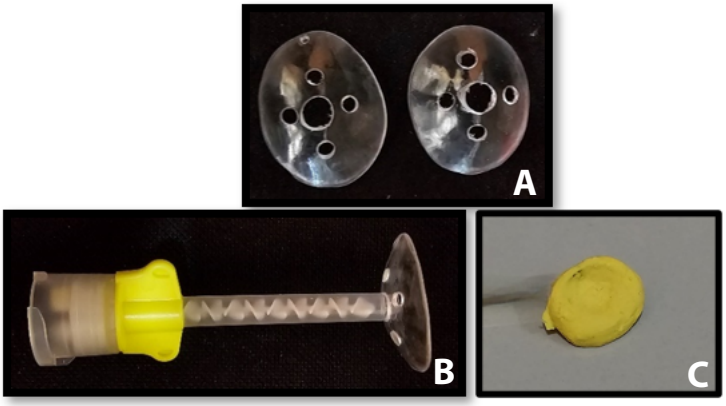

Figure 6. A. Physiological tray made from polyethylene sheet, B. Physiological tray that has been fixed on a syringe tip, C. Physiological impression results

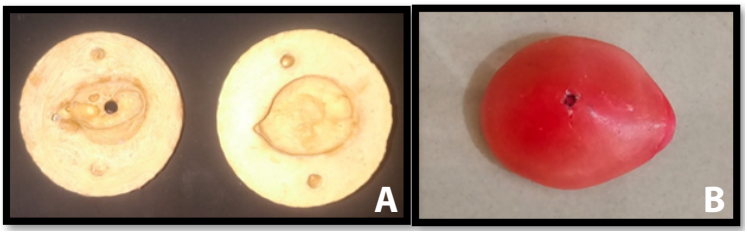

Figure 7. A. Physiological mold, B. Physiological wax sclera

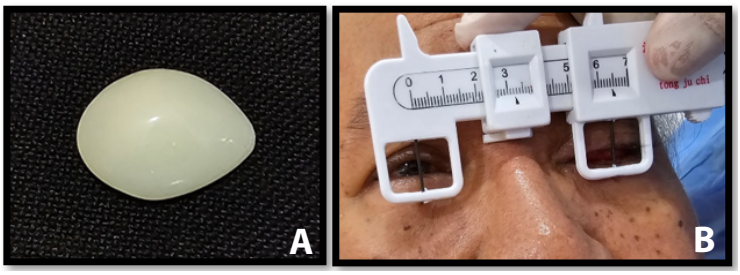

Figure 8. A. Photo of sclera made of resin, B. Photo of iris determination using pupillary distance ruler

prosthesis. Figure 8.

After that, make a putty index as a guide when placing clear acrylic for a clear lense effect. Then a reduction of sclera resin as deep as 4 mm according to the diameter of the iris that has been predetermined is carried out, colored according to the color of the patient's iris using acrylic paint, wait for it to dry with 1 hour according to the manufacturer's instructions, then coat it with UV resin and light using UV light. Figure 9.

Reduce sclera with putty index guidance then proceed with characterization of blood vessels in acrylic sclera using red thread. After that, curing the sclera again using clear acrylic. After finishing the curing, reduce the intaglio custom ocular prosthesis by about 2 mm, clean, apply adhesive primer, apply soft denture liner (Molloplast B), then press the cuvette for 10-15 minutes with a strength of 100 kPa using a hydraulic press, and rub with a temperature of 950C for 2 hours. The next step is polishing using polishing burs and pumice on the outer surface of the custom ocular prosthesis. Figure 10.

Custom ocular prosthesis is placed in the patient socket then appropriateness, aesthetics, and coordination of movements with the contralateral eye are evaluated. Post insertion instructions are given to the patient, regarding how to insert and maintain a custom ocular prosthesis. Figure 11 and figure 12.

Discussion

Custom ocular prosthesis modified soft denture liner with good comfort level is the goal of this case study. In previous studies, it was explained that the permanent addition of soft liner in the ocular prosthesis increases retention in shallow eye sockets of inadequate depth through increased close contact between the prosthesis and underlying tissue and also reduces traumatic impact on residual tissue through the even distribution of force load generated by the oculi orbicularis muscle.[6] Soft denture liner is a soft, resilient and elastic material that forms part of the surface of the ocular tissue of the prosthesis.[11-15] Soft denture liners can be temporary short-term liners, also known as tissue conditioners, and long-term liners / permanent soft liners.[10] The duration of use of the short-term liner is 1 month and the long-term liner reaches 1 year. Long-term liners are classified into auto-polymerised and heat-polymerised and can be either acrylic or silicone-based.[9]

This case study uses a permanent soft liner under the brand Molloplast B which is a silicone-based long-term soft liner with heat polymerization. This permanent soft liner was chosen because it has good hardness, modulus of elasticity and water sorption.[9] These characteristics are important parameters in determining the longevity of a soft denture liner. Research of Wright et al, which examined the length of time of permanent

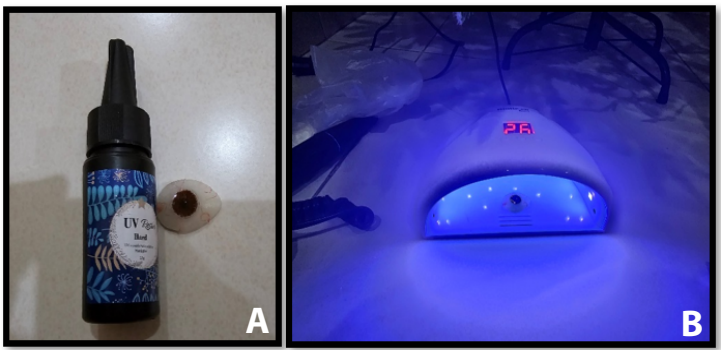

Figure 9. **A. UV resin, B. UV light**

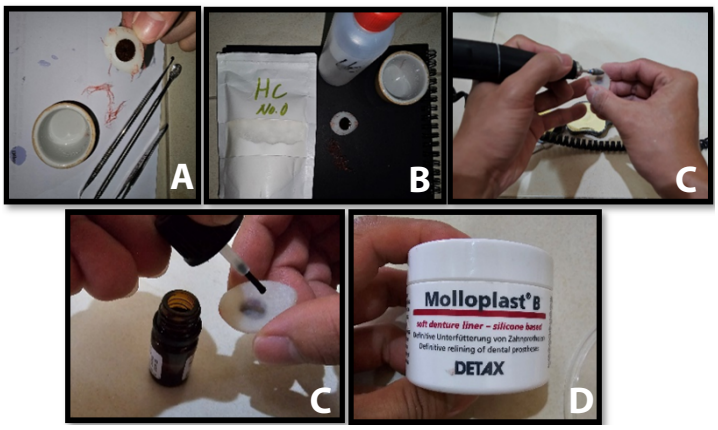

Figure 10. **A. Characterization of blood vessels using red thread, B. Clear acrylic application, C. 2 mm reduction in the intaglio section, D. Adhesive primer application, E. molloplast B**

Figure 11. **Custom ocular prosthesis**

Figure 12. **From left to right: Before insertion, insertion, 1st control, and 2nd control of custom ocular prosthesis**

soft liner use stated that the duration of use of Molloplast B reached 9 years.[16,17] Permanent soft liners made of silicone provide advantages in terms of viscoelasticity. Examined several permanent soft liners, both made from acrylic and silicone. The results of his research stated that silicone-based permanent soft liners are superior in terms of durability for viscosity properties.

The impact of using permanent soft liner in this case study is that it can better distribute pressure during functioning, absorb pressure and reduce the traumatic effects of postoperative eye tissue. This provides tissue comfort with a cushion effect between hard acrylic and soft tissue. This result is in accordance permanent soft liner materials produce a more even stress distribution on surfaces in contact with tissue and have excellent shock absorber properties so that eye tissue receives minimal pressure or load.

Conclusion

The fabrication of custom ocular prostheses modification with permanent soft liners is a new way to produce comfortable prostheses by minimizing direct trauma or pressure on the patient's eye tissue post-eviseration. This is because the soft liner provides a cushion effect, absorbs pressure / shock absorber and distributes pressure evenly.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Custom prosthetic rehabilitation of ocular defect in elderly

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Keywords: Custom prosthetic, Elderly, Ocular defect, Ocular prosthesis

ABSTRACT

Eye loss may cause deformities on patient's face that furthermore affect their psychosocial state. Ocular prosthesis is found to be effective to rehabilitate patients with eye loss due to trauma, congenital eye defect, tumor, or surgery. Elderly patients have special needs and limitations, such as communication, financial status, and access to healthcare providers. Through this case report, we present a successful fabrication of custom-made ocular prosthesis for elderly patient following right oculi enucleation. A 71-year-old male patient came with chief complaint of losing his old ocular prosthesis and wanted a new one. Initial impression was made with irreversible hydrocolloid. Final impression of patient's eye socket was made using individual custom tray and light body addition silicone impression material. A wax model was made and tried on patient, then processed with white acrylic resin to match patient's contralateral sclera color. Iris and pupil positioning were done, and ocular prosthesis was drawn to match patient's contralateral eye. The patient was satisfied with his new custom-made ocular prosthesis because of better fitting, comfort, and aesthetics compared to his old fabricated ocular prosthesis. Ocular prosthetic rehabilitation in elderly is associated with improvement of psychosocial status which leads to better quality of life. (IJP 2025;6(1):40-43)

Introduction

One of the most noticeable features of someone's face is their eyes which-play an important role in facial expression. Several unfortunate events such as trauma, congenital eye defects, or tumors may need surgical interventions that lead to loss of eye.[1] This condition is then followed by loss of vision and change of facial features which can lead to affect the patient's psychological and social state.[2]

Ocular prostheses have been used for a long time in the field of maxillofacial prosthetics as a way to rehabilitate patients who suffer from eye loss. The term of ocular prosthesis is described in the Glossary of Prosthodontic Terms as a maxillofacial prosthesis that artificially replaces a missing eye as a result of trauma, surgery, or congenital defect but the prosthesis does not replace missing eyelids or adjacent skin, mucosa, or muscle.[3] An ocular defect can be treated by prefabricated or custom-made ocular prosthesis. Custom-made ocular prosthesis usually provides better fitting and look like the patient's natural eyes hence helping them to feel more comfortable in wearing their prosthesis.[4]

The older population is now prevalent among patients in clinical settings, largely due to longer life expectancies. Many of today's elderly patients have socially active lives, seek information about their health, and remain engaged in society, leading to higher expectations for medical care. On the other side, elderly patients also have several limitations such as financial constraints, diminished cognitive and physical abilities, difficulty in communication, and some have suffered from low motivation. Treating elderly patients may have its challenges as many needs special care and treatment modification.[5]

An ocular prosthesis may enhance the physical appearance of patients who suffer from vision loss due to injury or illness that leads to eyeball loss. One of the primary goals in restoring anophthalmic socket with an ocular prosthesis is to enhance the patient's ability to manage the challenging rehabilitation of the eye loss and increase their quality of life.

Case Report

A 71-year-old male patient came to RSU Islam Klaten and reported to the Department of Prosthodontics, Faculty of Dentistry, Universitas Gadjah Mada with a defect in his right eye. A subjective and objective examination was done on this patient. The history of the patient revealed that this patient had undergone surgery to remove his right eye due to an infection that was caused by a chemical burn of fertilizer. Enucleation of the right bulbous right oculi causes an ocular defect that affects this patient's facial appearance. After the surgery, the ophthalmologist put a stock ocular prosthesis without telling the patient or his family. Three months after the surgery, the said stock ocular prosthesis was lost while this patient worked and hadn't worn any ocular prosthesis until his visit to RSU Islam Klaten. This patient felt embarrassed to go outside because he felt handicapped and wanted to make a new ocular prosthesis with a better fit and resembled his natural eye. An extraoral examination of the patient showed an ocular defect with a deep socket on the patient's right side figure

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Figure 1. A. Extraoral photograph, B. Inside socket

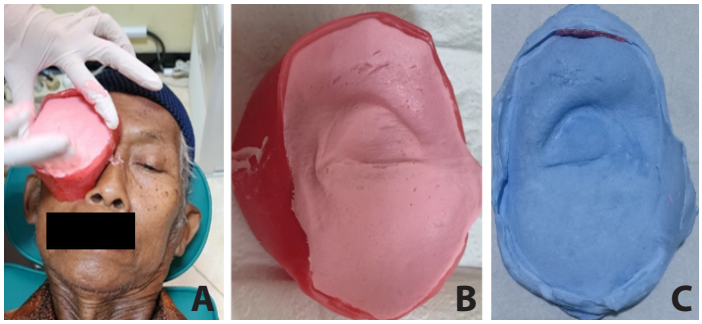

Figure 2. A. Initial impression making, B. Initial impression, C. Study model

Figure 3. A. Custom tray, B. Custom tray try-in, C. Final impression making

Figure 4. A. Scleral wax pattern try-in, B. Scleral color selection

1. The right eye socket has healed completely and retains muscle activity of surrounding muscles but often eye discharge was found on the anophthalmic socket. The treatment plan for this case is to fabricate a custom-made ocular prosthesis.

Several areas of impressions such as eyebrows, eyelashes, and the lining of the anophthalmic socket were lubricated using a separating medium (petroleum jelly). A custom tray was made using modeling wax and irreversible hydrocolloid was used as impression material for the initial impression figure 2.

The custom tray was created by shaping self-cure resin around the wax pattern obtained from the initial impression figure 3A. A custom tray was tried and adjusted before doing the impression and petroleum jelly was applied to the patient's eyelashes before the impression figure 3B. The 'final impression of the anophthalmic socket was made using the addition silicone impression material with light body consistency figure 3C. The patient was instructed to see straight ahead, perform all movements of the eyeball, and also blink his eyes when the impression was taken. The final impression was taken out from the patient socket using the handle of the custom tray when it was completely set.

The negative impression is filled in two parts. The first part of the mold is filled with a mixture of hard plaster until the widest part of the socket base, excess hard plaster is then smoothed out. Before the setting time ends, two or three grooves were made on the surface of the hard plaster which will later serve as keys. The hard plaster is then coated with petroleum jelly, and the second part of the mold is filled with a mixture of hard plaster. After the working model hardens, the impression material and impression tray are removed from the working model. The working model can be separated into two parts.

The scleral model was fabricated with modeling wax based on the working model impression. Try-in of the scleral model. The patient was instructed to sit upright and relax then the scleral model was inserted into the socket figure 4A. The scleral model should feel comfortable during eye movement and not irritate the underlying tissue. Determination of scleral color was done using photography with the assistance of a shade guide figure 4B. The results of the scleral model and color determination photograph are sent to the laboratory for the fabrication of the acrylic sclera.

The acrylic sclera was inserted into the patient's eye socket and then adjusted until natural eye contour was achieved and there was no discomfort when the patient performed all eye movements. Fitting and retention were also observed during this visit. The center of pupil and the diameter of iris were identified and marked on the blank acrylic sclera with the help of vernier caliper figure 5. A photograph of the patient's contralateral eye was taken to give guidance to the laboratory in drawing a natural iris on the prosthesis.

The prosthesis was inserted and assessed for any discomfort during eye closure or opening figure 6. The patient received instructions on how to remove and reinsert the prosthesis. Follow-up appointments were scheduled at 1 week, 1 month, and every 6 months to polish the prosthesis. The results of the post-operative assessments demonstrated a successful, efficient, and aesthetically

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pleasing rehabilitation of the ocular defect, resulting in a nearly normal appearance for the patient.

Extra care was given to this patient due to his age and psycho-social condition. Instruction was given in detail to patient and his family such as ways to care for and clean the prosthesis, when and how to wear it, and also how to manage his eye discharge that started after he was wearing his old prefabricated prosthesis.

One week follow-up showed no irritation on the surrounding tissues, good retention, and the patient was satisfied with his new ocular prosthesis. The initial eye discharge also lessened but he sometimes felt dryness on his ocular prosthesis side. This was handled with an artificial tear that happened to be relieving the dry eye syndrome.

Discussion

Ocular absence can arise from congenital factors or result from surgical interventions, necessitated by various conditions such as irreparable trauma, tumor, blindness painful eyes, microphthalmos, endophthalmitis, and suprachoroidal hemorrhage. Prosthetic solutions offer corrective measures for such ocular defects, serving multiple functions including aesthetic restoration, prevention of eyelid deformation, protection of the anophthalmic cavity, guidance of lacrimal flow, and prevention of fluid accumulation within the cavity.[6] It also reinstates natural eye-opening, provides support to the eyelid, enables partial movement restoration, and presents an aesthetically pleasing appearance with satisfactory mobility.[7] Moreover, ocular prosthetic rehabilitation plays a significant role in psychosocial enhancement, as prosthesis can positively influence interpersonal relationships, consequently improving overall quality of life.[8,9]

Before initiating the prosthesis design process, it is crucial to evaluate the psychological aspect to establish rapport and gain the patient's confidence. Additionally, conducting a thorough medical history assessment is essential, including the underlying condition that necessitated the excision or enucleation. This comprehensive evaluation helps identify any potential risks of recurrence and ensures a holistic approach to the patient's care.[10]

The shifting demographics in industrialized nations necessitate dentists to accommodate the increasing and diverse population of elderly patients. The aging population poses a significant challenge for modern societies. To promote both healthier and longer human lives, it is recommended to prioritize the creation of age-friendly environments and enhance social and healthcare facilities. This entails developing tailored approaches for dental and medical care to the varying levels of fitness, frailty, and dependency among older individuals. Dental and medical care for the elderly should be personalized, considering their unique daily routines and needs.[10,11]

Ocular prosthesis is usually classified into two types. The first one is stock eye prosthesis, which are available in various sizes, and the second is custom prosthesis. Stock eye prosthesis offer convenience as they are readily available, but they may not adapt perfectly to the ocular tissue bed. This can lead to issues like hollow spaces between the prosthesis and the tissue bed, which can accumulate mucus and increase the risk of infection. Custom prosthesis, on the other hand, are designed to fit the patient's tissues closely, provide more comfort, exact fitting on orbital socket that can lead to natural motility, and can better replicate the natural position of the sclera and iris.[12,13] Creating a custom prosthesis requires the prosthodontist to have a thorough understanding of ocular anatomy. They must accurately record ocular impressions to determine the precise iris position and address cosmetic concerns such as ptosis and reduced palpebral fissure in the affected eye.[12]

Figure 5. Iris positioning

Figure 6. Ocular prosthesis after insertion

Custom-made ocular prosthesis offers superior aesthetic results, enhancing the natural appearance and balance of the patient's facial features, because they involve fabricating and painting both the iris and sclera to match the patient's natural eye. Iris painting, a crucial step in the fabrication process, is complex and time-consuming. It demands artistic skills to ensure accurate replication of iris details.[14,15]

However, despite their benefits, custom prosthesis may be limited by factors such as age, systemic health conditions, and financial constraints, which can impact their availability and utilization. Some conditions such as aging may contribute to complicating the manufacturing of custom ocular prosthesis. Sagging lower eyelids are one example of this complication. The weight of the

prosthesis, combined with the upward force exerted by the upper eyelid, can contribute to the downward displacement of the lower eyelid, resulting in drooping.[16] Individuals wearing prosthetic eyes also frequently exhibit decreased tear production, leading to symptoms such as dryness, irritation, discomfort, and discharge associated with dry eye syndrome.[17]

Fabricating extraoral prostheses such as ocular prosthesis involves both artistry and scientific precision. Achieving seamless integration with surrounding natural tissues in terms of form, color, and texture is paramount.[18] Acrylic resin emerges as a favorable material for ocular prosthesis fabrication due to its durability, biocompatibility, ease of coloring, cost-effectiveness, easy maintenance, and reliable mechanical retention. Hence, it stands out as one of the preferred materials for crafting ocular prosthesis.[19]

An aesthetically acceptable ocular prosthesis accurately replicates the color, size, shape, and contour of the iris, enabling the patient to resume a normal lifestyle. The pivotal step in crafting custom-made ocular prosthesis is the positioning of the iris. Precise size, color, and location of the iris that match contralateral healthy eye leads to a successful ocular prosthesis.[20,21] While using a stock eye prosthesis may offer cost savings, it often lacks perfect adaptation to the eye's tissue bed, leading to discomfort and falling short of the patient's expectations. Enhanced aesthetics are achievable when the color and position of the iris match those of the unaffected eye, achievable through a fully customized ocular prosthesis. Prosthetic rehabilitation with a custom-made ocular prosthesis typically delivers superior aesthetic and psychological outcomes compared to stock eye prosthesis.[22]

Conclusion

Ocular prosthesis serves as a valuable solution for patients with eye defects, aiding in the restoration of aesthetics and improving overall appearance. Furthermore, it plays a significant role in psychological rehabilitation, particularly in cases where vision loss is irreversible. By providing a sense of normalcy and completeness, a prosthetic eye can positively impact the emotional well-being of individuals coping with permanent vision loss, especially in the elderly. Future studies could investigate the use of advanced biocompatible materials, such as silicone elastomers or 3D-printed polymers, in the fabrication of ocular prostheses. These materials may offer improved durability, comfort, and aesthetic outcomes compared to traditional acrylic resin. Incorporating digital technologies like CAD/CAM systems and 3D printing into the fabrication process could also streamline production, enhance precision, and reduce costs. Research into the feasibility and effectiveness of these technologies in ocular prosthetics could be valuable.

