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IMPLEMENTATION OF AN OCCLUSAL WAFER IN SEVERE MANDIBULAR FRACTURE CASES WITH POST-ORIF MALOCCLUSION: A CASE SERIES

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ABSTRACT

Introduction: Improper treatment of severe mandibular fractures can lead to malocclusion, which poses a significant challenge for reconstructive surgeons. The occlusal wafer provides an effective solution for managing malocclusion following ORIF plating of maxillofacial fractures during the one-month postoperative evaluation period. Made from acrylic resin, the occlusal wafer serves as an intermediate guide in orthognathic surgery. It helps reposition the maxilla, adjust the mandible, and modify the jawbones to achieve ideal occlusion. The device can reshape the dental arch to any pre-planned position within 2 to 4 weeks.

Case Illustration: We present two cases of patients with segmental fractures.Case 1: A 26-year-old male also had segmental fractures of the left angle and right body of the mandible. He achieved occlusion after ORIF plating; however, malocclusion developed during the three-week follow-up.Case 2: A 28-year-old female presented with segmental fractures of the left angle and right body of the mandible. She initially achieved occlusion after ORIF plating, but malocclusion was noted during the one-month follow-up.

Discussion: Both of these patients had segmental fractures and experienced malocclusion following ORIF plating, but occlusion was achieved after occlusal wafer installation.

Conclusion: The use of an occlusal wafer facilitates optimal occlusion, streamlines the surgical procedure by reducing operating time, and enhances the ease of postoperative monitoring. This approach proves particularly valuable in cases where ORIF plating has been performed yet ideal occlusal alignment remains unachieved.

Highlights:

1. This study shows that occlusal wafers can effectively correct malocclusion in patients with segmental mandibular fractures after ORIF plating.
2. Occlusal wafers help reshape the dental arch within 2 to 4 weeks, reduce surgery time, and simplify follow-up care, making them a valuable option for surgeons.

INTRODUCTION

Trauma, sports injuries, and auto accidents are common causes of maxillofacial fractures. The most prevalent maxillofacial fractures occur due to two-wheeled motor vehicle incidents, particularly among young males aged 20 to 40. The zygoma and maxilla are most frequently affected, followed by the jaw. Reduction surgery is often necessary for maxillary and mandibular fractures, while conservative treatment is typically used for zygoma fractures.[1]

After maxillofacial fracture surgery, various complications can arise. These may include dental issues, nonunion, malunion, malocclusions, soft tissue problems, temporomandibular joint disorders, facial asymmetry, nerve damage, osteonecrosis, and infections.[2]

Mandibular fractures are the most common types seen in maxillofacial trauma. Due to the unique structure of the mandible, including its hinge joint and the masticatory muscles attached to it, careful management is essential to prevent displacement during treatment.[3] Displacement during fracture reduction can lead to malocclusion.[4]

The three-dimensional position of the condyle in the condylar fossa will change when fractured mandibular segments reduce in the displaced position. Then, the issue of whether the temporomandibular joint could function completely comfortably in a new circumstance would arise. According to a previous study, temporomandibular joints still appear to be functioning normally despite distortion brought on by disease, trauma, or remodeling due to centric postural adaptation. Additionally, they insisted that the restorative phase should begin if the occlusion remains tolerably stable for up to three months and there are no other issues.[5] However, malocclusion can develop in some patients, whether during the initial trauma or the recovery period after surgery.

Post-traumatic malocclusion occurs in 5-20% of cases.[6] Even with proper treatment, complications like malocclusion can arise due to inadequate occlusion establishment, inaccurate anatomic reduction, and poor plate fixation. Malocclusion is the primary reason for additional surgical intervention after maxillofacial trauma.[2] According to some studies, 0.5% to 3% of cases would require a further revision surgery, and 4% to 8% of patients would require occlusal adjustment correction.[4]

Treatment options for malocclusion include occlusal modification with a wafer, post-traumatic orthodontics, and corrective jaw surgery. Surgeons must carefully assess changes in a patient's occlusion following mandibular fractures. Complications can lead to increased pain, longer hospital stays, higher healthcare costs, and disruptions in daily activities. Therefore, minimizing complications is crucial in managing mandibular fractures.[7]

The purpose of this article is to report the use of occlusal wafers in patients with severe mandibular fractures who experienced post-ORIF malocclusion. This clinical case series will describe patients who underwent ORIF for fractured mandibles that resulted in altered occlusion and the utilization of occlusal wafers to achieve stable occlusion.

CASE ILLUSTRATION

Case 1

A 26-year-old male presented to the Plastic Reconstructive and Aesthetic Surgery Department at Zainoel Abidin General Hospital with a primary complaint of lockjaw. The patient reported a one-month history of trismus following a traumatic incident in which he slipped and fell in his backyard. Notably, he did not pursue medical evaluation or treatment immediately after the injury.