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INDONESIAN JOURNAL OF PROSTHODONTICS

CASE REPORT

Management of mandibular flat ridge using modified suction-effective method in geriatric patient

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Keywords: Closed-mouth impression, Complete denture, Geriatric patient, Modified suction-effective method, Semi-adjustable articulator

ABSTRACT

Geriatric patient has compromised medical conditions, physical disability, and cognitive impairment, thus the treatment plan must consider many factors both local and systemic condition of the patient. The main problem that often arises when treating edentulous patients, especially in elderly patients, is severe mandibular ridge resorption. This makes it difficult to achieve retention and stabilization of the mandibular complete denture. One technique to overcome this problem is using suction effective mandibular complete denture introduced by Dr. Jiro Abe. This method can provide sealing of the entire denture border including the retromolar pad area. This report aimed to elaborate the management of flat mandibular ridge using modified suction-effective method in geriatric patient. A 71-year-old male geriatric patient with fully edentulous teeth came with history of hypertension and high risk of falling. The patient had never used any denture before and wanted to be able to eat properly and seek improvement in appearance. The mandibular showed highly resorbed ridge along with spongious tissue. Modification of this technique carried out by utilizing semi-adjustable articulator and the use of bite rim mounted on custom tray which facilitated closed-mouth impression that is in accordance with patient's functional movement in occlusion state. Rehabilitation of complete denture in elderly patients must consider efficient and appropriate method according to the patient's systemic and local conditions. Flat ridge management in geriatric patient using semi-adjustable articulator and modified suction-effective method can provide retention and stability in mandibular complete denture. (IJP 2025;6(1):44-49)

Introduction

Geriatrics is a branch of medical discipline that studies aspects of health and medicine for the elderly, including health services for the elderly by studying all aspects of health in the form of promotion, prevention, diagnosis, treatment, and rehabilitation. Geriatric patients are elderly patients who have more than one physical and/or psychological disease; or have one disease and experience disorders due to decreased organ function, psychology, social, economic, and environmental conditions that require integrated health services with a multidisciplinary approach that works in an interdisciplinary manner.[1]

Generally, geriatric patient has compromised medical conditions, physical disability, cognitive impairment, thus treatment plan must consider many factors both local and systemic condition and best treatment plan for patient.[2] Degenerative condition in elderly might affect treatment plan, design of prostheses, and modification in making a denture may be needed to restore the function of teeth.[3] In treating geriatric patient, prosthodontist must have knowledge not only about aging in general, pathologic, and oral manifestation of systemic condition, but also special communication with elderly.[4,5]

Local intraoral condition which frequently found in elderly is missing all the tooth. Edentulous ridge that has been left for a long time resulted in significant alveolar bone resorption. The mandible is more difficult to achieve stability, retention and support compared to the maxilla due to limited denture bearing area of the residual ridge, tongue mobility in the mouth, and extensively mobile mucobuccal fold during mouth opening and closing.[6,7]

The main problem that often arises when treating edentulous patients, especially in elderly patients, is severe mandibular ridge resorption.[8] This makes it difficult to achieve retention and stability of the mandibular complete denture.[9] One technique to overcome this problem is using suction-effective mandibular complete denture introduced by Dr. Jiro Abe.[8] This method can provide sealing of the entire denture border including the retromolar pad area with the aid of oral soft tissue which located in buccal mucosa, sublingual tissue, and the tongue sidewall.[10]

Good prognosis may be achieved due to optimal impression method which determine retention, stability, and support of soft and hard tissue in denture.[4] The preliminary impression play an important role in the making of suction-effective complete denture because it needs to record mandibular at physiological and rest position. it will affect the custom tray and final impression can imprint muscle attachment movement and minimal deformation in retromolar pad area thus creating suction effect.[7]

Suction-effective denture has the concept of creating

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Table 1. Result of P3G assessment form

Assessment	Result
Activity of Daily Living (ADL) with Barthel modification index	Score 19 Category B: mild dependent
Instrumental Activities of Daily Living (IADL) Lawton	Score 8 Independent
Risk of falling in elderly	Score 8: High risk of falling
Geriatric Depression Scale (GDS)	Score 3: No depression possibility
Mini Cog dan Clock Drawing Test (CDT4)	Score 2: Decreased cognitive function (Remember 4 words but couldn't draw a clock of 11.10)
Mini Nutritional Assessment (MNA)	Score 19 : Risk of malnutrition

Figure 1. Clinical intraoral photograph of right side, frontal, and left side

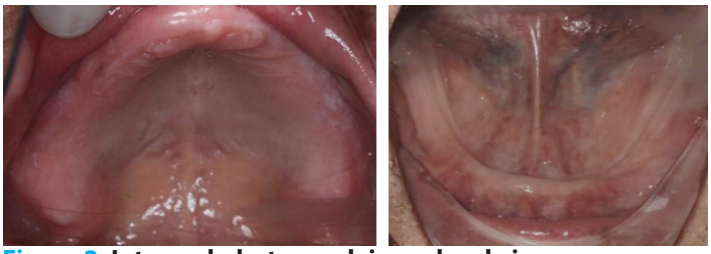

Figure 2. Intraoral photograph in occlusal view

Figure 3. Panoramic X-ray

negative pressure between inner surface of the denture border and mobile mucosa during swallowing or occlusion located in 4 areas which are labiobuccal, sublingual fold, retromylohyoid fossa and lateral of the tongue and buccal mucosa in retromolar pad area.[11,12] Modification of this technique carried out by utilizing semi-adjustable articulator and the use of bite rim mounted on custom tray which facilitated closed-mouth impression that is in accordance with patient's functional movement in occlusion state.

This report aimed to elaborate the management of complete denture in flat mandibular ridge using modified suction-effective method in geriatric patient.

Case Report

A 71-year-old male geriatric patient with fully edentulous teeth came to RSKGM FKG UI with history of hypertension and high risk of falling. There's no history of spontaneous bleeding in patient, last tooth extraction was conducted around 2 years ago at the front left upper tooth due to mobile tooth. There's also no history of making a denture before. This may ease the making of denture since patient didn't have any experience in using a denture. The patient wanted to be able to eat properly and seek improvement in appearance.

There's no abnormality found on extraoral clinical condition. The patient profile is concave. Intraoral examination showed missing all mandibular and maxillary teeth figure 1 and figure 2. The ridge is oval with medium in height, in maxilla. In mandibular, the ridge is flat in posterior left and right and oval in anterior with low tissue resistance. There's also present sufficient mobile oral mucosa in retro mylohyoid fossa and in anterior. The retro mylohyoid space is short, there's no tori or exostosis. The jaw relation is orthognathic.

At the first visit, the patient is also instructed to take a radiograph figure 3. Dental radiography, especially panoramic, has been used to predict lack of bone mineral density in patients. The mandibular cortical index (MCI) and panoramic mandibular index (PMI) have been developed to assess and quantify the quality and quantity of mandibular bone mass to observe signs of resorption in identifying osteopenia.[13] Radiographic examination showed missing in all mandibular and maxillary teeth. Cortical index is 3 mm. There's decreasing in bone density. Mandibular Cortical Index (MCI) is measured on the appearance of the lower border cortex of mandible, distal to mental foramen. MCI classified as C2 based on thickness and patterns of intra-cortical resorption of mandibular cortex. Meanwhile Panoramic Mandibular Index (PMI) is measured as ratio of superior margin of inferior mandibular cortex and bottom of the mandible at the middle of mental foramen.[13] Normal value is >0,3 while this patient has 0,3.

Geriatric patients have different characteristics and syndromes so they require a special approach oriented to bio-psycho-social aspects so that patient management can be complete.[14] By filling in the P3G form or known as Complete Geriatric Patient

Figure 4. A. Preliminary cast using FCB tray, B. Centric tray record, C. Centric tray mounted on articulator and custom tray were made with bite rim mount

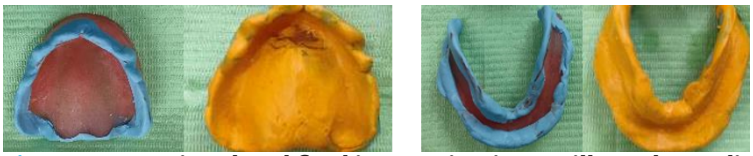

Figure 5. Functional and final impression in maxilla and mandible

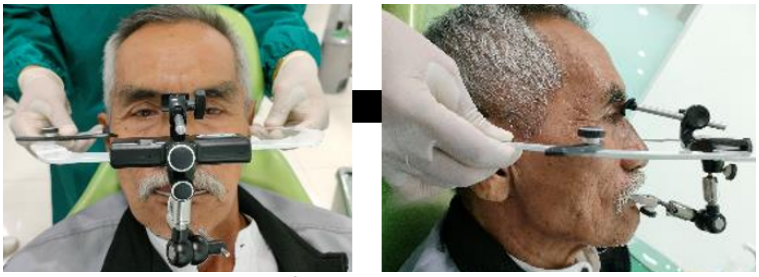

Figure 6. Facebow transfer using BioArt

Figure 7. Mounting on semi-adjustable articulator

Assessment, geriatric patients can be treated comprehensively, and their management becomes more effective and efficient. Components that need to be evaluated include assessing the patient's physical, functional status, mental and cognitive status, and nutritional status. It is hoped that this multidimensional assessment can enable operators to understand the condition of geriatric patients whole fully, thus supporting the success of the treatment that will be carried out on the patient.[14,15]

Based on the result of P3G assessment form table 1, the patient has a high fall risk score. The follow-up to this patient includes by identifying with yellow bracelets/ribbons while the patient in the hospital area. In addition, it is necessary to provide fall prevention education to patients and families. Treatment includes addressing risk factors for falls such as eye health, vision, hearing, and muscle health.[15] Therefore, prevention needs to be carried out by assessing the risk of falls in elderly patients with P3G form instruments.

The patient also has decreased cognitive function. Cognitive function is one of the complex functions in human body which located in brain. Cognitive is related to all mental activities associated with thinking, finding out and remembering.[16] Further evaluation needed to examine decreased cognitive function but communication with the care giver about cognitive function stimulation can be done. Cognitive function stimulation is an activity in the form of providing stimulation or incentives to elderly people to improve and optimize their cognitive function, such as physical and non-physical activity.[16] The patient also has risk of malnutrition. Recommendations for balanced nutrition for the elderly is needed. The care giver must be provided the information about setting dietary pattern for cognitive impairment.[17]

Management of this patient carried out with modified suction-effective method in mandibular complete denture. Started with preliminary impression of the maxilla with a stock tray, and the mandible with a Frame Cut Back (FCB) tray (J. Morita Corp., Tokyo, Japan). To obtain a seal in the posterior part of the oral cavity, contact between the denture and the soft tissue in the retro molar pad area is required.[18] This was helped by using FCB tray which has removed posterior lateral ridge wall and the retromolar pad area so that deformation at retromolar pad can be minimized.[7,12]

The initial impression is carried out with alginate irreversible hydrocolloid (Aromafine, GC, Japan) with two different consistencies. The patient is asked to rest his tongue on the tray, then the tray is pressed for 7-10 seconds, then the patient is asked to close his mouth until the material sets.[12] Do not press on the tray so that the situation in the oral cavity can be reproduced in real time. While waiting for setting, the patient's cheeks are gently massaged upwards to prevent the accumulation of impression material in the cheeks. The closed-mouth impression technique formed negative pressure on the inferior surface of the denture base when the denture sits on the alveolar

Figure 8. Try in complete denture wax

Figure 9. Polished acrylic complete denture intraorally

Figure 10. Modified suction-effective complete denture inserted in patient, A. Extra oral profile before insertion, B. Extra oral profile after insertion

ridge.[11,12] The retromolar pad must be imprinted well assuming that when the mouth is closed, the mandible is at rest position.[12,19] The impression then followed by type III gypsum for casting figure 4A.

At the same visit, the jaw relationship is recorded using a centric tray. Previously, the patient's vertical dimensions had been measured using the Niswonger method. Initial bite record measurements used heavy body material (Flexceed, GC, Japan) on the Centric Tray (Ivovlar Cicadent, AG, Schaan, Liechtenstein) figure 4B. The patient is asked to practice closing the mouth in a relaxed condition, then insert the centric tray slowly and the patient is instructed to close the oral cavity until the initial occlusion vertical dimension (OVD) size matches that before inserting the centric tray.[20] With this centric tray, initial VD is obtained 2-3 mm above the patient's original OVD.[12,18]

In this modified suction method, the study model was mounted on non-adjustable articulator. With the aid of the centric tray, individual custom trays were manufactured with bite rim mounts figure 4C.[11,12] The bite rim mounted in a custom tray helped in doing closed-mouth impression because the denture will sink slightly when teeth are brought into the occlusion from the mandibular resting position so that negative pressure will form, and a suction effect occurred. It is important to imprint the appropriate denture border that is in accordance with the patient's functional movement when the teeth are in occlusion.[12]

The custom trays were checked, the outline was different from the conventional custom tray which was based on muscle attachment.[11,18] The custom tray needs to cover the entire area required for the suction mechanism so that the denture border is completely sealed by the mobile oral mucosa. The custom tray must avoid buccal frenulum, mentalis muscle attachment, median inferior labial frenum, and sinew string. The sinew string mucosa forms in the area of buccal root of the retromolar pad, posterior to second molar when in tension. This will pull the buccal mucosa firmly inward when swallowing and closes the space posterior to M2 which affect the formation of the Buccal Tongue Contact (BTC) point. The posterior border seal is supported by contact of the buccal mucosa with the side of the tongue on the retromolar pad when closing the mouth which called as BTC point.[10,11,18,19]

At the second visit, final impression was acquired. Border molding was performed by functional movement to obtain a complete seal at the denture border and imprint the shape of the denture border which is in harmony with patient's functional movement when in occlusion. During the closed-mouth impression, the patient was instructed to move the lips forward, saying 'woo,' then asked the patient to retract the corner of the mouth, saying 'eeh,' to record the movement of the lips and buccal mucosa. After that, move the tongue to one side or another to record the movement of the tongue. The patient then asked to push the tray with the tongue to record the floor of the mouth in tension condition and the mylohyoid muscle during contraction. Asked the patient to swallow 2-3 times to record the mentalis muscle in active condition and records all movements of the oral cavity.[10-12,19]

The border molding firstly performed on maxilla by applying adhesive tray material at the edge and intaglio of maxillary individual tray. Inject PVS double impression (Flexceed Kit Putty and Light Body, GC, Japan) heavy body material on all its edges. The maxillary individual tray was inserted followed by mandibular individual tray. The patient was instructed to close the mouth and performed 5 functional movements which mentioned previously. The individual trays were removed subsequently, then evaluated and eliminated the excess of the material, especially the inner surface of the tray by using scalpel.[11] The procedure was continued by injecting light body material on the intaglio of individual tray to obtain final impression. The maxillary individual tray was inserted initially followed by mandibular tray, and the patient was instructed to do the same movement as in border molding. Wait for the material to set then remove the tray and cut the excess material. The next step was to acquire border molding of the mandible, the final impression then continued with the same procedure as in maxilla figure 5.[11] The final impression was performed beading and boxing then poured with gypsum type IV

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material to obtain a working cast.

The 3rd visit, the definite OVD was measured using Niswonger method. The correct OVD and closest speaking space were confirmed by counting down, checking the proper pronunciation space.[7] The bite rims fixated and patient's median, canine and smile line were marked. The facebow transfer then performed on patient using BioArt facebow transfer (Elite Facebow Transfer) figure 6. It resulted from plane orientations and angles according to the anatomical and physiology conditions of the patient's maxilla and horizontal axis.[21] The bite rims were mounted on working cast using BioArt semi-adjustable articulator figure 7. This provided the denture that had occlusion and articulation similar with that of the patient.[7] The tooth elements were then arranged based on centric occlusion, protrusive and lateral movement. The lingualized form of balanced occlusion was recommended for flat mandibular ridge which was done on the patient. Lingualized occlusion is indicated in patients with severe ridge resorption because it is more stable while chewing and can produce less occlusal force compared to bilateral balance occlusion so there is less pain.[7]

At the 4th visit, the complete denture wax was tried in for the patient figure 8. When trying it, listen to the patient's opinion and preferences in aesthetic aspect. Check tooth color, shape, and alignment to see if they match the patient's face.[12] The profile, retention, stability, and occlusion were checked by the operator. Then the gum cuff was performed then the complete denture wax was subjected to packing. The following visit was the insertion of modified mandibular suction-effective complete denture figure 9 and figure 10. The adaptation of denture bases with the mucosa were checked along with occlusion and articulation. The patient was given advice and instructions in using and cleaning the denture. The control visits were conducted to evaluate the adaptation of the denture.

Discussion

Rehabilitation of complete denture in elderly patients must consider efficient and appropriate method according to the patient's systemic and local conditions. The Complete Geriatric Patient Assessment or called as P3G form was provided by Indonesian Ministry of Health, which facilitated geriatric patients be treated comprehensively, and their management becomes more effective and efficient. Components that need to be evaluated include assessing the patient's physical, functional status, mental and cognitive status, and nutritional status.[14,15]

Dentures that sit on a resorbed residual ridge are more likely to be unstable. Therefore, it is more susceptible to air leaks at the edges and seals of the denture which can reduce the success rate of prosthodontic treatment. A study conducted by Hiroki Ii stated that mandibular suction-effective denture had a success rate of up to 86.9%.[8,20] The treatment stages are based on the concept of creating negative pressure between the denture and the alveolar mucosa by forming an effective and strong seal around the edges of the denture with the moving oral mucosa.[18]

Zarb stated that the aim of the denture impression technique is to expand the area that is resistant to pressure to achieve retentive and stable dentures.[22] This was obtained by initial impression of the oral cavity under static conditions. Dr. Jiro Abe developed the Frame Cut Back (FCB) Tray to support this. Modification of this technique carried out by utilizing semi-adjustable articulator and the use of bite rim mounted on custom tray which facilitated closed-mouth impression that is in accordance with patient's functional movement in occlusion state.[12]

Anatomical markings are factors that help in fabricating dentures so that they have maximum surface area without being affected by muscles.[20] The most important anatomical signs include retromolar pad, distobuccal border of denture, mylohyoid muscle, and Someya's sinew string.[20]

A study about masticatory movement in suction-effective denture showed efficient result. The masticatory patterns of right-side chewing, left-side chewing, free mastication showed reduction in mouth opening-closing time, an increase in the amount of mouth opening, an increase in speed of mastication and stable chewing rhythm.[6]

Conclusion

It can be concluded that flat ridge management in geriatric patient using modified suction-effective method can provide retention and stability in mandibular complete denture. Rehabilitation of complete denture in elderly patients must consider efficient and appropriate method according to the patient's systemic and local conditions. The patient had improved in appearance and masticatory function. It is hoped that the patient's malnutrition condition can also be improved by utilization of mandibular suction-effective denture and education regarding good nutrition.

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INDONESIAN JOURNAL OF PROSTHODONTICS

REVIEW

Accuracy of intraoral scanner on subgingival finish line with gingival retraction

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Keywords: Gingival retraction, Intraoral scanner, Precision, Subgingival finish line, Trueness

ABSTRACT

The development of intraoral scanner (IOS) technology has brought about a significant transformation in dentistry, enabling more efficient and accurate digital workflows. Studies show that IOS provides clinically acceptable accuracy similar to conventional methods, especially for fixed prothesis. However, there are special challenges when impression subgingival finish line accurately. The use of gingival retraction methods is essential for easy access to these margins. This literature review aims to describe the accuracy of IOS in impression subgingival finish line with the aid of gingival retraction, and compare the effectiveness of mechanical and chemical retraction methods in digital impression of subgingival finish line. Mechanical methods, such as the use of retraction cord, provide stability to the sulcus but may cause discomfort and potential damage to the periodontium. Meanwhile, chemical methods using aluminum chloride-based pastes show good results in displacing gingival tissue with minimal side effects. Based on existing studies, the combined method of mechanical and chemical retraction provides the best results for impression accuracy in the subgingival area, taking into account patient comfort and quality of the final result. Thus, choosing the right retraction method can improve clinical outcomes and ensure the long-term success of digital- based prosthodontic restorations. (IJP 2025;6(1):50-54)

Introduction

The advent of intraoral scanners (IOS) that permit digital workflows has shifted dentistry's focus in recent years towards digital approaches. Thanks to its numerous benefits, IOS has found its way into everyday practice. For example, patients love it since it's less painful than traditional impression methods. Additionally, IOS may decrease mistakes caused by the dimensional instability of traditional impression materials, speed up clinical operations, and enhance communication between patients, dentists, and lab personnel. Many recent in vivo and in vitro research have shown that these devices have clinically acceptable accuracy, which is equivalent to that of traditional impression, and subsequent scientific studies have focused on analysing the accuracy of IOS.[1] When taking an impression of a tooth to use as a denture support, be sure to imprint not just the area directly below the completion line but also the full preparation line. The marginal fit of the prosthesis may be assured by the tooth structure above the finish line, and the suitable extension of the prosthesis, like the emergence profile, can be determined by the tooth structure below the finish line.[2]

To ensure a proper internal and marginal fit for the prepared tooth, it is crucial to make accurate digital impressions. Properly fitting prosthetic restorations, which should be positioned to seal all margin preparations, is essential for their long-term effectiveness. The abutment teeth have a low chance of survival due to marginal penetration, cement disintegration from oral agents, plaque buildup, and the subsequent caries and periodontal issues that result from these issues. When the finish line preparation is supragingival, equigingival, or subgingival relative to the gingival margin, complications could occur.[1] A normal expansion into the gingival sulcus should not surpass 0.5 mm to 1 mm, according to several prior research. A major mistake that might lead to gingivitis and damage to the epithelial attachment tissue is placing the finish line at a depth greater than 1 mm.[3] When IOS is located in the gingival sulcus, it might be challenging to make an imprint of the finish line, according to many studies. Research in the lab has shown that scanning preparations that go deep into the sulcus is not advisable, and that scanning at the supragingival finish line yields better results than scanning at the subgingival level. This is because there are other variables, including neighbouring teeth or the gingival sulcus, that influence the IOS's performance and block the light from reaching the preparation margin.[1] In their research, Keeling et al. used IOS to model a number of confounding variables that impact finish line quality. The findings revealed that subgingival finish line scans often exhibited readily deformable characteristics, such as rounded edges and blurry borders.[2]

The restriction of the line of sight is the primary challenge when producing digital prints. In order to make digital imprints with gingival retraction and scanning the finish line easier and more

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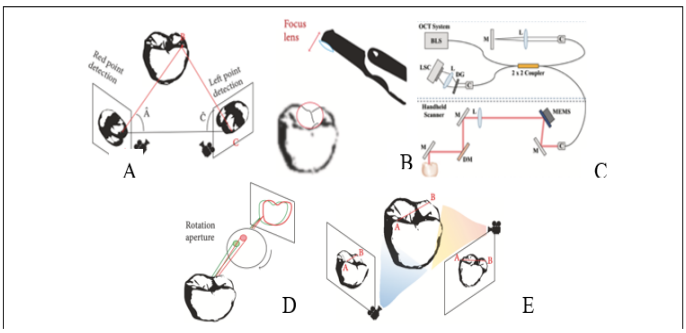

Figure 1. A.Triangulation, B. Confocal, C. Schematic of OCT working principle, D. AWS working principle, E.Stereophotogrammetry

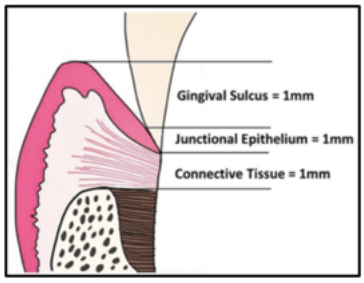

Figure 2. Supracrestal tissue attachment (SCTA)

accurate, a clean sulcus is a crucial need.[4] In its tenth edition, the Glossary of Prosthodontic Terms (GPT) provides the following definition of gingival retraction: "the displacement of the gingival margin away from the tooth."[5] In order to isolate and manage bleeding and fluid during impression formation, this technique atraumatically shifts the gingiva away from the abutment teeth. This improves visibility and accuracy.[6] A mix of mechanical, chemical, surgical, and/or all three approaches is often used.[7] Two metrics, Trueness and Precision, define accuracy in accordance with ISO 5725. Accuracy means consistently producing measurements under the same circumstances, while trueness means the IOS can record an object's 3D geometry as near as possible to its actual dimensions.[1]

According to Son et al.'s research, a subgingival finish line at a depth of 0.25 mm produced a trueness level below 100 μm when no retraction cord was used. However, when retraction cords were employed, the trueness level increased to 1 mm, and using gingival retraction cord increased the trueness level to 90%.[3] Manghani et al. found that physically pushing the retraction cable into the gingival sulcus resulted in more retraction than using retraction paste, which demonstrated proper margin retraction and allowed the IOS to record accurately. On the other hand, the patient may experience some pain or discomfort due to the retraction chord.[6] Research on the optimal retraction technique for digital impression subgingival finish line is still in its infancy. With the use of mechanical and chemical retraction techniques, this literature review aims to characterise the accuracy of digital impression on the depth of the subgingival finish line.

Literature Study

Intraoral Scanner (IOS)

A medical device called an intraoral scanner (IOS) uses a 3D measuring system to capture data on the size and structure of the dental arch. It then uses that data to create 3D models of the teeth and soft tissues in the mouth, allowing for a full digitalisation of the oral anatomy.[8] Using light, IOS is able to take optical imprints of implants and teeth. Projected light is necessary for the camera, regardless of the image method used by the IOS. A software program records each of these light beams as a distinct picture or video, and then it estimates where the objects of interest are.[9]

IOS Working Principle

The following is the process that iOS uses to capture an object's 3D geometry: Light Projection: In order to enlighten, IOS makes use of a light source, whether it a laser or structured light. Teeth and the tissues around them will be illuminated by this light;[10,11] Capturing images: the scanner's camera records photos of the tooth and its surrounding tissues as they reflect light. Information on the object's shape and features are included in this picture, which is taken in video or still form; Processing Data: The software that records the pictures is then used to process the data. A three-dimensional representation of the region that was scanned is created by combining the photos in the program; 3D coordinate recording: x, y, and z coordinates are used to record each point on the object's surface. The picture provides the x and y coordinates, while the distance from the item to the camera determines the z coordinate; Analyse and store: Create a digital format, such STL (Standard Testellation Language), to save the three-dimensional model.

IOS Technology

The idea behind the IOS approach known as triangulation is that two points of view may be used to determine the location of an item or triangle point. You can get these two perspectives by using two separate detectors, or by taking pictures at different times, or by putting a prism on one detector.[12] Using a combination of focussed and unfocused pictures taken at a predetermined depth, confocal imaging may pinpoint an object's precise location in relation to the lens's focal length. Subsequent photographs captured from various perspectives and with varying focus and aperture settings may then be used to recreate the item.[12,13] Utilising coherent light waves to generate three-dimensional (3D) pictures of oral and dental soft tissues is the fundamental idea behind Optical Coherence Tomography (OCT) at IOS. The method is based on reflecting infrared light from the different layers of oral tissues. Time and intensity measurements of the reflected light waves are used to produce a precise three-dimensional model. An off-axis aperture module, which rotates at the point of focus (POF) by following a circular route around the

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optical axis, is necessary for the AWS surface imaging method, which employs a camera. Stereophotogrammetry relies only on computational picture processing to provide all three coordinate estimations (x, y, and z). Smaller, more user-friendly, and less expensive cameras are used since this technology depends on passive light projection and software rather than active projection and hardware.[12]

Indications and Contraindications

Digital impressions are utilised in prosthodontics for a variety of purposes, including but not limited to: designing and fabricating single tooth crowns, endodontic crowns, veneers, fixed partial dentures, removable partial denture frameworks, digital smile design (DSD), and implant bridge posts and cores. Furthermore, guided implant surgery may be developed using IOS as well. Certain types of dentures, such as long-span implant-supported fixed partial dentures, full removable dentures, and long-span fixed partial dentures, are not recommended. The patient's incapacity to remain still, a small mouth opening, an excessively big head scanner, interference from the tongue, or the use of an orthodontic device are all examples of common contraindications. Furthermore, to ensure sufficient pictures are obtained during scanning, it is crucial to prevent bleeding beforehand.[14,15]

IOS Accuracy

The effectiveness and durability of the prosthesis depend on its precision.[13] Two metrics, Trueness and Precision, define accuracy in accordance with ISO 5725. Accuracy means consistently producing measurements under the same circumstances, while trueness means the IOS can record an object's 3D geometry as near as possible to its actual dimensions. For prints to pass muster as realistic reproductions, they must exhibit the utmost degree of accuracy and precision.[1,16] The minimal accuracy when scanning the complete dental arch is 60 μm, and while scanning prepared teeth it is 23 μm, according to a systematic study that looked at the average accuracy of digital technology, including intraoral scanners. The accuracy of scans on implants ranged from 19 to 112 μm, whereas scans on a single prepared tooth showed a range of 20 to 40 μm.[17]

Other investigations have also stressed the significance of precise digital impression production in ensuring a proper internal and marginal fit for the prepared tooth. Properly fitting prosthetic restorations, which should be positioned to cover all margin preparations, is essential for their long-term effectiveness. Despite extensive study on the topic, scientists still lack a definitive upper limit for the adaptability of fixed prostheses with respect to the marginal space between crowns and abutment teeth. Hence, the clinically acceptable gap value of up to 120 μ m, established by McLean (1971), is still used as a benchmark by other writers. Newly available IOSs have shown clinically acceptable accuracy in horizontal and vertical finish line designs, independent of the shape of the abutment teeth, according to current research.[1]

Factors Affecting Scan Accuracy

Operator: The operator's proficiency with the device, the scan's distance and angulation, and the operator's pattern or sequence are three operator-dependent elements that substantially impact IOS's accuracy. The effect of operator experience on scan accuracy has been shown in several studies. Lim et al. found that trueness after several scans, particularly in the maxillary arch, was much improved with longer clinical experience. Operator experience is a key factor in mistake reduction, according to Revell et al.'s research. Scanners with less experience are more likely to make deviations.[18]

Scanner: Light, heat, scanner head size, and software are just a few of the scanner-related factors that have been the subject of several research as they relate to IOS accuracy. The accuracy of IOS may be affected by ambient illumination conditions, however the optimal circumstances differ for each form of IOS. According to research by Revilla-Leonet al., certain scanners might yield varied findings depending on the illumination. Accuracy is improved in both natural and artificial illumination, similar to the iTero Element (Align Technology). Accuracy was maximised in low-light settings using the CEREC Omnicam (Densply Sirona). Under typical indoor lighting, TRIOS 3 (3shape) had the best accuracy. Furthermore, the research conducted by Hayama et al. revealed that bigger IOS scanner heads resulted in improved accuracy and precision with a decrease in the number of scanned pictures needed. Consistent with the findings of An et al., smaller scanner heads provide lower trueness but quicker scan rates, demonstrating that the size of the scanner head has a substantial impact on trueness.[18]

Intra oral conditions: The accuracy of intraoral ultrasound is greatly impacted by the patient's intraoral circumstances. Among these important considerations are the features of the scanned oral cavity region, including the edentulus's position, intraoral moisture, and the tooth's finish line preparation design.[18] Results indicated that preparation of the supragingival end resulted in superior accuracy, but preparation of the subgingival end resulted in incorrect accuracy, according to the location of the finish line. In light of these findings, it seems that the finish line preparation site could influence the IOS's precision.[16] Digital imprints need a clean sulcus for gingival retraction to be conducted and for scanning the finish line to be easy and error-free.[6] Gingival retraction cord use promotes truthfulness by 90%, according to Son et al.[3]

Preparation of Finish Line

The preparation of finish line can be placed above the gum (supragingival), parallel to the gum (equigingival), or below the gum (subgingival). Supragingival and equigingival finish line are easier to prepare, impression, and polish for a smooth surface. This makes it easier to clean plaque and maintain healthy gums. However, in some cases, such as when there are old restorations, caries, aesthetic needs, or the need for retention, subgingival finish line are required. Restorations have exposed and rough margins that easily harbor plaque when compared to natural tooth surfaces. The higher the margin of the restoration (near the gum surface), the easier the access for plaque removal, resulting in healthier gum tissue. Therefore, subgingival margins should be avoided if possible as they are often problematic. In terms of periodontal health, subgingival finish line almost always cause an inflammatory response in the gums. The degree of inflammation

can vary from mild, invisible inflammation to severe inflammation with symptoms of swelling, redness, pain, bleeding and even bone destruction.[19]

The most crucial biological metric for gum health is the location of the finish line preparation, which allows for better patient and dentist-led hygiene management and a longer restoration life. Dentists need to be familiar with supracrestal tissue attachment (SCTA), also known as biologic width, in order to properly place finish line preparations. All of the connective tissue around the teeth, including the junctional epithelium and the supracrestal layer, form this connection. Microorganisms are unable to infiltrate the periodontium due to the barrier action of the SCTA. Inflammation of the gingival edge, faster bone loss, and deeper sockets are all possible outcomes of rupturing this connection. Incorrectly positioned repair margins, which promote persistent inflammation, are a common cause of SCTA breaches. When it comes to periodontal health, nothing is more important than keeping the SCTA proportions correct. Figure 2 shows the optimal dimensions for the SCTA width, which are 1 mm for the depth of the sulcus, 1 mm for the junction epithelium, and 1 mm for the attachment of the supracrestal connective tissue.[20] There are three guidelines that can be used in the placement of finish line preparations based on the depth of the gingival sulcus, including if the depth of the gingival sulcus is ≤1.5 mm, the edge of the preparation is placed below the gingival crest, the depth of the gingival sulcus is >1.5 mm. To make a 1.5 mm deep gingival sulcus, the edge of the preparation is positioned 1.5 mm below the gingival crest, which is 1½ times the depth of the gingival sulcus. If the depth of the sulcus is >2 mm, particularly in the facial aspect, it is evaluated whether a gingivectomy can be done on the tooth. Following that, the first guide is repeated.[21]

Gingival Retraction

The tooth must undergo gingival retraction after the pretreatment step prior to taking an imprint. An explanation for gingival retraction is given in the 10th edition of the Glossary of Prosthodontic Terms (GPT) as "the displacement of the gingival margin away from the tooth." The goal of this atraumatic displacement of the gingiva away from the abutment teeth is to improve accuracy and visibility during impression formation by isolating and regulating fluid and haemorrhage.[5,6] In order to capture the precise contours of the prepared tooth borders on the imprint, this technique aids in the transient vertical and lateral displacement of the gingival tissue. Common techniques for retraction of the gingiva include mechanical, chemical, surgical, and hybrid approaches. When using mechanical procedures, tools like retraction cords and rubber dams are used to compress the gum tissue. In chemical-mechanical approaches, the sulcus is kept dry and bleeding is reduced by combining retraction cord with medicines like epinephrine, aluminium chloride, and aluminium sulphate. For inflammatory gingival disorders, a surgeon with specialised expertise may use rotary curettage, electrocautery, or a laser to temporarily remove or relocate gingival tissue. This procedure is helpful, but it does need careful attention to prevent tissue damage.[4]

Gingival retraction most commonly uses retraction cord. The retraction cord physically compresses the gingiva, while the chemical controls the fluid in the gingival sulcus from the sulcus wall. Errors in the selection of retraction cord and chemicals used can lead to irritation of the gingival tissue and inaccurate results. The selection of retraction cord depends on the shape of the gingiva, the thickness of the gingiva and the depth of the gingival sulcus. The deeper the gingival sulcus and the thicker the gingiva, the larger and more retraction cord are used. Usually patients will complain of pain and discomfort with the use of retraction cord, which can even cause permanent damage to the gingiva.[22] This has led to innovations in recent developments, several new materials and technologies have been introduced, such as retraction paste and foam, which are claimed to be more atraumatic and easy to use. The use of aluminum chloride-based retraction materials or injectable kaolin matrix can effectively open the sulcus without damaging the gingival tissue.[4]

Discussion

There are three possible places to prepare the gingival border for a fixed denture: supragingival, equigingival, and subgingival. According to studies conducted by Son K et al., scan accuracy varies depending on where the finish line preparation is located, and subgingival finish lines are particularly inaccurate. The marginal and internal fit of the temporary crowns were shown to be altered by the positioning of the finish line, according to another research by Son et al. The findings obtained by marginal fit were most favourable for the supragingival finish line and the least favourable for the subgingival finish line. Although this research has its limitations, the findings indicate that the placement of the finish line during preparation may impact the final dental prosthesis manufactured using IOS.[23] The According to Son YT et al., there were notable variations in IOS trueness at the subgingival finish line at depths of 0 mm, 0.25 mm, 0.5 mm, 0.75 mm, and 1 mm. At a depth of 0.5 mm, the marginal portion of the subgingival finish line had a trueness more than 100 μm in this research, and at a depth of 1 mm, the marginal zone had the worst trueness (>200 μm). The scan accuracy that is clinically suggested is less than 100 μm, according to Brawek et al. and Shim et al. While prior study has validated IOS's correctness, there is a lack of studies that assess its veracity in relation to the finish line's position.[3]

When taking impressions for a permanent denture, it is crucial to isolate the region around the finish line and treat the tissue carefully. Particularly for equigingival and subgingival finish lines, this is essential to ensure accurate scanning and a clear final product. Hence, it is essential to retract the gums.[6] Methods might be mechanical, chemical, surgical, or a mix of these.[7] To retract the gingiva, the mechanical technique is most often utilised. This technique entails inserting a cable soaked with medication into the sulcus depth in a non-traumatic manner. The lack of systemic adverse effects has led to aluminium chloride's rise to the position of most-used medication.With a maximum retraction of 0.61 mm and a retraction efficiency that was consistent across various kinds of knitting cord (#000, 00, 0), the

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clinical trial conducted by Zeena et al. indicated that knitting cord is superior than braided cable. Furthermore, due to the mechanical pushing of the cord into the gingival sulcus, Manghani et al. discovered that retraction cord caused a larger gingival displacement than non-cord.The benefits of a method without a retractable cable include greater preservation of gingival health, less pressure, less time spent on the procedure, and more patient comfort.[6]

There are a number of cordless retraction systems on the market that work much like cord, including pastes, foams, and gels. Materials like kaolin paste, silicone foam that cures in an addition, and kaolin paste mixed with aluminium chloride are common choices. Gingival retraction accuracy and impression accuracy are both compromised by retractor fibres that remain in the sulcus (retraction cord fibres.[6] Cleaning the sulcus and reducing impression mistakes may be achieved by adding 15% aluminium chloride to the kaolin matrix.[4] The amount of gingival displacement with retraction cord and paste was compared by Choudhary et al., who found that the cordless method was more effective and that the retraction cord could cause discomfort and periodontal damage if not used carefully.[24] Furthermore, Manghani et al. found that sulcus breadth and depth could be adequately achieved using either retraction cord or retraction paste; however, retraction paste was superior in terms of clinical handling convenience.[6]

Conclusion

The accuracy of intraoral scanners (IOS) in capturing subgingival finish lines depends significantly on the gingival retraction method used. While IOS offers clinically acceptable accuracy, subgingival finish lines pose challenges due to restricted visibility and access. Mechanical retraction, such as retraction cords, provides stability but may cause discomfort and potential periodontal damage, whereas chemical retraction using aluminum chloride-based pastes effectively displaces gingival tissue with minimal side effects. Research suggests that combining mechanical and chemical retraction yields the best results in terms of both impression accuracy and patient comfort.

Thus, more studies are required to determine the precision of digital impression on the subgingival finish line, particularly at depths of 0.5 mm and 1 mm, using mechanical gingival retraction cord retraction and chemical retraction paste.

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REVIEW

Hybrid ceramic as an alternative material for crown restoration treatment

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Keywords: Additive (3D printing), CAD/CAM, Hybrid ceramic, Subtractive (milling)

ABSTRACT

All ceramic materials are often used in crown restorations for anterior and/or posterior teeth due to their aesthetic value and high strength. However, some all-ceramic materials such as monolithic zirconia have the disadvantage that they can cause wear problems on antagonistic teeth due to their high hardness. As an alternative to overcome this problem, hybrid ceramic materials are being developed. This literature review aims to look at using hybrid ceramic materials as an alternative material for making crowns. A hybrid ceramic material blends the characteristics of ceramic and composite materials, resulting in a material with excellent mechanical strength and aesthetic qualities. It has a similar elastic modulus value to dentin thus reducing the occurrence of wear on antagonistic teeth. Hybrid ceramic materials is fabricated by CAD/CAM system with subtractive (milling) and additive (3D printing) processes. The subtractive fabrication method (milling) produces restorations with high strength properties but has a longer and more complicated manufacturing process. The additive (3D printing) method, on the other hand, is faster and requires less material than subtractive (milling). Therefore, hybrid ceramic materials should be considered as an alternative material for crown restorations. (IJP 2025;6(1):55-59)

Introduction

All ceramic materials have often been used for crown restorations. The choice of All-Ceramic material for crown restorations is generally used in anterior teeth and some cases in posterior.[1] All ceramic materials consist of oxide ceramics, silicate ceramics, and resin matrix ceramics (RMC). The most commonly used all-ceramic material for crown restoration cases is Monolithic Zirconia which belongs to the Oxide Ceramic group which has high aesthetic properties and biocompatibility. However the material has the disadvantage that it can cause wear on antagonistic teeth because it has a high level of hardness (1387 Hv).[2] Tooth wear can cause loss of vertical dimension, tooth sensitivity, and also reduce the aesthetics of the patient.[3]

Alternative materials have been developed that can be used to overcome this. Hybrid ceramic is one of the materials used which belongs to the Resin Matrix Ceramic (RMC) group. The material is designed to have the mechanical and aesthetic strength of ceramic and composite materials. Ceramic hybrid materials are indicated in the case of single tooth (anterior /posterior) crowns restorations, and implant-supported crowns.[4] The laboratory procedure for the manufacture of Hybrid ceramic materials can be carried out with CAD/CAM system procedures. The advantage of using CAD/CAM system is the quality, speed, and ease of manufacturing a restoration. In the chairside system, the restorative procedure can be done in a single visit.[5]

Currently, additive (3D Printing) and subtractive (Milling) processes are often used as CAM (Computer-Aided Manufacturing) processes in various fields of dentistry in the manufacture of restorative materials. The advantages of the Additive (3D Printing) process is that it has a faster fabrication process and can make more complex prosthesis shapes such as facial prostheses and metal frameworks. Making prostheses that require greater load resistance is done by the subtractive process (Milling) because it can produce more uniform objects microscopically.[6] The disadvantages are higher cost and produce more residual material.[7]

Literature Study

Dental Ceramics

Dental ceramic materials are often described as non-metalic, inorganic structures composed primarily of oxygen compounds combined with one or more metallic elements.(8) Dental ceramic materials consist of various types based on their chemical composition, manufacturing method, and structure. Dental ceramics are mainly divided into 3 groups: Resin matrix ceramics (RMCs), silicate ceramics, and oxide ceramics figure 1.[9] Each type of ceramic mentioned has different clinical applications table 1.