On September 12, 2022, the patient underwent ORIF plating surgery, with

satisfactory occlusion initially achieved postoperatively. However, three weeks following the procedure, he reported discomfort in his bite and difficulty with mouth opening. Clinical examination revealed malocclusion and a pronounced open bite, with the absence of contact across all teeth. The patient was subsequently diagnosed with an old segmental mandibular fracture involving the left angle and right corpus, accompanied by malocclusion (Figure 1).

Figure 1. Clinical photographs A) preoperative, B) post-first ORIF procedure, and C) three weeks postoperative.

On October 4, 2022, a secondary ORIF procedure was performed, with an occlusal wafer applied to address the malocclusion. At the six-week postoperative follow-up, the patient presented with corrected occlusion, a comfortable bite, and full mouth-opening capability (Figure 2).

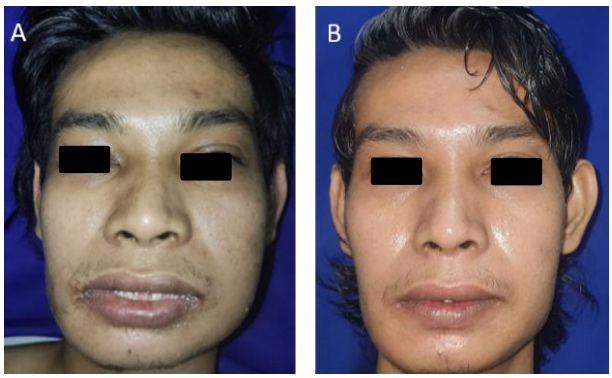

Figure 2. Clinical photograph during A) post second ORIF procedure B) six weeks post operative

Case 2

A 28-year-old female presented to the Plastic, Reconstructive, and Aesthetic Surgery Department at Zainoel Abidin General Hospital with a primary complaint of difficulty in fully closing her mouth. She reported that this issue had persisted for one week following a slip and fall in her garden. In November 2021, the patient underwent ORIF plating surgery, achieving prompt fixation and satisfactory postoperative occlusion. However, three months post-surgery, she began experiencing discomfort during biting and limitations in mouth opening. Examination identified a pronounced malocclusion, characterized by the absence of contact between all teeth (Figure 3).

Based on the assessment, this patient was diagnosed with a segmental fracture of the mandible (left angle and right corpus) and severe malocclusion.

Figure 3. Clinical photograph A) Preoperative, B) Post-first ORIF procedure, C) Three months postoperative

Following assessment, the patient was diagnosed with a segmental mandibular fracture involving the left angle and right corpus, along with severe malocclusion. To address these complications, a secondary reconstructive ORIF plating procedure was scheduled and performed on May 24, 2022, with the placement of an occlusal wafer to maintain proper occlusion. At the six-week postoperative follow-up, the patient demonstrated established occlusion, reported a comfortable bite, and displayed no limitations in mouth opening (Figure 4).

Figure 4. Clinical photograph A) Post-second ORIF procedure, B) Six months postoperative

DISCUSSION

Despite being the largest and strongest facial bone, the mandible is the most frequently fractured bone (36-70% of the time). These injuries are most commonly seen in men in their thirties.[8-10] Mandibular (jaw) fractures are primarily caused by assaults (48–65%), followed by car accidents, slips and falls, and gunshot wounds.[10-11] The high prevalence of mandibular fractures can be attributed to its unique characteristics, including prominence, an unprotected position on the face, mobility, and less bone support compared to other facial bones.[12] Our cases also involved falls, which supports this observation. The mandible is the only mobile facial bone, making it more susceptible to fractures than the mid-face in cases of maxillofacial injury.[13]

Mandibular fractures frequently develop at multiple sites, depending on the direction and intensity of the trauma. These fractures can be classified according to their anatomical sites, including the symphysis/parasymphysis, horizontal branch, angle, ramus, condyle, and coronoid process.[10] The most frequently fractured areas are the body (29%), condyle (26%), angle (25%), and symphysis (17%), while the ramus (4%) and coronoid process (1%) are less commonly fractured.[14] Consistent with these statistics, the present cases also involved fractures of the body and angle of the mandible.

Car accidents, motorcycle accidents, and physical assaults are the primary causes of fractures in the condyle, symphysis, and angle, respectively. Mandibular fractures can result from direct or indirect trauma and can be complete or incomplete, open or closed, single, double, or comminuted.[15]

Depending on the fracture location, patients may present with symptoms such as pain that worsens with jaw movement, trismus, dental malocclusion, swelling, bleeding, external and intraoral tenderness, dysphagia, and a step deformity at the fracture site. Anesthesia of the lower lip may occur due to injury to the inferior alveolar nerve.