Hybrid Ceramic / Resin Matrix Ceramics

The term keramos is derived from a Greek word meaning ceramic. According to the American Ceramic Society (ACS), ceramic are defined as inorganic , non-metallic materials.[8] Some historians say

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Table 1. Types of ceramics and its applications

Type of Ceramic	Brand	Application
Lithium Silicate Ceramics	VITA Suprinity PC, VITA Zahnfabrik	Inlays, onlays, veneers, crowns
Leucite-Reinforced Glass Ceramics	Celtra Duo, Dentsply Sirona IPS Empress CAD, Ivoclar Vivadent	Veneers, inlays, onlays, crowns, anterior and posterior crowns
Zirconium Oxide Ceramics	NobelProcera Zirconia, Nobel Biocare	Single crowns, bridges, prosthetic restorations covering the entire dental arches, mainly posterior segment
Aluminium Oxide Ceramics	InCeram Alumina, VITA Zahnfabrik	Single crowns, bridges, primary telescope crowns, cantilever bridges
Resin Matrix Ceramics (Hybrid Ceramic)	Lava Ultimate, 3M-ESPE VITA Enamic, VITA-Zahnfabrik Cerasmart, GC	Onlays, inlays, veneers, single crowns, implant crowns

Table 2. Mechanical characteristics and chemical composition of resin matrix ceramics

Type of Materials	Flexural Strength (MPa)	Fracture Resistance	Modulus of Elasticity (GPa)	Composition
Resin based Ceramics/Nano-Ceramic	200	5.1 ± 0.4 MPa m1/2	12	Polymerized resin, dispersed nanometric colloidal silica, ZrO2 spherical particles
PICN	124-180	1.09-1.4 MPa m1/2	30	SiO2, Al2O3, Na2O, K2O, B2O3, ZrO2, CaO, urethane dimethylacrylate, triethylene glycol dimethylacrylate

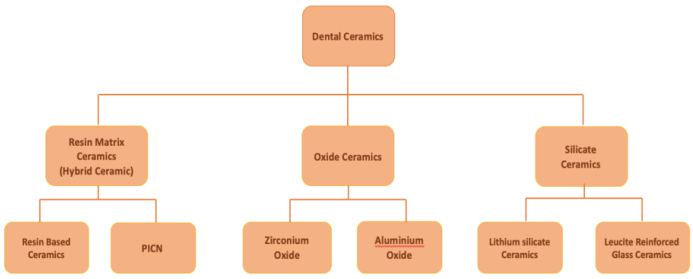

Figure 1. Classification of dental ceramics

the use of ceramics was already done by the Chinese.[11] In recent years, hybrid ceramic materials have been developed, which consist of organic and inorganic materials.[4,12,13] Resin-based ceramics are a new type of composite material, although they are not technically ceramics. However, they have properties similar to ceramic materials, including aesthetics, strength, adhesion, wear resistance, and other characteristics close to porcelain materials.[10]

Technological developments in the field of composites have evolved in the last 10 years. Hybrid ceramic materials can be used for several types of restorations such as inlays, onlays, veneers, crown restorations, and bridge restorations. Paradigm MZ100 (3M ESPE, USA) is a type of composite that was first designed for CAD/-CAM systems in 2000. MZ100 has components of composite resin and 85% wt filler ceramic (ultrafine zirconia and silica).[7] Resin matrix ceramics are divided into 2 according to their structural differences, Resin-based ceramics (Resin nano-ceramic) and Polymer Infiltrated Ceramic Network (PICN).

Resin Based Ceramics / Resin nano-Ceramic

Lava Ultimate & OnX (Sprintray) figure 2 are types of Resin Nano-Ceramic (RNC) materials because they contain nanoceramic particles (nanomer and nanocluster particles) cross-linked with a polymer matrix. These materials exhibit strong fracture resistance and strength, similar to composite materials. Lava Ultimate also inherits advantages from glass ceramics, including gloss retention and excellent esthetic properties. Resin Nano-Ceramic consists of nano-sized particles of ceramics, along with resin matrix. The resin matrix is composed of nanomer silica (20 nm) and nanomer zirconia (4 to 11 nm). Silane molecules create chemical bonds that link the resin matrix with the nano-particle structure.The small dimensions scale of the nanoparticles allow a high proportion of ceramic filler (80%) material and integrated it into the resin (20%). The material is then put into a process by heat treatment for several hours, and it will cause the material to hydrate, so no further firing is required after the milling process.[14,15] Nano-ceramic resin-based materials have higher flexural strength (200Mpa), wear and fracture resistance than composite-based materials, along with high polish and aesthetic properties.

Polymer Infiltrated Ceramic Network (PICN)

In recent years, PICN materials consisting of organic and inorganic materials are also referred to as hybrid materials that consist of ceramic matrix structure (86%) that has been infiltrated by the polymer matrix (14%).[16,17] Its indications include anterior and posterior restorations as well as implant-supported crowns.(18) VITA ENAMIC and VarseoSmile figure 3 ceramic PICN are the result of polymer-permeable ceramic materials based on glass-permeable ceramic technology. In this material, the material is put into a heat process to create porosity for the ceramic network. Then coupling agent is applied. The mixture of monomers will then infiltrate the inorganic network, followed by a polymerization process to form a polymer network. Chemical bonding is then achieved through the

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Figure 2. A. Example of 3d printed nano-ceramic material, B. Example of Nano-ceramic Milling material

Figure 3. A. Example of PICN 3d Printing material, B. Example of PICN Milling material

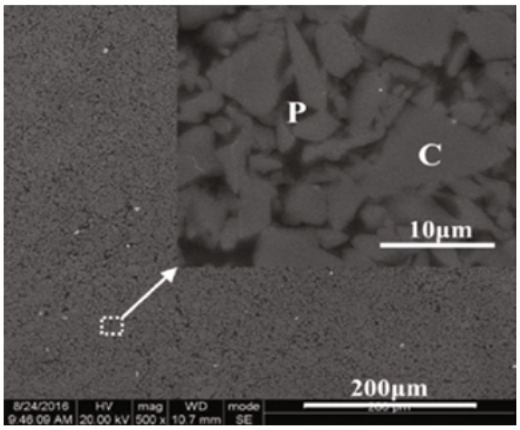

Figure 4. The microstructure of Enamic. 'C' shows the ceramic and 'P' indicates polymer

coupling agent for the two networks figure 4.[4]

Additive (3d Printing) and Subtractive (Milling)

Hybrid ceramic materials can be fabricated using CAD/-CAM methods for various types of dental restorations. The CAM process that is often used in the fabrication of restorations is a subtractive process (milling). The milling method uses a milling bur to shape the restoration according to the CAD design. The subtractive (milling) process is able to produce restorations with high flexural values because the material is more uniformly shaped.[6] Meanwhile, the additive (3d printing) process forms a restoration layer by layer. The additive process (3d printing) has several advantages, namely, a short fabrication process, being able to fabricate complex model shapes (dental models, surgical guides, etc.), low cost, reducing waste by as much as 40%.[7]

Mechanical characteristics of Resin Matrix Ceramics and its Chemical Composition

The following are some of the mechanical characteristics and chemical composition of materials made from resin matrix ceramics, table 2.

Utilization of Hybrid Ceramics in Crown Fabrication

Hybrid ceramic materials offer advantages similar to composite resins, such as good repairability, causing minimal wear on opposing teeth, and excellent chemical compatibility with adhesive resin materials. According to a study by Tokunaga et al.[24] hybrid ceramics possess mechanical properties similar to enamel in terms of hardness and wear characteristics, making them suitable materials for dental restorations. These materials also have a low modulus of elasticity resembling dentin and exhibit adequate fracture resistance compared to other ceramic materials.[10]

Discussion

Hybrid ceramic contains both organic (resin matrix) and non-organic materials (silica & zirconia).[25] Fracture resistance is an important mechanical property to determine how much load the material is capable of receiving before fracture. Alaaeldin Elraggal et al. evaluated the fracture strength of PICN (Vita Enamic) material with a value of (0.76 ± 0.17) with artificial saliva.[26] Della Bona et al. conducted a similar study obtaining a result of 1.09 MPa.(27) Coldea et al. was comparing PICN and other ceramic materials and found PICN with 1.51 MPa, feldspathic porcelain (Mark II and VM9) with 1 MPa, glass-infiltrated alumina-based ceramic with 3.73 MPa,lithium disilicate glass-ceramic with 2.37 MPa , and 4.94 MPa for Y-TZP.[28]

According to Satheesh B. Haralur's research, the fracture resistance of a restoration material is also affected by the occlusal thickness of the crown. The author compared 3 different materials namely, Lithium disilicate (LD), High translucency zirconia (HTZ), and PICN materials with thicknesses of 2mm, 4.5mm, and 4.5mm with radicular expansion of 2mm. The study showed the a few results being, fracture resistance of LD ceramics at 2 mm, 4.5 mm, and radicular extension thicknesses were 62.55 MPa, 45.80 MPa, and 74.27 MPa, respectively. The corresponding values for PICN and HTZ ceramics are 26.30 MPa, 21.65 MPa, 25.66 MPa, and 23.47 MPa, 27.30 MPa, 37.29 MPa, respectively.[23]

According to Möhn M et al, 2022, the occlusal thickness required for Hybrid Ceramic materials is 1-1.5mm.[29] The research conducted by Suksuphan et al., 2024, showed that the fracture resistance of the Hybrid Ceramic material (Cerasmart, CE; PICN, Vita Enamic, VE) with a milling procedure with a load force of 2000N was not found to occur at a thickness of 1 and 1.5mm, while the Hybrid Ceramic material with 3D Printing technique (Varseosmile, VS) showed the occurrence of fractures with a thickness of (0.8mm, 1480.3

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±226.1; 1mm, 1629.4 ±118.5; 1.5mm, 1747.2 ±108.7B).[30]

Cristian et al (2023) compares the fracture resistance of PMMA material with the Milling technique with two hybrid ceramic materials with printing technique with occlusal thickness of 2mm, showed that the fracture resistance of PMMA (Poly-methyl methacrylate) which was Milled was higher (1427.94 N) compared to two hybrid ceramic materials with printing technique (1231.0 N; 1029.9 N). This is because the milling process produces a more microscopically uniform material. While the printing technique produces a more irregular and porous material. All restorations that require greater load acceptance are recommended to use the milling fabrication technique.[6] However, in a study conducted by Khalid et al. compares hybrid ceramic materials with 3d printing method (with angles of 0º, 45º, and 90º) and milling, showed that hybrid ceramic with 3d printing method has a lower flexural strength value than milling, but has a higher compressive strength value.[7] This proves that the angle of the 3d printing method affects the properties of a material.

Aside from fracture resistance, the mechanical properties of flexural strength of hybrid ceramic materials were also investigated by Satheesh et al. (2020) who found the flexural strength of PICN to be 130MPa with a modulus of elasticity similar to dental dentin.[23] This is supported by Albero et al (2015), the flexural strength with 3mm thickness value of PICN (180.9 MPa) has similar values from nano-ceramic resin (164.3 MPa). Lithium disilicate (271.6 MPa) showed higher values compared to PICN, but PICN has higher values compared to feldspathic porcelain (137.8 MPa).[31] Argyrou et al (2016), showed higher flexural strength in nano-ceramic resin (170 MPa) compared to PICN (124 MPa).[21] Similarly, Choi et al (2019) found higher flexural strength with 1.5mm thickness values with nano-ceramic resin (159.1 MPa) when compared to PICN (140.1 MPa).[32]

Tooth of wear of antagonistic teeth caused by ceramic restorations is very common. Lithium disilicate and zirconia have higher Vickers hardness values than tooth enamel, while hybrid ceramic materials have a Vickers hardness values and elastic modulus similar to tooth enamel, resulting in lower wear rates than other ceramic materials. Research conducted by Francesco et al (2018) who compared wear rates with hybrid ceramic materials (0.9 ± 1.9 Bab) and lithium disilicate (6.0 ± 7.3 Aa) found that lithium disilicate produced high wear rates on antagonistic teeth.[22] The glazed zirconia material has a rough surface that causes wear on the antagonist teeth.[24,33]

Repairability of a material is also very important to preserve the remaining tooth structure. The repair process of CAD/CAM materials is cost effective because it eliminates laboratory processes. Research conducted by Hasibe and Yusuf (2020), evaluated several surface treatments for nano-ceramic and PICN resin materials, concluding that both materials could be repaired with composite resin after surface treatment application with laser (Er,Cr:YSGG) with 2.78 μm wavelength and bur grinding.[34] The use of silane materials is still recommended even if silane-containing adhesive materials are used.

Conclusion

From the literature review on Resin Matrix Ceramics (Hybrid Ceramic), we can conclude that hybrid ceramics materials have been made to combine mechanical properties and aesthetics from ceramic and the flexibility of resin materials. These materials are able to reduce wear on antagonistic teeth, which is one of the problems with traditional ceramic materials such as monolithic zirconia. The process of creating restorations using CAD/CAM technology, whether through subtractive (milling) or additive (3D printing) techniques and/or Occlusal thickness can also affect the mechanical properties of a material.

Therefore further studies are needed to determine which fabrication process combined with occlusal thickness to obtain the best mechanical properties values.

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REVIEW

Printing parameters of layer thickness in 3D printing digital light processing on absolute marginal discrepancy and marginal gap in hybrid ceramic-resin crown

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Keywords: Absolute marginal discrepancy, Hybrid ceramic-resin, Layer thickness, Marginal gap, 3D printing DLP

ABSTRACT

Marginal adaptation in the form of absolute marginal discrepancy and marginal gap is one of the parameters for long-term clinical success in single crown restorations. The use of 3D printing digital light processing (DLP) additive manufacturing technology can produce accurate and efficient restorations. However, one of the printing parameter, layer thickness, can affect the accuracy of marginal adaptation. This review aims to evaluate the effect of layer thickness variation on absolute marginal discrepancy and marginal gap in definitive hybrid ceramic-resin crown manufactured using 3D DLP printing technology. Results show that a layer thickness parameter of 50 µm is preferred for good fitting accuracy and small cumulative deviation. Smaller layer thickness will increase the number of layers, and manufacturing time but on the other hand will reduce accuracy. Optimalization of the layer thickness is required to obtain the best marginal adaptation of a single crown. (IJP 2025;6(1):60-63)

Introduction

The digital revolution has brought major changes in the field of dentistry, computer-aided design and computer-aided manufacturing (CAD-CAM) has been used in dentistry for more than a decade.[1] The advent of intraoral scanners, along with computer-aided design (CAD) software and manufacturing technologies have changed the way dental impressions are taken and prostheses are manufactured.[2] Examining the development of manufacturing technology in dentistry, there are currently two types of manufacturing technology, namely: subtractive manufacturing (SM) and additive manufacturing (AM).[1-8]

The subtractive manufacturing (SM) process is known as 'milling',[9] while additive manufacturing (AM) is more commonly known as '3D printing'.[9,10] 3D printing was first introduced by Chuck Hull (Charles W. Hull) in 1986.[11,12] According to EN ISO/ASTM 52.900 terminology standard, AM process is "The process of combining materials to create an object from 3D model data, usually layer by layer, as opposed to subtractive manufacturing methods.[13] The advantage of 3D printing technology when compared to milling technology and conventional manufacturing techniques lies in the ability of 3D printing to produce structures with complex geometries,[5] simultaneously in a shorter time (rapid prototyping),[1,12] with greater precision and less residual waste[1,3,10,14,15] and no need to change drill as in milling technology.[7,8]

3D printing DLP technology has occupied a leading position in dentistry.[16] Understanding the factors that can affect the end result of manufacturing is critical to achieving the maximum potential of this technology, factors such as: the type of 3D printing technology used,[9] printing materials and printing parameters (printing strategy). These factors are known as the 'manufacturing trinomial.[17] 3D printing DLP technology has important applications in the field of prosthodontics. So far, the application of 3D printing technology has been limited to the manufacture of crowns and interim bridges.[1,2,14] With the development of technology and materials, it has become possible to use chairside 3D printing DLP technology for manufacturing definitive fixed crown restorations with hybrid ceramic-resin materials.[2]

The success of a definitive crown restoration depends on four requirements: aesthetics, mechanical strength, biocompatibility and good marginal adaptation.[18,19] Adequate marginal adaptation ensures minimal cementation material thickness and thus prevents microleakage that could potentially lead to plaque accumulation, caries, gingival inflammation, and lead to decreased fracture resistance of the restoration.[8] The assessment of margin adaptation of a single crown focuses on two things, namely absolute marginal discrepancy and marginal gap[8]. However, little information is available on the margin adaptation of definitive crown restorations with hybrid ceramic-resin materials manufactured using 3D printing DLP technology.[1,2,8,17,20,21]

Understanding the properties of materials used in dentistry is essential to compare with conventional materials, verify manufacturers' claims or to determine the material's weaknesses.[14] Accuracy of margin adaptation is one of the parameters that affect the success

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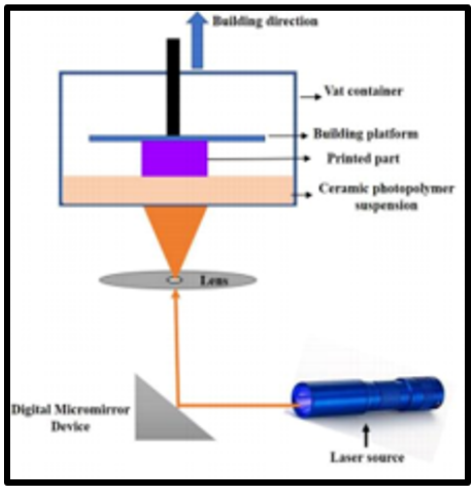

Figure 1. Schematic illustration of bottom-up DLP 3D printing

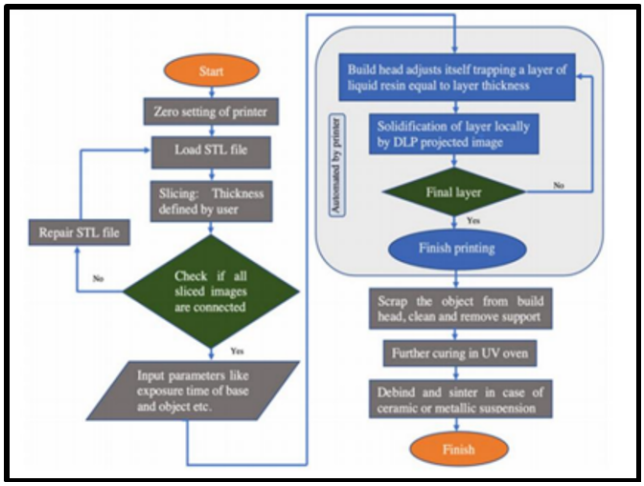

Figure 2. Schematic flowchart of the 3D printing DLP process

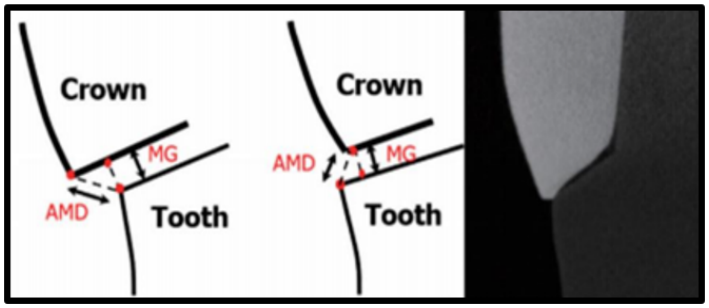

Figure 3. Measurement of marginal adaptation (perpendicular distance between the crown and the margin of the master die). AMD: absolute marginal discrepancy, MG: marginal gap

of a definitive restoration, so further research is needed to determine the effect of layer thickness as a printing parameter that can affect the absolute marginal discrepancy and marginal gap of hybrid ceramic-resin crown, so the purpose of this review is to explain the variation in layer thickness that can affect the absolute marginal discrepancy and marginal gap in hybrid ceramic-resin crown manufactured with 3D printing digital light processing (DLP) technology.

Literature Study

Digital Light Processing

3D printing DLP is part of the vat-photopolymerization additive manufacturing (AM) technology that uses a digital light projector with short light waves (380 nm to 405 nm)[13] which is projected by a digital micromirror device (DMD),[17,22] to then harden the material in a container (VAT), layer by layer at a time to form a three-dimensional object.[6]

Working Principle of Digital Light Processing

In a DLP 3D printing system, there are three unit parts: a light source, a printing platform, and a container (VAT) containing photosensitive material. The process starts with the projection of an image of each layer of the three- dimensional model onto a container (VAT) containing photosensitive resin. The exposed areas of resin harden, while the platform moves slowly providing space to form the next layer. This continues until the entire three-dimensional object is fully formed.[14,22,23]

Here's how 3D printing DLP works:[22,24,25] The designed CAD model is sliced into layers using slicing software to generate data. Subsequently, this data will be reflected as image slices by a DLP with a light source at a specific wavelength; The view of a certain part of the layer is projected on the surface of the resin and thin layers of resin start to solidify and harden due to photochemical reactions activated by photons; After hardening, the printing platform will move upwards and the other display parts will be projected on the resin to harden and form the next layer; The light distribution and intensity are modulated depending on the light exposure required to harden the resin to a certain thickness; Repeated exposure to light hardens the resin layers and the stack of layers is controlled by the printing platform until the object is fully formed; Once the object is formed and released from the printing platform, object will be clean, and post-polymerization processing to be performed to complete the polymerization process. Each printer technology and tool will have its own post-processing techniques recommended by the manufacturer.

There are two different configurations of 3D printing DLP systems: top-down and bottom-up.[24] Research has shown the advantages of bottom-up 3D printing systems over top-down 3D printing systems, especially in terms of material usage, accuracy, and the types of materials that can be used. Bottom-up 3D printing systems require less material, thus reducing costs and waste compared to top-down systems.[25] Bottom-up and top-down config-

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urations have their own advantages, but the advantages of bottom-up DLP 3D printing to handle complex geometric objects with high accuracy and less resin usage make it a superior choice.[25,26]

Parameter Printing Layer Thickness

3D printing DLP layer thickness refers to the height of each layer of resin polymerized during the manufacturing process. In the context of making dental prostheses, bridges and crowns, thinner layer thicknesses result in better detail and smoother surfaces, because in thinner layers the pattern formed by the stacked layers will produce a smoother stair-step effect, resulting in more accurate reproduction and finer detail.[3,15] A study comparing coating thicknesses for dental prostheses and crowns found that the use of a 100 μm coating thickness resulted in more surface accuracy deviations compared to a 50 μm coating thickness.[3,16] Layer thickness selection in 3D printing DLP should consider accuracy, mechanical performance, and manufacturing efficiency. The decision should be based on the application and the desired properties of the object being manufactured.

Hybrid Ceramic-Resin

Dentistry has a long history with resin materials, and by the mid-20th century, composite resins had replaced silicate cements as an aesthetic material for direct restorations. Buonocore invented an etching technique using orthophosphoric acid to bond acrylic resin to enamel.[27] A study conducted by Sabih and Jasim (2024) comparing the fracture resistance between dental crowns produced with technology using Vericom mazic duro hybrid ceramic-resin material, and dental crowns made from zirconia, showed that zirconia has the highest fracture resistance, but hybrid ceramic-resin crown have satisfactory fracture resistance, so they can be used as an alternative for making definitive dental crowns.[28] Jeong et al (2024) also found that although the photopolymer material in 3D printing has the lowest flexural strength, it can still meet the ISO requirement of 65 MPa.[5] Suksuphan et al (2023) evaluated the marginal fit and fracture resistance of milling and 3D printing hybrid ceramic-resin crown with varying occlusal thicknesses, finding that all tested hybrid materials showed clinically acceptable marginal adaptation. Notably, the 3D printed crowns outperformed the milled crowns in terms of marginal fit, while the milled crowns showed better fracture resistance under load.[18]

Marginal Adaptation

Imprecise marginal adaptation leads to plaque build-up, sensitivity of vital abutment teeth and bacterial infiltration that cause secondary caries. In implant-supported restorations marginal inaccuracy increases the risk of inflammation of the peri-implant tissues. Some literature specifies that the ideal margin gap should not exceed 25 μm, but some studies also suggest that marginal discrepancies of up to 150 μm are still clinically acceptable.[2] An in vivo study by McLean and Von Fraunhofer on 1000 restorations over 5 years concluded that 120 microns is a clinically acceptable marginal discrepancy, but to date there is no definitive definition of an appropriate marginal discrepancy size for clinical use.[19]

Marginal gap

Marginal gap refers to the vertical distance between the restoration and the vertically prepared tooth. Research shows that the marginal gap can vary depending on the manufacturing technique. A study by Refaie et al. (2023) comparing the marginal gap and internal fit of monolithic zirconia crowns 3D printed with milling, showed that although both methods produced clinically acceptable marginal gaps, milling crowns provided better accuracy, especially in internal fit.[29] A study conducted by Emam & Metwally (2023) who also examined the marginal gap in posterior dental crown copings of different materials, zirconia and polyether-ether-ketone (PEEK), emphasized that dental crown copings manufactured by 3D printing DLP method showed comparable or even better marginal gap when compared to copings made by conventional methods, especially in zirconia copings, which showed good marginal gap due to its high stiffness and stability properties during the DLP printing process.[30]

Absolute marginal discrepancy

Absolute marginal discrepancy refers to the distance formed as a result of the angular combination of marginal gap and extension error (either over-extension or under-extension), measured from the cavosurface margin of the preparation to the cervical margin of the crown.[19] A study by Liang et al (2023) compared marginal discrepancies in fixed dental bridges with ceramic materials fabricated using conventional and digital technologies. The study highlighted the advantages of digital techniques, which resulted in smaller marginal discrepancies compared to conventional methods. This study demonstrates the importance of digital technology to produce precise dental restorations.[31] These findings suggest that 3D printing DLP, if optimized, can provide clinical outcomes comparable to other manufacturing methods. Research by Zhao et al (2023) emphasized the importance of controlling resin flow and post-printing procedures in 3D printing DLP. This study showed that improper resin flow can cause absolute marginal discrepancy, due to uneven layer thickness and incomplete curing.[32]

Discussion

Mangano et al (2024) found that there was no significant difference between crowns produced through three manufacturing methods (printing, milling and conventional), All restorations showed good margin quality, occlusal and interproximal contacts. These data are consistent with those reported by recent studies, which validated the digital approach in the manufacture of definitive dental restorations in different materials, such as zirconia, lithium disilicate, and more recently, hybrid ceramic- resin.[2] Sebastian et al. assessed the feasibility of digitization in edentulous jaws and concluded that although digitization is a welcome change in denture manufacturing, the accuracy is still variable and requires further research. Molinero et al. have made 3D printed interim crowns with polylactic acid material from scanned mold models and achieved good marginal accuracy. A number of studies have compared digital and conventional impressions and found that digitally made impressions and interim restorations have

fewer marginal and internal discrepancies.[33]

Previous studies have shown that the marginal adaptation of CAD-CAM restorations depends on the type of material used.[8] In the case of interim dental crowns manufactured by 3D printing, factors that affect margin accuracy include; printing speed, build orientation, number of layers, printer type, shrinkage between layers, post-manufacturing process, manufacturing time, and layer thickness. Layer thickness in 3D printing is a controllable parameter that affects the accuracy of interim crowns, so proper adjustment of layer thickness is important to achieve maximum clinical results. Layer thickness can be controlled between 20 and 150 μm in 3D printing systems.[6]

In a study conducted by Zhang et al (2019) found that for 3D printing DLP technology, a layer thickness of 50 μm is the best choice in accuracy and deviation during manufacturing, besides that the study also states that DLP printers are superior when compared to SLA printers in terms of printing accuracy with the same layer thickness with better printing speed.[12] On the other hand, research by Kim et al. reported the opposite result that the accuracy of DLP is lower than SLA, this result was obtained probably because in the study there were different layer thickness settings, 50μm in SLA printers, and 75μm in DLP printers.[12] According to Zhang et al. the problem arises when increasing the number of layers will increase the cumulative deviation which reduces the accuracy, at a layer thickness of 100 μm, although the cumulative deviation is reduced due to the smaller number of layers, high fitting accuracy cannot be achieved because the layer thickness will limit the curing process. Therefore, a layer thickness of 50 μm is considered to be the best option considering the fitting accuracy and cumulative deviation, where the smallest gap can be observed at the marginal and internal areas.[6]

Yang et al (2022) evaluated the influence of build orientation and layer thickness on the marginal fit and absolute marginal discrepancy of a three-unit fixed dental bridge (FPD) manufactured by 3D printing, reporting that the marginal fit of the restoration was not significantly affected by the difference in layer thickness. His study quantified the marginal fit of interim restorations manufactured with two different thicknesses (50 and 100 μm) on implant-supported abutments using micro-CT scanning techniques.[6] In contrast, Çakmak et al. evaluated the trueness and hardness of interim restorations manufactured in different thicknesses and focused on marginal and internal fit.[6] The results showed significant differences in the marginal and internal gaps of interim crowns manufactured with varying layer thicknesses. This is contrary to the study conducted by Yang et al. This may be due to the limited range of thicknesses, different methods of evaluating marginal fit, and different types of restorations (FPD or single crowns on implants or abutment teeth) are possible explanations for the different results. Gad & Fouda, Yang et al., Yao et al., Ryu et al., and Beuer et al. reported marginal gap ranges of 150-280, 58-113, and 100-150 μm for interim crowns, respectively. In addition, Peng et al. also reported an average marginal gap of 240 μm in interim crowns made with PMMA material by manufacturing using 3D printing.[6]

The study by Dimitrova et al. (2023) stated that 3D printed polymers for prosthodontic applications, found that the improvement in manufacturing accuracy was closely related to material selection and manufacturing process. Interestingly, although DLP technology has good accuracy, post-manufacturing procedures can significantly affect the accuracy margin, so attention is needed in the handling and curing process to avoid the occurrence of discrepancies and shrinkage of the manufactured object.[34] A study by Farkas et al (2023) to evaluate the tensile and compression tests performed on a micro filled hybrid resin material (Next Dent C&B MFH) showed that reducing the layer thickness can improve accuracy, as with thinner layers a more detailed reproduction can be achieved. This study also found that the angle formed from the printed layer affects the accuracy of the final product, if using a smaller layer thickness with a build angle of 45º will result in the largest deviation.[14] Unfortunately, the research conducted by Farkas et al. focused more on the mechanical characteristics of the hybrid material without involving margin adaptation. Research conducted by Yilmaz and Çakmak (2023) found a correlation between margin adaptation and the mechanical characteristics of the material. The findings of Gracis et al (2023), corroborate the results of previous studies, highlighting that finer layer thicknesses improve the accuracy of the digital workflow, particularly in implant-supported restorations. This study emphasized that coating thickness directly affects the overall surface smoothness and accuracy of the restoration margins.[35]

Dimitrova et al. study (2023) explains the correlation of greater layer thickness to increased absolute marginal discrepancy, this is due to the stair-step effect, where the transition between layers will create a rougher surface. This study shows that reducing layer thickness improves fitting, while increasing manufacturing time and material utilization, resulting in a trade-off between efficiency and accuracy.[34] Layer thickness has an inverse effect on object accuracy and manufacturing duration; lower layer thickness is required to obtain high accuracy, while higher layer thickness will shorten manufacturing time.[15] In the case of manufacturing with complex anatomy such as dental crowns, it seems that a smaller layer thickness is required to obtain more accurate results.

Theoretically, a smaller layer thickness could result in better surface quality and overall accuracy. Studies on additively fabricated interim crowns confirm these results, as smaller layer thicknesses are reported to result in higher trueness.[15] Thinner layer thickness will increase the number of layers, and resolution in the Z-axis.[16] However, in a study by Favero et al, it was argued that the accuracy of the printing model would decrease as the thickness decreases.[16] In line with the study conducted by Zhang et al (2019) using a special resin material for dental models, they found that if the layer thickness is reduced to 30 and 20 μm, the accuracy of the printed object will decrease. This may occur because there are areas of deviation so that the potential for error increases with the increase in the number of layers, as it is known that the resin material will shrink during polymerization with the increasing number of layers, the deviation

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that appears shrinkage will be greater. This phenomenon may occur because the distance between atoms of low molecular weight monomers is reduced during the polymerization process, which in theory would lead to a reduction in the chemical distance between atoms[6] which manifests as shrinkage in the material during the polymerization process. Therefore, to obtain accurate printing results an operator should not only use the parameters provided by the manufacturer, but should also be determined by scientifically evaluating the trueness of the printing object.[16]

The main cause of the difference in results is due to the use of different 3D printing techniques, different printers, and various other factors such as build orientation, type of support structure, type of material used for crown fabrication, tooth model, design variations, different final margins, number of cement gaps, and measurement methods,[6] making comparisons between one study and another difficult.[20] It is important to consider the impact of layer thickness on manufacturing with 3D printing DLP on marginal adaptation.

Conclusion

Several researchers have stated the advantages of DLP technology in terms of manufacturing speed and cost, but there is still controversy over the accuracy of objects manufactured with 3D printing DLP technology. The printing parameter setting of layer thickness significantly affects the accuracy of marginal adaptation, especially the absolute marginal discrepancy and marginal gap. The printing parameter setting of 50 μm layer thickness is a good choice considering the marginal accuracy and minimal manufacturing deviation. Literature discussing chairside additive manufacturing technology and hybrid ceramic-resin materials is relatively scarce, as these materials are newly introduced.

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INDONESIAN JOURNAL OF PROSTHODONTICS

REVIEW

Optimization of complete denture treatment for flat ridges with various occlusal schemes in distributing stress and masticatory force

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Keywords: Complete denture, Direct measurement, Flat ridge, Masticatory force, Stress distribution

ABSTRACT

Edentulism impacts an individual's ability to chew and digest food effectively, leading to a decline in quality of life. This issue worsens with flat ridge conditions, which increase mucosal stress distribution under masticatory load. Excessive stress beyond the pressure-pain threshold results in poor masticatory performance, emphasizing the importance of selecting an ideal occlusal scheme for such ridge conditions. The basic concept of occlusal schemes aims to preserve residual ridge integrity and prevent further damage over time. Lingualized and monoplane occlusions are schemes that can be used in flat ridge complete dentures to evenly distribute stress and reduce masticatory load. The stress distribution between dentures and the underlying dental mucosa is critical for understanding the relationship with the patient's pressure-pain threshold. Therefore, in vitro measurements can simulate stress distribution and masticatory force assessments. This literature review discusses the measurement of stress distribution and masticatory force on flat ridge complete dentures with different occlusal schemes. (IJP 2025;6(1):65-70)

Introduction

Edentulism refers to the absence of natural teeth.[1,2] When complete, it results in a state of full edentulism where no natural teeth are present in the oral cavity.[2] This condition is a common oral health problem in the elderly, significantly affecting masticatory ability and lowering the quality of life.[3] Tooth loss impacts mastication, speech, and facial aesthetics, often making individuals look older.[4] Salivary flow, biting force, the height and form of residual alveolar ridges, and the stability and retention of complete dentures are some of the factors that affect masticatory function.[5] Mastication becomes increasingly impaired when the edentulous mucosal area is reduced due to ongoing resorption, as seen in flat ridges. The smaller the mucosal area, the greater the difference compared to the periodontal ligament area in dentate patients, leading to concentrated chewing forces over a much smaller area in flat ridge cases.[6]

Complete dentures play a crucial role in rehabilitating fully edentulous patients by improving masticatory ability, addressing psychosocial issues, and enhancing oral health.[7] From a biomechanical perspective, well-distributed occlusal forces over a maximum denture-bearing area minimize excessive pressure concentrations, thereby slowing the progression of residual ridge resorption.[8] Excessive occlusal pressure increases bone resorption rates, especially when forces exceed the balance between bone formation and resorption.[8,9] Therefore, limiting excessive ridge resorption—which may compromise the stability and retention of removable dentures as well as the overall denture-wearing experience—requires an understanding of the amount and pattern of pressure given to the oral mucosa.[9]

Complete dentures are supported by mucosa, which transfers occlusal forces to the underlying bone.[8] The oral mucosa has physiological and mechanical capacities that, when subjected to excessive pressure, can cause pain or discomfort. This occurs due to injury to both soft and hard tissues, and will affect masticatory performance when wearing a denture.[9] The highest pressure that the mucosa can withstand before experiencing discomfort is known as the pressure-pain threshold (PPT).[10] Pain caused by excessive pressure on the mucosa can be mitigated by reducing the load transmitted to the ridge and minimizing movement resistance.6 Selecting a particular occlusion scheme, such lingual or monoplane, is one approach to accomplish this; nevertheless, there are worries that various occlusion schemes may also have an impact on masticatory function and appearance.[11,12] The quantity and direction of pressure received by the periphery are strongly correlated with the occlusal contact between the teeth during centric and eccentric motions of the jaw.[13]

Prior research has documented the denture mucosa's maximal allowable capacity under masticatory pressure.[10,13] It is still unclear how pressure and pain threshold relate to one another in the oral mucosa of denture-wearing edentulous people. Although recent research has looked into the relationship between hydrostatic pressure and soft tissue-induced alveolar bone resorption, much remains unknown regarding the oral mucosa's physiological and

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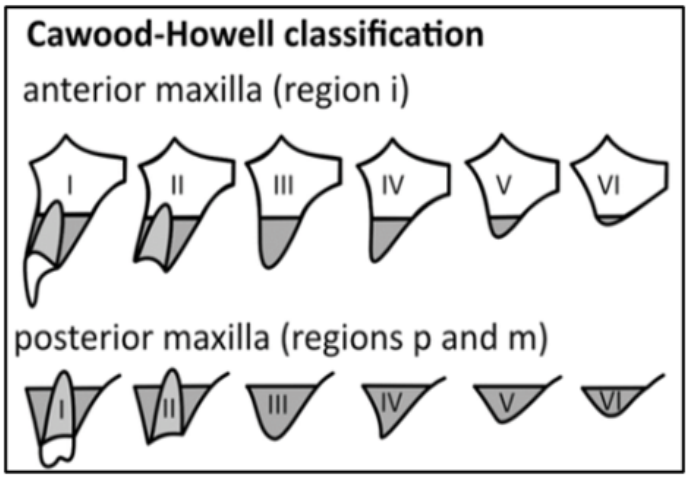

Figure 1. Bone classification according to Cawood and Howel

mechanical capabilities. Prior research measured the pressure produced under detachable prostheses using a variety of techniques, including finite element analysis (FEA), strain gauges, transducers, and tactile sensor sheets. Because of this, it is challenging to compare the findings of different investigations.[9,14] Considerate the relationship between the denture and the patient's pressure-pain threshold requires an awareness of the range of pressure distribution that exists between the denture and the underlying oral mucosa.[8]

The purpose of this review is to discuss the measurement of stress distribution and grinding force on flat-iron complete dentures with different occlusion schemes to obtain preliminary data which is then applied to actual clinical conditions and future clinical studies.

Literature Study

Complete Edentulous

Complete edentulism has a high global prevalence, affecting 0.1-14.5% of individuals under 50 years and 2.1-32.3% of older adults.[15] After tooth extraction, alveolar bone resorption causes continuous changes in shape and reduction in size.[6] Progressive remodelling of the residual alveolar ridge will occur rapidly especially in the first year after tooth extraction in patients with edentulous in the mandible rather than maxilla, with the average rate of resorption varying depending on the individual.[16] The alveolus bone undergoes changes in shape from its initial location, becoming low, rounded, or flat. These changes occur not only on the alveolus bone surface in the vertical direction but 6 also in the labio-lingual/palatal direction.[17]

Tooth loss reduces chewing efficiency, limiting food choices to softer, easily chewable options. Chewing efficiency in complete denture wearers is reported to be less than one-sixth of that in individuals with natural teeth; consequently, edentulous individuals without dentures experience significantly poorer masticatory efficiency.[18] Patients wearing a complete denture will experience masticatory changes associated with increased masticatory cycles, longer masticatory times, and decreased chewing averages. A full denture has traditionally been the preferred prosthetic treatment for addressing this, with the goal of rehabilitating edentulous patients to enhance comfort, appearance, occlusal and facial support, masticatory function, and pronunciation.[15]

Biomechanic of complete denture support

The surface area of the edentulous mucosa available to bear the load from complete dentures is smaller compared to dentate patients. Studies estimate the average edentulous mucosal surface area to be 22.96 cm^2 in the maxilla and approximately 12.25 cm^2 in the mandible. Additionally, the mucosa has limited adaptability to denture use.[18] Mucosal elasticity causes denture instability during functional and parafunctional movements, with chewing and swallowing being the most common vertical activities. However, lateral or tilting movements have the most damaging effects, causing denture displacement and uneven load distribution across the supporting tissues.[6,19,20] Prolonged heavy loads can damage the mucosa and alveolar bone, necessitating dentures with broad bases that fit closely against the mucosa to distribute masticatory forces evenly.[6]

The alveolar ridge include the denture-supporting mucosa, submucosa, periosteum, and residual alveolar bone. Residual ridge changes occur after tooth extraction and denture use. Natural teeth supported by alveolar bone receive tensile forces via the extensive periodontal ligament area, whereas edentulous residual ridges bear vertical, diagonal, and horizontal forces from dentures over a much smaller surface area compared to the natural periodontal ligament.[19]

Flat ridge

Three fundamental requirements must be met for complete dentures to be successful: support, stability, and retention. Compared to upper jaw dentures, lower jaw dentures have more difficulty achieving these characteristics. This is because, in comparison to the upper ridge, the lower residual ridge experiences greater resorption and offers less retention and support. Mandibular bone resorption is four times higher than maxillary bone resorption, based on Atwood and Tallgren research.[21]

Cawood and Howell refined Atwood's classification of bone such as: Class I: Dentate; Class II: Immediately post-extraction; Class III: Well-rounded bone with adequate height and width; Class IV: Knife-edge bone with adequate height but insufficient width; Class V: Flat bone; and Class VI: Depressed ridge with basal area loss.[17]

After tooth extraction, sharp edges become rounded due to external osteoclastic resorption, leaving a well-rounded residual ridge. The knife-edge gradually narrows and eventually turns into a knife-edge as resorption from the labial and lingual aspects proceeds. The knife-edge gets shorter and eventually disappears as the process continues on, turning into a flat, rounded, or flat ridge. The

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ridge will eventually resorb and turn into a depressed ridge.[21]

Occlusal Scheme

The occlusal surfaces of the denture transmit masticatory forces during chewing to the residual ridge's supporting tissues. The size, form, and occlusal plan of the posterior teeth as well as the denture design all affect how these forces are transmitted. The health of the supporting tissues beneath the entire denture is significantly influenced by the distribution of masticatory pressures along the underlying ridge. The quantity and direction of pressure on the residual ridge are strongly correlated with the occlusal contact between the teeth during centric and eccentric motions of the jaw.[12] One of the most important considerations when creating a complete denture is the occlusion scheme selection. Complete dentures frequently employ a variety of occlusion methods, including lingualized, monoplane, and bilateral balance.[6,12]

The bilateral balanced occlusion scheme uses anatomical factors to provide a more natural appearance and good masticatory efficiency. The lingualized occlusion uses anatomical factors in the maxilla and non-anatomical factors in the mandible so that the pre-molar area remains natural in appearance. Monoplane occlusion uses non-anatomical annuli throughout so that lateral movement reduces pressure on the mucosa.[6] The different shapes of the annuli help in reducing the load to be transmitted to the bone and also minimize resistance during movement, but have the impact of reduced masticatory efficiency, less aesthetic appearance, and modifications to the annulus need to be made.[6,22] This will be more obvious if the occlusion scheme chosen is a monoplane scheme with all non-anatomical annuli.[23]

Masticatory Performance

The act of chewing food in order to swallow and digest it is called mastication.[24] Wearers of complete dentures typically chew longer, chew more frequently, chew slower, and swallow larger food particles.[25] These behaviors have an impact on their overall health, raising their risk of physical frailty, cognitive decline, and a lower quality of life.[26] According to studies, people who wear complete dentures have a harder time chewing hard foods than people who have natural teeth,[26,27] and their masticatory ability is only around 50% that of people who have natural teeth.[27-29] Thus, it's critical to preserve and control masticatory function to avoid malnutrition in those wearing complete dentures.[27]

Mastication performance in denture-wearing patients is determined by many factors, such as tooth loss, residual ridge, maximum bite force, tongue, and lip function, salivary secretion, denture experience, and denture stability and retention.27 The larger surface area of the denture pad will result in greater retention. Adhesion, cohesion, interfacial surface tension, air pressure, and capillary attraction are a few of the retention variables that work between the denture and the denture pad's mucosal tissue. Important physical elements in denture retention include cohesion and adhesion. The amount of retention produced by bonding is directly proportional to the area covered by the denture base. The molecular strength limit gives an effect of 10-6 cm (0.000001cm), therefore, arch shapes that have a large bearing area will result in greater retention.[30]

Because the height and shape of the residual ridge are essential for maintaining the denture and preventing denture detachment, poor residual ridge morphology is a major problem for physicians seeking to accomplish successful total denture therapy.28 Residual ridge resorption causes the ridge height to diminish, which reduces the bracing and salivary retention in addition to the denture support area. Furthermore, because the residual ridge's morphology is connected to the distribution of stress in the denture bearing area, it has been demonstrated that this complicated morphology significantly affects the denture's functional performance.[27] There are various factors that affect masticatory performance, it is important to develop accurate assessment methods to understand how well edentulous patients can chew food with a complete denture.

Conventional techniques that are often used to assess mastication performance are the comminution method which uses test food that is crushed by chewing, and the resulting particles are then sieved using sieving techniques,[31] or the use of fuchsine beads and spectrophotometry, or silicone cubes with multiple sieves.[23] In addition, there is also a mixing ability method that uses a special test food in the form of chewing gum with two colors, the patient is asked to chew and observe the color change in the gum,[32] or with an aroma sensor that uses chewing gum with a special aroma that will be measured after chewing is complete using an odor sensor.[33]

Measurement of stress distribution and bite force

Borelli (1681) conducted one of the first investigations in the field of bites force assessment, using a weighted thread looped across the lower teeth of an open jaw. Sauer (1870) used a similar method over two centuries later, substituting a hard metal strip across the molars for the string. The experimental methods used to measure biting force in the past and present can be divided into three categories: piezoelectric sensors, strain gauges and induction methods, optical approaches, and gnathodynamometers and other mechanical devices.[34]

Bite force measurement techniques have advanced significantly over the last 70 years, with a shift away from mechanical tools (such as manometers, pneumatics, and gnathodynamometers) and toward electronic ones like the strain gauge. Howell and Manly (1948) described one of the first electronic bite force measurement systems. This device uses the principle of inductance, which is the movement of silver foil towards an inductance coil under bite pressure. Force gauges can now be smaller because to the usage of electronic gadgets. This makes it possible to employ strain gauges that are placed in fully restored teeth or dentures. Additionally, there is a beam-type version where bite pads are positioned between each tooth and the strain gauges are fixed on a cantilever. By using several strain gauges linked to the dental bridge, the measurement device's lower size also enables the simultaneous measurement of bite and per-tooth forces.[34]

Discussion

The marginal surface area of the edentulous is an important parameter for analyzing and assessing tissue cushioning in the jaw edentulous with regard to better denture retention and stabilization and for pre-prosthetic treatment plans and reconstructive surgery. Retention is an inherent quality of a denture, which serves to resist the force of forces that dislodge it along its attachment direction. Retention variables including adhesion, cohesion, and interfacial surface tension increase retention when the denture bearing surface area increases.[30]

Zarb et al. stated that the support area of the alveolus bone ranged from 22.96 cm2 in the upper jaw and 12.25 cm2 in the lower jaw.6 In the lower jaw, resorption occurred four times greater than in the upper jaw. Atwood and Co. stated that the average resorption was 0.4 mm in the lower jaw and 0.1 mm in the upper jaw. Alveolar bone resorption was greater in the horizontal direction (29-63%; 3.79mm) than in the vertical direction (11-22%; 1.24mm buccally, 0.84mm mesially, and 0.80 distally) at six months post extraction. Ashman stated that the bone height of the alveolus is reduced by 40-60% at 2-3 years post extraction.[35] The posterior region of the mandible also has the greatest risk of resorption as the result of the large concentration of occlusal pressure.[36]

The surface area of the maxillary complete denture is larger (3831mm2) than that of the mandible (2924.63mm2) resulting in a statistically greater mean pressure value (212.82 ± 136.9 kPa) on the buccal ridge of the mandibular complete denture.[7] This correlates with the clinical condition where patients wearing a set of removable complete dentures report feeling more pain pressure on the mandible than the maxilla.[34] The magnitude of alveolus bone loss requires special attention due to the minimal area of tissue support.[17] Physiologically, the periosteal plexus vessels, which provide blood to the mandible, are prone to rupture under pressure, resulting in pain and discomfort. Inflammatory cells will become involved if the pressure continues, resulting in hydrostatic pressure that is higher than capillary pressure. The resorption condition of the margins will come from the nutrient supply being hindered, which will cause increasing resorption.[13,37]

The occlusion scheme and position of the posterior tooth annulus are important factors to achieve denture stability and masticatory efficiency.[11] The healthy tissues receive the masticatory pressure exerted on the denture's occlusal surface. Numerous studies have demonstrated that the shape of the residual ridge affects the use of various posterior denture annuities. The fundamental idea behind the various occlusion strategies that have been researched is to prioritize maintaining the residual ridge's integrity and stopping it from degrading further over time.[12]

In an in vitro study conducted by Ohguri et al11 on the effect of occlusion scheme on pressure distribution in complete dentures said, in monoplane occlusion, the force required to crush soft food or carrots is greater than that in full balanced occlusion and lingualized occlusion. In Madallil et al.'s study,[12] there was no discernible pressure difference between the lingualized occlusion scheme and the fully balanced occlusion during centric occlusion. This may be due to the position of the mandibular posterior teeth of both experimental dentures and the point of application of occlusal force was almost the same. In comparison to fully balanced and lingualized occlusion, the overall disparity in pressure distribution was far reduced in monoplane occlusion.

These findings corroborate studies by Swoope and Kydd that found that variations in the denture's cusp shapes and occlusal surface areas were associated with denture base deformation. Reduction of the posterior denture cusp angle resulted in a significant decrease in the pressure value of the complete denture base.[38] This is in line with the research conducted by Chandratara et al.[39] that non-anatomical dental preparations produce uniform and dispersed stress areas. Whereas in anatomical dental preparations, stresses tend to be concentrated only in certain areas of the photoelastic model. The stress intensity is more in anatomical teeth than non-anatomical teeth, which may increase the possibility of bone resorption rate.

In the fully balanced, lingualized, and monoplane occlusion schemes, virtually little pressure was observed on the maxillary buccal shelf of the nonworking side while imitating unilateral mastication. The denture teeth may be moved from the buccal shelf as a result of this.[12] These results are supported by a study conducted by Frechette et al. in which, it was studied that with each denture tooth, the pressure on the residual ridge of the working side increased by 30-80% in unilateral mastication.[40] Based on the results of a study conducted by Fatola et al37 using FEA, The lingualized occlusion scheme only displayed one small area that exceeded the PPT, despite the fact that the monoplane occlusion scheme displayed the lowest stress distribution when compared to other occlusal schemes. Taking into account aesthetic concerns and masticatory efficiency, the researchers came to the conclusion that the lingualized occlusion scheme is the best occlusal scheme for denture fabrication with resorbed alveolar ridge, given that the average masticatory load needed for chewing is around 50 N.

Evaluation of the occlusion scheme aims to provide better stress distribution to the supporting tissues. The maxillary residual ridge is the primary stress bearing area, and the rugae is the secondary stress bearing area. The primary stress bearing area in the mandible is the external oblique ridge or buccal shelf.[41] In a study conducted by Inoue et al[41] showed that during centric occlusion, the pressure value in the maxillary buccal area was greater than in the palatal area. A decrease in pressure was found on the buccal slope working side and non-working side when using the lingualized occlusion scheme compared to the completely balanced occlusion. This indicates that lingualized occlusion provides lingual resultant force on the buccal slope to improve the stability of the lever in the mandibular denture.

In a study conducted by Paraz et al[9] found that the highest stress value was on the buccal ridge, followed by the retromolar pad,

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buccal shelf, and anterior part, the same as the direction of the right unilateral masticatory load. Whereas in the direction of the left unilateral masticatory load, the highest stress value is on the buccal ridge, followed by the retromolar pad, anterior part, and buccal shelf.

Therefore, it is important to examine the stress distribution and masticatory forces exerted on the oral mucosa to minimize excessive resorption of the alveolar ridge on the flat ridge with various occlusion schemes.

Conclusion

Management of edentulous cases, especially flat ridge conditions, requires a deeper understanding of how the occlusal scheme can play a role in maximizing the patient's masticatory performance while preserving the ridge mucosa and underlying alveolar bone from further pain and resorption. Therefore, studies that offer standardized data applicable to the denture mucosa's pressure distribution are required. Understanding the relationship between the patient's pressure-pain threshold and the pressure distribution range on the denture and oral mucosa is essential.

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INDONESIAN JOURNAL OF PROSTHODONTICS

REVIEW

Accuracy of digital impression scanning strategies for free-end edentulous

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Keywords: Free end, IOS, Precision, Scan strategy, Trueness

ABSTRACT

Scanning using intraoral scanners (IOS) offers better accuracy and time efficiency compared to conventional impression methods, especially in overcoming the challenges of free end edentulous cases. The quality of IOS scans is measured by accuracy, which is influenced by scan strategy. Scan strategies include scanning paths, sequences, and combinations. Study conducted that the right scan strategy can affect accuracy as assessed by trueness and precision. However, there is no manufacturer's standard and only a few studies on scan strategies in edentulous free end cases. This literature review aims to describe scan strategy in improving digital impression accuracy in free end edentulous case. A zig zag scanning path will help the IOS to capture the tooth morphology better and a linear scanning path will result in smaller deviations. Scanning sequences from the teeth to ridge will reduce the jigsaw effect at the fulcrum point, resulting in a more stable framework during removable denture fabrication. (IJP 2025;6(1):71-76)

Introduction

Technological developments in dentistry have undergone significant changes since digital workflow was first introduced in the early 1970s. At that time, Dr. Duret and Termoz patented the first procedure for indirect restorations.[1,2] Today, digital processes in prosthodontics involve the use of intraoral scanners (IOS) for various purposes, such as crowns, implants, partial dentures, and complete dentures. IOS technology simplifies and speeds up the workflow in the fabrication of various types of dental restorations, and provides advantages in terms of accuracy and time efficiency.

Various types of IOS are available in the market with their own advantages, such as accuracy, portability, scan speed, and digital reconstruction quality. Some of the leading brands, such as Dentsply Sirona, Align Technologies, 3Shape A/S, Carestream, Medit Corp offer innovative features that make it easy to capture detailed dental and soft tissue data. Although IOS is widely used in restorative cases such as crown and bridge manufacturing, its application in removable denture cases is still challenging. This is due to the dynamic variations in oral soft tissue anatomy and the need to produce a stable and comfortable denture base for the patient. One of the crucial procedures for making a partial denture is impression. It is important that the prosthesis can be properly designed for maximum retention, stability, support and aesthetics following appropriate insertion and removal directions.[3] Conventional anatomical and secondary impression procedures on the free end edentulous using alginate and elastomer are performed to obtain more accurate impression results because there is a difference in compressibility between the mucosa of the edentulous region and the existing dentition. However, these impression are prone to inaccuracies due to distortion, inappropriate water to powder ratio, and shrinkage of the impression material.[4]

In digital workflow, scanning intraoral is used to obtain digital models. Digital impression has several advantages, namely high impression quality, ease of reimpression, easy model visualization, time efficiency, reduce the number of patient visits, laboratory work, and increase patient comfort and has a cut-out rescan feature that allows operators not to repeat the scan from the beginning if the errors occur.[4] The quality of IOS scans can be measured in terms of accuracy. Accuracy is a key method in evidence-based research to assess the quality of IOS scans for clinical use. Studies show digital impression results have higher accuracy than conventional impression.[5]

According to ISO 5725-1, there are two factors that need to be considered when measuring the accuracy of IOS scans, namely trueness and precision. Trueness refers to the ability of the IOS to accurately capture the 3D shape of an object according to its original dimensions. Meanwhile, precision measures the consistency of the scan results when the IOS is used repeatedly under the same conditions.[6] There are several factors that affect the accuracy of scanning using IOS including intra oral factors, such as the extent of the edentulous and oral cavity's condition, the scanner, such as lighting, temperature, scanner head size, and software, operator, such as operator expertise, distance, angulation and scan strategy.[7]

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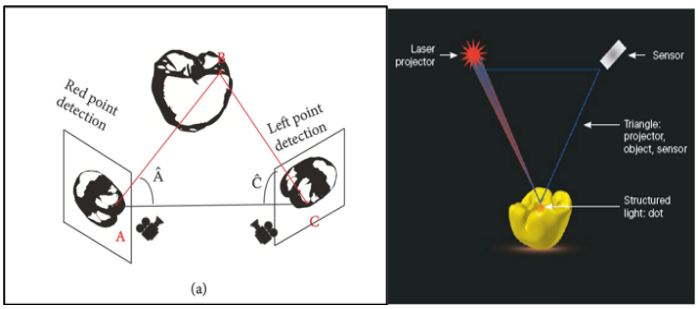

Figure 1. Triangulation: the distance BC is determined by the formula BC = AC × sin Â / (sin Â + Ĉ)

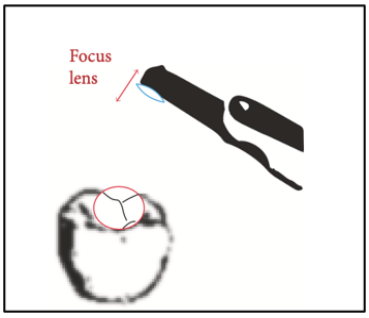

Figure 2. Confocal: The distance to the object is determined based on the focal distance

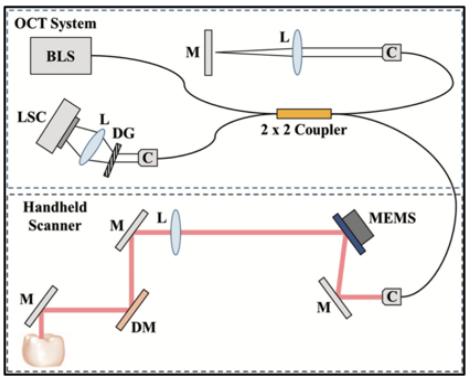

Figure 3. Schematic of OCT working principle

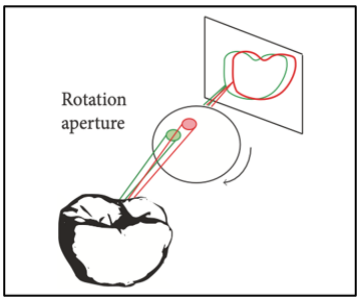

Figure 4. AWS requires a camera and an off-axis module that moves on a circular path around the optical axis. This module generates rotation at the points of focus of attention

Various conventional (manufacturer's) scan strategies have been recommended to produce accurate images in dentate arch. Scan strategies include scanning paths, sequences or combinations. A study by Chang I-Chang et al (2023) showed higher accuracy results in the Mucosa-Dental strategy but recommended the Tooth-Mucosa strategy using the TRIOS 3 Pod Scanner due to reduced leverage effect and more stable denture results.[2] A study by Gavounelis NA et al (2022) showed that a combination sequence of zigzag on the anterior and linear on the posterior produced the best accuracy compared to linear and zigzag only.[8] A study by Feng CW et al (2021) stated that linear and circular movements showed the highest trueness in maxillary impression.[1] To date, there is no recommended manufacturer's standard and few studies have discussed scan strategies in free end edentulous cases.

The purpose of this review is to discuss the IOS scan strategy on digital impression accuracy in free end edentulous.

Literature Study

Intraoral scanner (IOS)

An intraoral scanner (IOS) is a device used for direct optical impressions in dentistry. Just like other three-dimensional (3D) scanners, it projects a light source (such as a laser or structured light) onto the object to be scanned, in this case the jaw arch, including the tooth preparation and implant body scan (a cylinder mounted on the implant, used to transfer the 3D position of the implant).[9] Images of the dental and gingival tissues captured by the image sensor are then processed by the device.

Working principle of IOS

Here is how the IOS works in capturing the 3D geometry of an object:[10,11] Light projection: IOS uses a light source such as a laser or structured light, to illuminate. This light will then be projected onto objects, such as teeth and surrounding tissues; Image capture: the camera in the scanner captures the light reflected from the tooth surface and surrounding tissues. This image is captured in the form of a photo or video and contains information about the contours and shape of the object; Data Processing: the captured images are then processed by the scanner software. This software combines the images to form a three-dimensional model of the scanned area; Coordinate recording: each point on the surface of the object is recorded in the form of three-dimensional coordinates (x, y, and z). The x and y coordinates are obtained from the images, while the z coordinate is calculated based on the distance between the camera and the object; Storage and analysis: the resulting three-dimensional model can be saved in a digital format such as STL (Standard Testellation Language) or other formats.

IOS Technology

Triangulation is an IOS method based on the principle that the position of a point in a triangle (object) can be calculated if we know the position and angle of two viewpoints figure 1. These two

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Various IOS manufacturer scan strategiesvantage points can be obtained from two different detectors, one detector using a prism, or they can be captured at two different times.[12]

Confocal irradiation is a technique that uses focused images. This technology can detect areas of image sharpness to determine the distance to the object related to the focal length of the lens. Dental images can be composed by successively taking images at various focus and aperture values and from different angles around the object figure 2. The area of sharpness is highly dependent on the operator's skill which can affect the motion blur effect, and the technique also requires bulky optics which can make it difficult to implement in clinical practice.[12]

Optical Coherence Tomography; The working principle of IOS using Optical Coherence Tomography (OCT) is based on the utilization of coherent light waves to produce three-dimensional (3D) images of dental tissues and soft tissues in the mouth. The process works by sending out infrared light which is then reflected by the various layers of oral tissues figure 3. The reflected light waves are measured in time and intensity, and then used to build an accurate 3D reconstruction.[12]

Active Wavefront Sampling (AWS) a surface imaging technique that requires a camera and an off-axis aperture module. The module moves in a circular path around the optical axis and generates rotation at the point of focus (POI) figure 4. Information on distance and depth is then obtained and calculated based on the pattern generated from each point.[12]

Stereophotogrammetry estimates all coordinates (x, y, and z) only through algorithmic analysis of the image. Since this method relies on passive light projection and software instead of active projection and hardware, the cameras used are relatively small, easier to use, and cheaper to produce.[12]

Accordion Fringe Interferometry (AFI) uses acousto-optics for non-contract 3D imaging by projecting interference fringes (e.g. Moire patterns) onto objects for measuring distances. This involves projecting two gratings of identical frequencies that are superimposed to form an interference fringe pattern. The laser wavelengths between 300 nm and 500 nm limit the illumination to the surface of translucent objects.

Indications and Contraindications

In the field of prosthodontics, IOS can be used to perform digital impressions in the treatment and production of various types of dental restorations such as single crowns, endocrowns, onlays, inlays, veneers, fixed dentures, removable dentures, implant bridge posts and cores, temporary restorations, digital smile designs.

In the field of orthodontics, digital impressions can be used for diagnosis, treatment plans as well as making orthodontic aligners, special appliances, and retainers. Digital impressions are also useful for creating guides in implant surgery.

In general, contraindications to digital impression using IOS are patients who are unable to sit still in the dental unit, patients with limited mouth opening due to certain reasons, such as patients

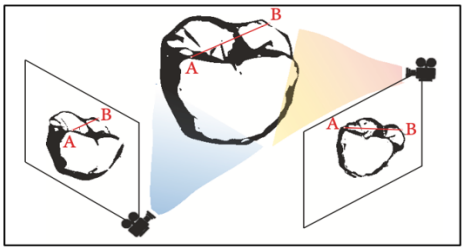

Figure 5. Stereophotogrammetry is a technology that generates files by analyzing multiple images using algorithms

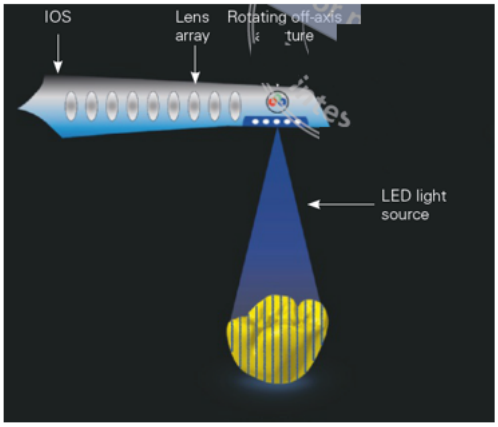

Figure 6. An intra-oral scanner with AFI technology

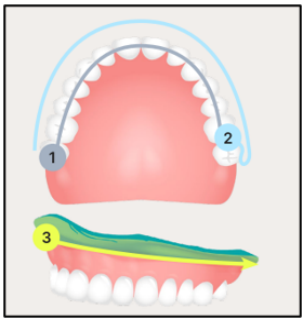

Figure 7. Scan strategy on upper jaw

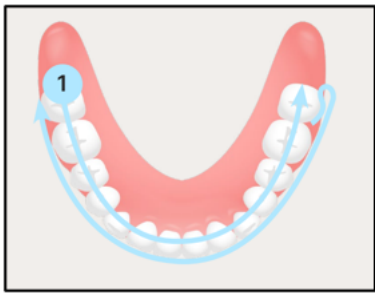

Figure 8. Scan strategy on lower jaw

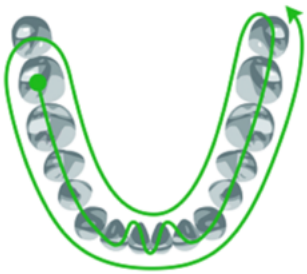

Figure 9. Scan strategy on upper jaw

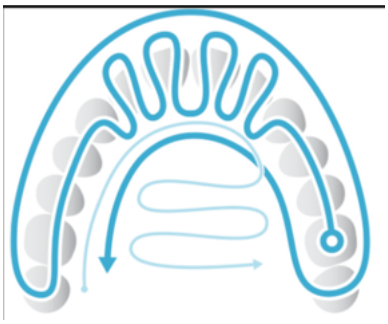

Figure 10. Scan strategy on lower jaw

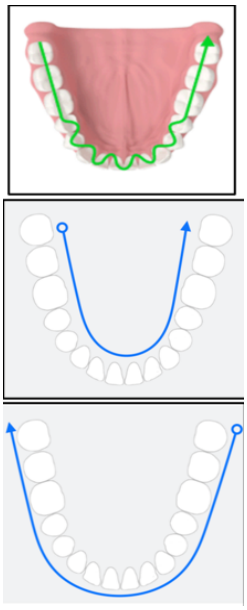

Figure 11. Scan strategy

with TMD disorders with limited opening, head scanners that are too large, tongue movement or using orthodontic devices. In addition, it is important to control bleeding before scanning in order to produce good images.[13,14]

Accuracy of IOS Digital Prints

Digital impression accuracy in dentistry can be assessed using the ISO 5725-1 standard, which specifies methods for measuring and evaluating the accuracy of measurement results. This standard defines two main concepts in measuring accuracy: trueness and precision. Trueness refers to how close the digital measurement results are to the true value of the object being scanned, while precision refers to the consistency of the measurement results when performed repeatedly under the same conditions.[6] In the context of dental digital impression, these two aspects are crucial to ensure that the three-dimensional model produced from intraoral scanning is accurate.

A systematic review examining the average accuracy of digital technologies, including intraoral scanners, found that the accuracy of jaw arch scans with laboratory scanners and IOS ranged from 17 to 378 µm. For prepared teeth, the minimum accuracy was 23 µm, while when the entire dental arch was scanned, the minimum accuracy was 60 µm. Scans of a single prepared tooth showed an accuracy between 20 and 40 µm, and scans of implants had an accuracy between 19 and 112 µm. Accuracy on partial and full edentulus ranged from 30-220 µm, while for fully edentulous dental arches, the accuracy ranged from 44-591 µm. The authors of the review concluded that current digital technology is accurate enough for certain applications, but scanning of the edentulous dental arch is still challenging.[15] Other researchers have also stated that this is due to tissue mobility and the lack of reference points in the dental arch edentulous.[14] Overall, accuracy results varied among various IOS systems.

Factors Affecting Scan Accuracy

Intraoral conditions; The state of the tooth to be scanned will affect the accuracy of the digital print. According to Alfaraj A (2024) IOS accuracy is influenced by the length of the edentulous area and the type of scanner used. Primescan AC shows a lower level of trueness compared to TRIOS 3 for most partial edentulous conditions, while both scanners have the same precision.[16] Intraoral conditions such as the presence of fluid or wetness will decrease the accuracy of digital impression. This is because the presence of wet dental and gingival tissues will cause uneven or distorted light reflection and interfere with the digital scanning sensor which causes disruption of the data captured by the sensor.[17]

Scanner; Another factor that can affect the accuracy of the IOS is related to the scanner. These are light, temperature, scanner head size, software. Environmental lighting conditions can affect intraoral scanner (IOS) accuracy, and the ideal conditions vary depending on the type of IOS used. In a study conducted by Revilla-Leon et al (2023) stated that various lighting conditions produce different results for each scanner. For the iTero Element (Align Technology) scanner , better accuracy was obtained under chair and room lighting. In contrast, the CEREC Omnicam (Densply Sirona) scanner obtained optimal accuracy in unlit conditions. Meanwhile, the TRIOS 3 (3Shape) scanner showed the highest accuracy under standard room lighting conditions.[16]

IOS comes in the market with various scanner head sizes. Scanners with smaller heads show much greater errors in terms of trueness and precision compared to larger scanner heads. This is because smaller scanner heads can be more easily moved around the oral cavity, allowing easier access to hard-to-reach areas. This can result in better accuracy in capturing complex details, although it may require more scans to cover the entire dental object.[4]

Operator factors play an important role in influencing the accuracy of digital impression results on teeth. Research by Revell et al. states that the skill and experience of the operator in using the IOS can affect the quality and accuracy of the results

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obtained. Inconsistent or less careful scanning techniques, such as too fast or unstable movements, can cause data deficiencies in digital models. In addition, the operator's understanding of how to optimize lighting, scanning angle and scan strategy is also crucial.

Scan strategy; During a scan, the clinician must place the object to be scanned in the center of the view finder and move the IOS scanner head along a specific path called the scan strategy.[8] These strategies include scanning paths, sequences, or combinations.[2] Medina et al (2018) and Pasos et al tested various IOS systems and found that the scan strategy affects IOS accuracy differently, depending on the data capture method.[18] Anh et al (2016) stated that the precision of the digital model depends on the starting point of the scan.[19] There are conventional scan strategies derived from the manufacturer's instructions as well as modified scan strategies.

Conventional Scan Strategy (Manufacturer)

Various scan strategies on toothed cases are suggested by the manufacturer depending on the brand and type of IOS technology used as follows:

Primescan (Dentsply)

Scan strategy maxilla; Begin the scan on the occlusal buccal surface of the molar and direct the scan to the entire dental arch; Tilt the scan approximately 60° buccally and guide the scanner around the entire dental arch. Continue the scan along the buccal border and loop the scan back across the entire dental arch to capture all border areas.

Scan strategy mandible; Start the scan at the last molar and scan its lingual surface; If scanning one arch, scan up to the opposite molar; If scanning one quadrant, scan up to the midline; Turn the scanner to the occlusal surface and scan back to the last molar; Rotate the scanner to the fascial surface and scan up to the location where you stopped on the previous implant; Fill in missing data in important areas such as margins or implant locations.

3S Trios

Scan strategy maxilla; Start by positioning the scanner on the occlusal surface of the molar tooth, wait for 3-5 clicks; Move the scanner towards the incisor, while capturing the occlusal surface; Continue the scanner slowly through the incisors and continue along the occlusal surface until it reaches the last molar tooth; Slowly rotate the scanner in a buccal direction by rotating it 60-90 degrees at the last molar and complete the buccal scan, taking note of areas where soft tissue may interfere with the scan results; Scan along the buccal side until you reach the last molar on the opposite side; Then, rotate the scan to the palatal direction and complete the scan on the palatal side.

Scan strategy mandible; Start by positioning the scanner on the occlusal surface of the molar tooth, wait for 3-5 clicks; Move the scanner towards the incisor, while capturing the occlusal surface; Continue the scanner slowly through the incisors and continue along the occlusal surface until it reaches the last molar tooth; Slowly rotate the scanner in a buccal direction by rotating it 60-90 degrees at the last molar and complete the buccal scan, taking note of areas where soft tissue may interfere with the scan results; Scan along the buccal side until you reach the last molar on the opposite side; Then, rotate the scan to the palatal direction and complete the scan on the palatal side.

Medit

Start the main scan on the occlusal surface from the last molar to the anterior teeth; When scanning the anterior teeth, ensure that the scan data is sufficient so that the anterior teeth appear green on the display layer; Scan the lingual side of the anterior teeth, tilt the scan tip for the incisal surface, and tilt again for the labial side scan; Complete the scan of the anterior tooth, then proceed to the occlusal surface until you reach the opposite molar tooth; On reaching the opposite molar, tilt the scan tip to the lingual side so that the lingual side of the tooth, lingual gingiva and occlusal surface are visible in the proportion of 1:1:1. Continue to the lingual side of the opposite molar until you return to the molar where you started the scan. Make sure to scan the anterior teeth from various angles.

Modified Scan Strategy

Some studies on modified scan strategies include scanning path, sequence or combination. Scanning path refers to the movement pattern of the scanner head and sequence refers to the sequence of steps or areas scanned. Research by Liu CT et al (2024) stated that the best accuracy was produced in the TQ scan strategy, which started from tooth 17 then went to quadrant II, then turned to tooth 21 through the palatal side and the scan continued to the buccal side of tooth 17. Next, the scan turned at tooth 21 from the buccal side to the occlusal surface of quadrant II, continued to tooth 27 back to the palatal surface, and returned to the palatal side of tooth 21. Then, the scan turned to the buccal side of quadrant II and ended at the buccal side of tooth 27.[21]

Chang et al (2023) stated that the recommended scanning strategy for the maxillary Kennedy Class I is the TR (Tooth-Ridge) strategy because it can reduce the seesaw effect and high RPD skeletal stabilization compared to the M (Manufacturer) and RT (Ridge-Tooth) strategies.[2] Chu K et al (2022) stated that the strategy of partially scanning the region of interest first in a continuous manner with the head scanner in a horizontal position at full jaw resulted in good accuracy. However, the authors do not recommend performing vertical rotation movements.[2] Gavounelis et al (2022) conducted a study with three different scan strategies namely linear, zigzag and combination (linear on posterior and zigzag on anterior). The results of this study stated that the best accuracy was obtained from the combination scan strategy. However, these three scan strategies are still within the acceptable accuracy range.[8] Diker B et al (2021) examined the scanning sequence in the partial edentulous, namely ScanR where this strategy starts from the right region and ScanL starting from the left region in the upper jaw. The results show the difference between the two because the deviation results will be smaller in the quadrant starting the scan.[23] According to Feng CW et al (2021), S-shaped and figure 8 movements are not recommended, while linear and circular movements show high accuracy. In the mandible, 8-shaped movements were also not recommended, while the other five movements (linear, circle, wave, S, AP) showed similar and lower deviations.[1]

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Discussion

The scan strategy is the specific path and movement that the IOS head scanner follows along the scanned object. Various in vitro studies have shown the influence of scanning strategy on data capture accuracy. In addition, the influence of scanning strategy on the accuracy of digital scanning is reported to vary depending on the IOS used. An inappropriate scanning strategy can lead to inaccuracies in the model, which in turn can affect the precision and comfort of the denture being produced. Most IOS manufacture recommends specific scan strategies for their systems, but these strategies are usually described for the dentate jaw arch. In general, the recommended scan strategy starts from the most posterior region. Different scanning strategies and techniques for scanning edentulous arches especially the free end are still very limited.

Some research on modified scan strategies include scanning path, sequence or combination. Scanning path refers to the movement pattern of the scanner head and sequence refers to the sequence of steps or areas scanned. Research by Chang et al (2023) stated that the recommended scanning strategy for maxillary Kennedy Cluster I is the TR (Tooth-Ridge) strategy because it can reduce the seesaw effect and high partial denture frame stabilization compared to the M (Manufacturer) and RT (Ridge-Teeth) strategies. This may be due to the fact that scans on teeth which have complex geometry shapes will be better for using complex best-fit algorithms compared to simple objects such as edentulous which are relatively flat and smooth will cause errors in alignment of scan data.[24]

Research by Liu CT et al (2024) stated that the best accuracy was produced in the TQ scan strategy, which started from tooth 17 then went to quadrant II, then turned to tooth 21 through the palatal side and scanning continued to the buccal side of tooth 17. Next, the scan turned at tooth 21 from the buccal side to the occlusal surface of quadrant II, continued to tooth 27 back to the palatal surface, and returned to the palatal side of tooth 21. Then, the scan turned to the buccal side of quadrant II and ended at the buccal side of tooth 27.[21]

This study is in line with previous research by Feng CW et al (2021) which states that undulating scanning movements will help IOS to capture tooth morphology better.[1] However, the results of this study obtained different results from the study by Oh et al (2022) who did not recommend performing vertical rotation on the IOS.[22]

Gavounelis et al (2022) conducted a study with three different scan strategies namely linear, zigzag and combination (linear on posterior and zigzag on anterior). The results of this study stated that the best accuracy was obtained from the combination scan strategy. However, these three scan strategies are still within the acceptable accuracy range.[8] This study is in line with research conducted by Zimmerman (2017) which states that the tendency of distortion is enlarged in the distal and anterior expansion due to the steep shape of the tooth morphology.[25] So that in the anterior scan a zigzag movement is carried out as in Feng CW et al (2021) which states that wavy movements will help IOS to capture tooth morphology better.[1]

Conclusion

Scan strategies including scanning path and sequence affect the accuracy of digital impression using IOS. Digital impression on Kennedy Class I, II requires a different scan strategy than Kennedy Class III and IV. Conventional scan strategies are not necessarily better than modified scan strategies.

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INDONESIAN JOURNAL OF PROSTHODONTICS

ORIGINAL ARTICLE

Epidemiological aspects of bruxism at the Abidjan Odonto-Stomatological Consultation and Treatment Center

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Keywords: Bruxism, Epidemiological aspects, Prevalence

ABSTRACT

Bruxism is a factor that both promotes and aggravates certain oral diseases. The importance of the repercussions of bruxism shows the interest of our work which is to know the frequency and the prevalence of bruxism. The general objective of our work is therefore to contribute to the epidemiological study of bruxism in Côte d'Ivoire. This was a descriptive cross-sectional study of three hundred (300) patients attending the Centre de Consultation et de Traitements Odonto-Stomatologiques d'Abidjan, who underwent a questionnaire and an odonto-stomatological examination. The criterion used to diagnose bruxism was that of Dr Gilles Lavigne et al. Our study population consisted of 300 individuals ranging in age from 4 to 82 years, the majority of whom were women [18-40 years], with a bruxism frequency of 22.33%. Our population of bruxers was predominantly female, accounting for 59.70%. Also, the prevalence of bruxism increased with age. In our study population, our survey reveals that the prevalence of bruxism is still significant. Practitioners must therefore be provided with the appropriate equipment for better diagnosis and patient management. (IJP 2025;6(1):77-79)

Introduction

Bruxism is an oral habit consisting of involuntary, non-functional, rhythmic or spasmodic tapping, grinding or clenching of the teeth, apart from chewing movements. It frequently occurs unconsciously, associated with abnormal wear of the teeth and discomfort of the manducatory muscles.[1]

A distinction is made between nocturnal and diurnal bruxism. However, the terms sleep bruxism and awake bruxism are increasingly preferred. This is because people can be awake or asleep during the day and still grind their teeth.[2]

Bruxism is multifactorial in origin, and stress appears to be an important triggering or aggravating factor.[3,4] Bruxism is a factor that both promotes and aggravates certain oral diseases. In fact, even if bruxism is not the cause of oral disease, it can, in some cases, make it more complex. In periodontitis, for example, bruxism accelerates attachment loss, thus aggravating periodontal disease.[5-7]

It also compromises the durability of conservative care, prosthetic restorations and all other therapies applied to the oral cavity. The importance of the repercussions of bruxism shows the interest of our work, which is to know the frequency and prevalence of bruxism.

The general aim of our study is therefore to contribute to the epidemiological study of bruxism in Côte d'Ivoire.

Material and Methods

This was a descriptive, cross-sectional study of three hundred (300) patients attending the Abidjan Centre de Consultation et de Traitements Odonto-Stomatologiques, who underwent a questionnaire and an odonto-stomatological examination to identify oro-maxillo-facial signs. All patients consulting the CCTOS consultation service during the study period who were fully dentate or partially edentulous and wearing fixed or removable dental prostheses were included in our study.

The criteria used to diagnose bruxism were those of Dr. Gilles Lavigne et al., supplemented by Rozencweig's classification of different stages of dental wear table 1 and table 2.[8,9]

Table 1. Diagnostic criteria for bruxism according to Lavigne et al

Nocturnal or daytime noises associated with teeth grinding, tapping or rubbing. Ideally, this noise should be reported by the spouse or friends, since bruxism sufferers are generally unaware of their nocturnal noises.
Abnormal wear of non-functional teeth (e.g. attrition)
Hypertrophy of masseter (and l or temporal) muscles during voluntary isometric contraction
History of muscle stiffness or pain in the morning
Positive stories of teeth clenching and masticatory muscle contractions during the day.
In addition, the following points are sometimes used as additional diagnostic elements:
o History of headache; joint pain and cracking of temporomandibular joints; muscle pain; exacerbated periodontal problems; indentations on the edge of the tongue

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Table 2. Classification of wear stages according to Rozencweig

Stage 1: wear limited to enamel and at least 3 pairs of teeth
Stage 2: enamel and dentine wear in islands, less than 6 pairs of teeth.
Stage 3: enamel and dentine wear without islands, more than 6 pairs of teeth
Stage 4: wear beyond the middle of the crown
Stages 3 and 4 correspond to brycosis.

Table 3. Breakdown of study population

	Man		Women		Total	
	Number	%	Number	%	Number	%
4-17 years	39	13	37	12.33	76	25.33
18-40 years	59	19.67	75	25	134	44.66
41-59 years	23	7.66	39	13	62	20.66
60 et plus years	15	5	13	4.33	28	9.33
Total	136	45.33	164	54.66	300	100

Table 4. Prevalence of bruxism in the target population

	Bruxers	No Bruxers	Total
Man	27	107	134
Women	40	126	166
Frequency	67	233	300
%	22.33	77.67	100

Table 5. Proportion of men and women in the bruxer population

	Bruxers	%
Man	27	40.30
Women	40	59.70
Total	67	100

Statistical processing was carried out using Excel version 2010 and Epi-data 3.1.

The descriptive study of variables was carried out by calculating means and standard deviations around means, frequencies and percentages. Results were presented in the form of tables and graphs.

Informed patient consent was required for all these examinations. The study respected the anonymity of the people surveyed, and the collection and management of information was carried out in a confidential manner.

Prevalence of bruxism in the age group [60 years and over]. The prevalence of bruxism in our study population was 22.33%. Females accounted for the largest proportion of bruxers (59.70%). The prevalence of bruxism in the [4-17 years] age group is (7.89%). The prevalence of bruxism in the 18-40 age group is (20.14%). La prévalence du bruxisme dans la tranche d'âge de [41-59 ans] est de (30,64%). The prevalence of bruxism in the [60 and over] age group was 53.57%.

Discussion

The prevalence (number of cases) of bruxism can never be established with great rigor. This is mainly due to the fact that it is an activity that occurs during sleep, and that the main people involved are unaware of it.

Our study population of 300 individuals ranging in age from 4 to 82 years, mostly women [18-40 years], showed a bruxism frequency of 22.33%.

Our results coincide with those of Manfridini et al. and Melis M., but are much higher than those of Chapotat et al.[3,10,11]

This high rate of bruxism in our study population could be explained by the greater presence of stress factors in this population, as also described by certain authors.[3,12]

However, this high rate is due to the difference in living standards: the more difficult living conditions (underdevelopment, poverty) in Africa, particularly in Côte d'Ivoire, subject populations to significant psychological stress, resulting in high stress levels and therefore a greater risk of developing bruxism.

For the purposes of our study, it is important to note that the CCTOS is a referral center with specialized departments, notably a maxillofacial prosthetics department, to which patients suffering from bruxism are referred. This could also be the reason for the high rate of bruxism in our study population.

In terms of gender, sleep bruxism affects both sexes, with a slight preponderance of women (59.70% of women versus 40.30% of men).

Marcello Melis observed little difference between men and women. On the other hand, he shows that divorced people are more represented among bruxers.[10]

The predominance of women in the bruxer patient population may be explained by the fact that the study population was predominantly female (54.66%). It could also be explained by the fact that women are more susceptible to stress, and therefore

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Table 6. Prevalence of baruxism in the age group [4-17 years]

	Bruxers		Non Bruxers	
	Number	%	Number	%
Man	2	2.63	37	48.68
Women	4	5.26	33	43.42
Total	6	7.89	70	92.10

Table 7. Prevalence of bruxism in the age group [18-40 years]

	Bruxers		Non Bruxers	
	Number	%	Number	%
Man	14	10.44	45	33.59
Women	13	9.70	62	46.27
Total	27	20.14	107	79.86

Table 8. Prevalence of bruxism in the age group [41-59 years]

	Bruxers		Non Bruxers	
	Number	%	Number	%
Man	4	6.45	19	30.64
Women	15	24.19	24	38.71
Total	19	30.64	43	69.35

Table 9. Prevalence of bruxism in the age group [60 years and over]

	Bruxers		Non Bruxers	
	Number	%	Number	%
Man	7	25	6	21.43
Women	8	28.57	7	25
Total	15	53.57	13	46.43

more at risk of developing bruxism.

In our study, we found an increase in the frequency of bruxism with age. These results contrast with the majority of studies carried out in the West, which found a decrease in the frequency of bruxism with age.[13,14]

This difference between the evolution of bruxism frequency in the West and in Côte d'Ivoire can be explained by the difference in social level.

In Côte d'Ivoire, the increase in the frequency of bruxism is thought to be due to an increase in stress levels with age.

Indeed, in the first age bracket [4-17 years], with a prevalence of 7.89%, individuals are generally under the responsibility of their parents. This contrasts with studies by Camoin A. et al. who found a prevalence of 33% among 6-year-olds.[15]

As we move on to the [18-40 years] age group, the cord begins to be cut, and responsibilities begin to take shape. The individual is studying, looking for work, and the conditions of study and work are difficult. This individual will add to his initial stress the stress caused by his new situation, the stress level being higher and so is the risk of bruxism.

In the third age bracket [41-59], the individual is in a period of fulfillment, generally preparing for retirement or projects to ensure his or her post-working life, and this increases stress.

Individuals in the fourth age bracket [60+] are mostly retired, and retirement in Côte d'Ivoire represents a real challenge. The loss of work-related privileges sometimes plunges individuals into precariousness, adding further stress and making them more vulnerable to bruxism.

The highest frequency of bruxism in our study was found among people aged 60 and over (53.57%). These sixty-somethings have reduced incomes, and are also subject to numerous constraints when it comes to paying their pensions. Unemployment is also high, and they sometimes have dependents.

All these difficulties put them under stress, making them more vulnerable to bruxism.

Conclusion

Bruxism is a repetitive activity of the maxillary muscles, characterized by clenching or grinding of the teeth and/or clenching or thrusting of the mandible. It is a widespread parafunction with numerous consequences for the body. In our study population, our survey reveals that the prevalence of bruxism is nonetheless significant. Practitioners therefore need to be provided with the appropriate equipment for better diagnosis and patient management.

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ORIGINAL ARTICLE

Radiographic evaluation of treatment by orthopedic procedures of mandibular fractures in Abidjan Odonto-stomatological consultation and treatment center

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Keywords: Mandibular fractures, Orthopedic procedures, Radiographic evaluation

ABSTRACT

In Abidjan, mandibular fractures are generally treated surgically in the stomatology and maxillofacial surgery department of the Hospital and University Centers (HUC) of Cocody and Treichville. They are also treated with orthopedic devices at the Dental Surgery Consultation and Treatment Center in Abidjan, within the Maxillofacial Prosthesis (PMF) section of the Clinical Prosthesis and Occlusodontics department. Are these orthopedic devices effective in the management of mandibular fractures?. Do these methods achieve satisfactory results in the management of mandibular fractures?. This is a retrospective descriptive analytical study based on the evaluation of usable clinical and radiographic files of patients admitted to the maxillofacial prosthesis section of Odonto-Stomatological Consultation and Treatment Center (CCTOS) who presented fractures to the mandible. The data was processed using epi data software and the search for correlations was carried out using the khi-deux test. Maxillo-mandibular restraint is the most used with a rate of 85%. 83% of patients have good bone density on radiography after healing. Orthopedic treatment of mandibular fracture could be indicated in cases of non-displaced fracture with excellent alignment or approximation of bone fragments and some easily reducible fractures. (IJP 2025;6(1):80-85)

Introduction

Fracture is defined as a bone injury consisting of a complete or incomplete loss of continuity with or without displacement of the fragments. Mandibular fractures represent 2/3 of cases of facial fractures. They can be open to the skin, or oral or closed mucosa without communication with the outside.[1,2] The aetiology of fractures is varied. We distinguish: Traumatic causes such as road accidents, fights, falls, sports, ballistic trauma, etc; Iatrogenic causes such as extractions of impacted wisdom teeth, excision of large cysts, etc; Pathological causes such as significant osteitis, tumors, specific infections (osteoradionecrosis).[3-7]

Mini-plate osteosynthesis surgery is the appropriate treatment for mandibular fractures.[8-11] However, the orthodontic and/or orthopedic method can be used. In certain cases, abstention is appropriate.[12] The orthopedic technique is also carried out in certain cases of mandibular fractures and uses devices with essentially dental support.[13] In Abidjan, mandibular fractures are generally treated surgically in the stomatology and maxillofacial surgery department of the Hospital and University Centers (HUC) of Cocody and Treichville. They are also treated with orthopedic devices at the Dental Surgery Consultation and Treatment Center (DSCTC) in Abidjan, within the Maxillofacial Prosthesis (PMF) section of the Clinical Prosthesis and Occlusodontics department.[14]

Are these methods effective in the management of mandibular fractures?. Do these methods achieve satisfactory results in the management of mandibular fractures?. Different radiographs are taken in the evaluation of these devices. Indeed, evaluation is defined as the process which consists of collecting a set of relevant, valid and reliable information, then examining the degree of adequacy between this set of information and a set of suitably chosen criteria with a view to base decision-making.[15] It is in this context that our study aims to evaluate the impact of orthopedic devices in the management of mandibular fractures.

Material and Methods

It consisted of: Clinical and radiographic records of trauma patients; Computer equipment. This is a retrospective descriptive analytical study based on the evaluation of usable clinical and radiographic files (pre, per and post operative) of patients admitted to the maxillofacial prosthesis department of the (DSCTC) who presented fractures to the mandible. The data was processed using epi data software and the search for correlations was carried out using the khi-deux test. 41 clinical files were retained and consisted of panoramic radiographs (pre, intra and post-operative) of patients registered in the maxillofa-

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Table 1. numerical summary of ages

Minimum	8
1st Quartile	23
Median	30
Average	29.59
3rd Quartile	35
Maximum	58
Variance	87.85
Standard deviation	9,37

Table 2. Digital summary of treatment duration

Minimum	21
1st Quartile	45
Median	45
Average	47.34
3rd Quartile	45
Maximum	90
Variance	103.78
Standard deviation	10.8

Table 3. Distribution according to the location of mandibular fractures

Fractures	Multiples	Parasymphyseal	Angular	Symphyseal	Horizontal Branch	
numbers	15	11	7	6	2	41
%	36.59	26.83	17.07	14.63	4.88	100

Table 4. Distribution of subjects according to the used orthopedic device

Devices	Vestibular arch	Leblanc	Gutter and vestibular	Vestibular arch	8 Ligature and leblanc	Total
numbers	30	3	1	6	1	41
%	73.17	7.32	2.44	14.63	2.44	100

cial prosthesis (MFP) department for mandibular fractures. Poorly completed or incomplete files of patients with mandibular fractures and non-usable paper radiographs were excluded.

Results

The average age of the subjects in our population is 29 +/-9 years. We have a strong age distribution reflecting the heterogeneity of our population.

The average duration of treatment for the subjects in our sample is 47 days+/-10. We note that the duration of treatment varies greatly from one subject to another (Standard deviation=10.18). Most patients present with multiple fractures with a rate of 36.59%. Displaced fractures are the most common fractures with a rate of 66%. Maxillo-mandibular restraint is the most used with a rate of 85%. The most used device is the vestibular arch with a rate of 73.17%. 83% of patients have good bone density on radiography after healing. 80.49% of patients present good bone consolidation. There is a strong correlation between bone density and the alignment of bone fragments. This implies that when the bone fragments are well aligned, consolidation is better. The bivariate statistical analysis also gives us a strong correlation between bone density and the level of consolidation of bone fragments. There is no significant link between bone density and the shape of mandibular fractures. There is no significant link between bone density and the type of mandibular fractures.

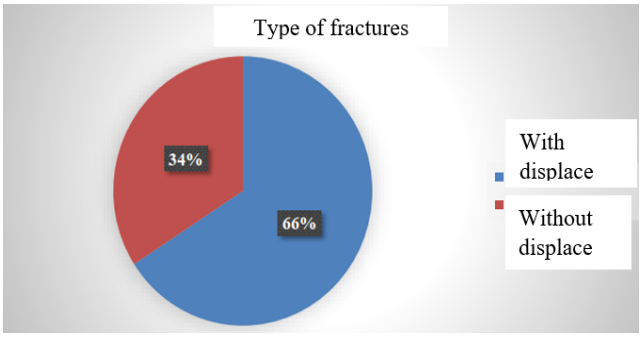

Figure 1. Distribution of subjects according to the shape of the Mandibular fractures

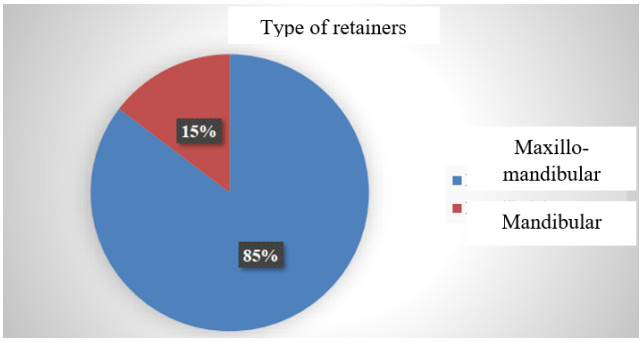

Figure 2. Distribution of subjects according to the type of used restraint

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Table 5. Distribution of patients according to the level of bone consolidation

Bones' consolidations	Good	Avarage	Bad	Total
numbers	33	4	4	41
%	80.49	9.76	9.76	100

Table 6. Statistical analysis of bone density based on alignment bone fragments

Alignments Densities	Good	Gap	Total
Good	31	3	34
Avarage	3	4	7
Total	34	7	41

X-squared=6.4639, df=1, p-value=0.01101

Table 7. Statistical analysis of bone density according to level of bone consolidation

Consolidations Densities	Good	Bad	Avarage	Total
Dense	31	1	2	34
Not Dense	2	3	2	7
Total	33	4	4	41

X-squared=22.386, df=2, p-value=0.0001679

Table 8. Statistical analysis of bone density according to the shape of the mandibular fractures

Shape of fractures Densities	With shifting	Without shifting	Total
Dense	23	11	34
Not Dense	4	3	7
Total	27	14	41

X-squared=0.0092287, df=1, p-value=0.9235

Table 8. Statistical analysis of bone density according to the type of reduction

Types of reduction Densities	Mandibular	Maxillo-Mandibular	Total
Dense	5	29	34
Not Dense	1	6	7
Total	6	35	41

X-squared=1.0606e-30, df=1, p-value=1

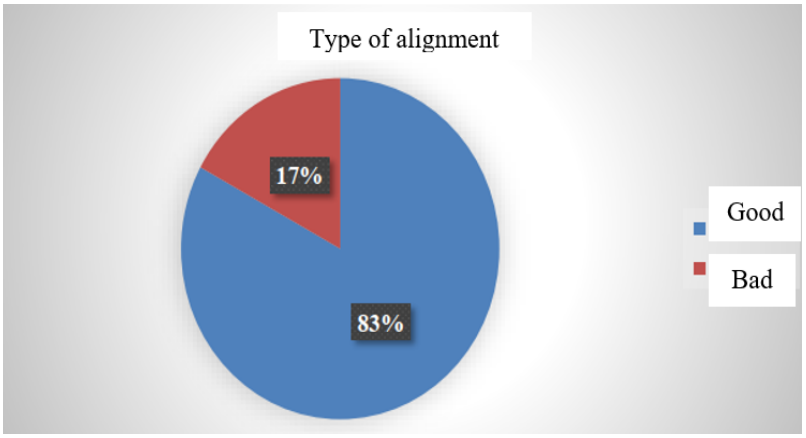

Figure 3. Distribution of patients according to the type of fragment alignment bony

Discussion

Mandibular fractures can occur at any age. In our study, most affected age 's average is 29 years table 1. These results are consistent with those of Soukèye and al.; Keubou and al. for whom the age range is between 27 and 30 years.[16,17]

The orthopedic devices for treating mandibular fractures were generally maintained for 47 days table 2. These results are in accordance with those of Champy J.P., Kouakou N. and Crezoit.[12,14,18]

The minimum duration of 21 days was observed in patients of young ages. The maximum duration is 90 days table 2. Indeed, the less restrictive mandibular devices can be maintained in order to achieve perfect consolidation after blocking. Thus, Menard and al. advise leaving the mandibular device in place until bone densification occurs.[19]

In our study, 36.59% of mandibular fractures are multifocal figure 8. Then, parasymphyseal fractures which are at 26.83%, mandibular angle fractures are at 17.07% figure 4, symphyseal fractures are at 14.63%, and fractures of the horizontal branch are at 4 .88% table 3. Our results differ from those of Keubou for whom only 21.28% were multifocal and the horizontal branch was the most affected with 35.08%.[17]

Mandibular fractures with displacement of the fracture segments are the most encountered cases, the rate of which is 65.85% in our study figure 1.

This explains the choice of using maxillo-mandibular restraints, the rate of which was 85% in our study figure 2.

In the presence of any mandibular fracture with displacement, some authors recommend rigid bimaxillary retention after reduction in order to avoid possible mobility of the fracture fragments. This type of treatment gives almost identical results to the surgical method.[20,21]

The most used devices in our study are the vestibular arches fixed by associated peridental ligatures or not with LEBLANC ligatures, with a rate

Figure 4. Intraoperative panoramic radiography (left angular fracture) of a patient aged 20

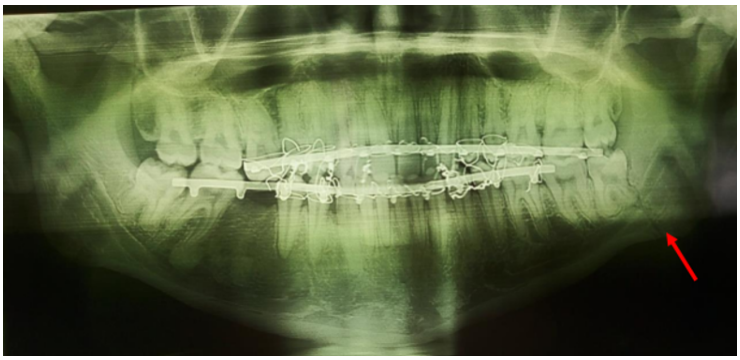

Figure 5. Intraoperative panoramic X-ray control on day (D) 14 of a patient aged 20

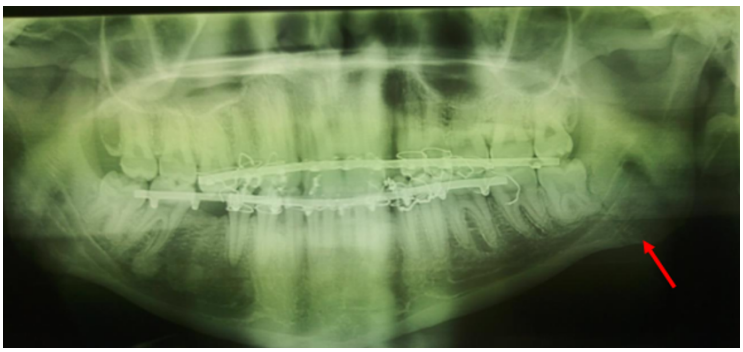

Figure 6. Intra-operative panoramic radiograph for control on day 30 of a patient aged 20

of 73.17% but different from Keubou and al. where intermaxillary blockade by Ivy ligation was most often performed table 4.[17]

Bone consolidation takes place in two main phases: the first concerns the union of the bone fragments and the second the remodeling of the fractured bone. This process requires bone and vascular changes.

In our study, 80.49% of fractures had good bone union table 5. Based on the post-operative panoramic x-ray (the last control x-ray), we note an opaque radio image at the level of the fracture line(s) figure 7 and figure 11. Indeed, we note the disappearance of the fracture line. On the first control x-ray images, we also observe the intimate rapprochement of the fracture edges, which will allow the formation of bone callus which is the beginning of the process of bone consolidation because it allows the union of the two bone segments figure 5, figure 6, figure 9 and figure 10.

For Joachim, bone healing is visible in medical imaging, it means, a bone callus forms and creates a sort of link between the two segments of the fractured bone, parallel to the circulation. local blood returns to its place; guarantee of good consolidation.[22]

On the other hand, for Goodship and Panjabi, there is an unsatisfactory correlation between conventional imaging (or at least its interpretation) and the real solidity of the fracture site.[23,24] For them, there is no strict radiological criterion allowing an assessment of bone healing. Therefore, the conventional radiographic tool must therefore be used with caution and be correlated at all times with a detailed clinical examination.

Panayiotis, Robin and Florence present the sought radiological criteria to attest to a favourable healing process.[25] For them, initially it is a matter of comparing successive images and ensuring that the reduction is maintained. Secondly, the x-ray allows us to attest to the appearance of a bone callus and the disappearance of the fracture line.

We also noted 9.76% of cases where the healing was not perfect because after two months of treatment, on the x-ray the fracture line persisted because there was a clear x-ray image. But patients did not complain of pain. We can say that the fractured banks were not intimately close. This situation is seen in cases of multifocal fractures with displacement in the mandible.

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For Quevauvilliers, maxillomandibular blocking is often sufficient to treat mandibular fractures without displacement and osteosynthesis indicated for mandibular fractures with displacement.[26]

In our study, 82.93% of cases showed good alignment of the basilar rim; indicating perfect reduction of the fracture figure 3.

We have 17.07% of patients in whom we note bone base shifts figure 3. This complication is observed in cases of multifocal fracture with displacement. This state of affairs was also reflected in Keubou's studies with 19.14% complications including malocclusion and delayed union with 22.22% each.[17]

These offsets are of the order of a millimeter at most. They have an impact on dental occlusion, so at the end of the treatment, i.e. after removing the devices, we carry out an adjustment and balancing of the occlusion to correct the caused occlusal disorders.

For Denhez, O. Giraud the treatment of disorders of the dental articulation ranges from successive grinding to an interruptive osteotomy or not with realignment of the bone segments in the three directions of space.[27]

In our study, we have a strong correlation between bone density and the alignment of bone fragments on the one hand and on the other hand with the level of consolidation of bone fragments table 6 and table 7. In addition, there was no significant link between bone density and the shape of the fractures on the one hand and on the other hand with the type of reduction table 8 and table 9.

Thus, we can say that the treatment of mandibular fractures by orthopedic procedures gives satisfactory results. However, we note some inadequacies such as the offset of the bone bases and the non-approach of the fracture segments.

These results are almost identical to those of N'Gouoni with a prevalence of 81% success for orthopedic treatment.[21]

For Sylvie, orthopedic devices are often sufficient to treat mandibular fractures as shown by the results of our treatment of mandibular fractures using orthopedic procedures at DSCTC.[28]

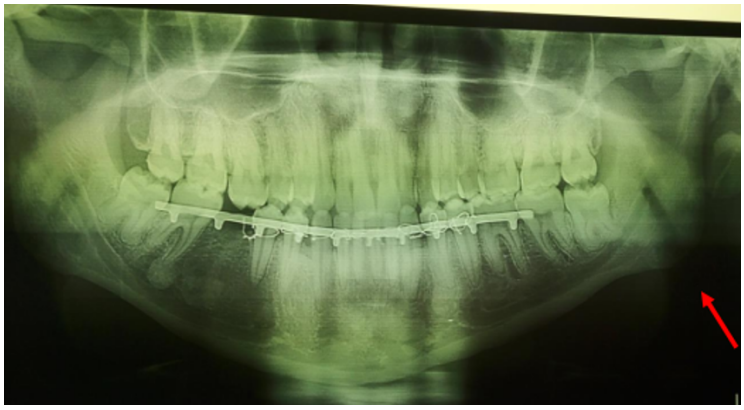

Figure 7. Intra-operative panoramic radiograph for control on day 45 of a patient aged 20

Figure 8. Panoramic x-ray (fractures between 37-38, 44-45) of a patient aged 23

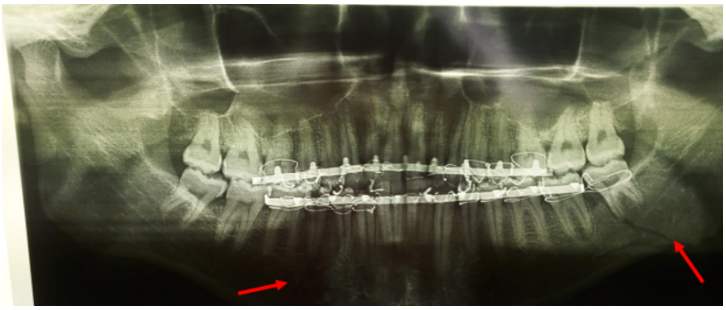

Figure 9. D14 panoramic control radiograph of a 23year old patient

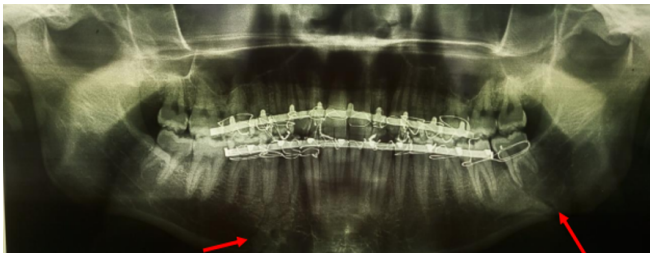

Figure 10. D30 panoramic control radiograph of a 23year old patient

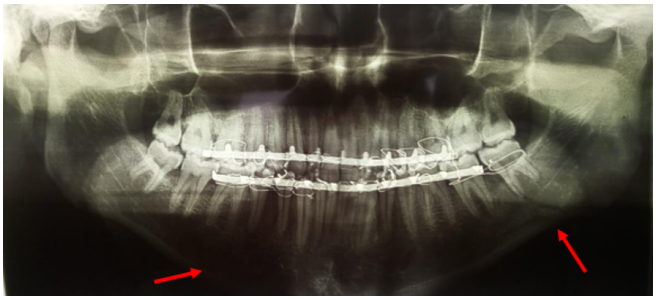

Figure 11. D45 panoramic control radiograph of a 23year old patient

Conclusion

Mandibular fractures are a frequent reason for consultation in Odontology and Stomatology. Their treatment must be judged on the quality of restoration of the occlusion, the manducative function, the anatomy of the bone contours, in the short and long term. In our study, we set out to assess pre-, intra- and post-operative radiographs during the treatment of mandibular fractures using orthopedic procedures.

Consolidation and bone density are the determinants of excellent treatment which would be linked to the quality of the reduction of bone fragments. Orthopedic treatment of mandibular fracture could be indicated in cases of non-displaced fracture with excellent alignment or approximation of bone fragments and some easily reducible fractures.

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