Mandibular fractures can also lead to complications, including malocclusion, persistent pain, temporomandibular joint syndrome, and impaired chewing.[16] In the present cases, both patients suffered fractures of the angle and body of the mandible, resulting in severe malocclusion and trismus.

Mandibular fracture treatment aims to precisely reduce the fractured bone to reconstruct pre-traumatic occlusion and

restore normal masticatory function, pronunciation, shape, and sensation. Rigid fixation is essential for the formation of primary callus, leading to the development of various treatment methods. Despite careful planning and execution, complications can arise during the postoperative period. These may include malocclusion, infection, nonunion, malunion, and exposure of foreign objects.[16]

In the present cases, we noted the occurrence of malocclusion in both patients, particularly when early occlusion was achieved. The delayed onset of malocclusion may be attributed to the complexity of the fractures and their natural progression. Based on the classification by Nakamura et al.[17], our cases fall into the category of complications that can arise even after appropriate treatment.

When malocclusion is deemed too significant for correction through occlusal equilibration or orthodontic therapy alone, surgical options must be considered. Generally, combining orthodontic therapy with orthognathic surgery yields the best results. However, if ideal occlusion is achievable on articulated models, one may proceed without orthodontics. Combining orthodontics with surgery allows for the correction of major malocclusions, provided that the post-traumatic bones and joints are functional.[18] In our cases, we employed a combined surgical and orthodontic approach to address the severe malocclusion that developed after the initial ORIF procedure.

The orthognathic surgery wafers serve multiple purposes: a) they provide an intermediate guide for repositioning the mobilized maxilla relative to the intact mandible, b) they help achieve the planned final occlusion, and c) they offer post-operative proprioceptive guidance. The wafer allows dental arches to be placed in any desired preplanned position, reducing the need for intra-operative decisions that can be limited by access issues, especially when viewing posterior segments. These cases also highlight the use of occlusal wafers when post-operative occlusion is not sufficiently stable.[19,20] Additionally, the wafer can act as post-operative proprioceptive guidance. After rigid fixation of the mandible, the wafer can be wired to the maxilla or, less frequently, to the mandible. This provides proprioceptive guidance for up to two weeks, helping the patient achieve the planned occlusion with or without elastics, overriding the patient's pre-operative proprioceptive drive. This also enhances the arch relationship for any final orthodontic refinement.[21]

Wafers can be made from self-cured or heat-cured methyl methacrylate, or in rare cases, cast from silver or cobalt chromium alloy for complex cleft palate cases. It is crucial to use recent models for wafer construction. Impressions must be taken at least two weeks after any final adjustments of the orthodontic stabilizing arch wire. Using models from before the removal of an appliance is ineffective. A poorly designed wafer can compromise even the best surgical technique.[22] Proffit and White recommend that for patients whose arches have been leveled before surgery, wafers should be as thin as possible, with 1 to 2 mm of material between the teeth to prevent breakage. High-impact acrylic can help resolve this issue.[23] It has also been suggested to make the wafer slightly thicker posteriorly (<2mm) to allow for upward recoiling of the condyle post-operatively.[19]

However, various challenges arise in constructing these wafers. Acrylic wafers have poor compressive and tensile strength, take time to make, and can be bulky. They may also distort during curing, increasing the risk of inaccurate jaw localization during surgery. To expedite the preparation of acrylic wafers, self-cured acrylic resin is often used, but this can cause irritation to soft tissues due to

monomer leaching. Strength can be enhanced by incorporating carbon fibers. Alternatively, a clear silicone wafer has been recommended to reduce preparation time and overall cost, although this material may be too flexible for accurate jaw positioning.[24]

Problems may be encountered in stabilizing an acrylic wafer during orthognathic operations while the maxilla and mandible are being repositioned. Previously scalloped labio-buccal extensions to the wafer, which are perforated, have been used to wire the wafer to the orthodontic brackets. However, the wafer is cumbersome and both the construction in the laboratory and the placement in theatre are time-consuming. To overcome these problems of labour intensity, dimensional stability and occlusal accuracy, a new technique for making wafers has been developed using light cured acrylic resin. To stabilize the wafer during operation, orthodontic elastic power chain is incorporated into the wafer.[25] Because of its advantages in stability and accuracy we also utilized acrylic resin wafer to resolve severe malocclusion in our presenting cases.

The acrylic resin wafer is a valuable tool in the management of mandibular fractures, offering a quick and effective solution for achieving dental alignment. With a fabrication time of just 15 minutes, the wafer's thin and rigid structure ensures a precise fit for the patient's dental arches. Its dimensional stability and inert nature prevent the leaching of harmful monomers, making it a safe choice for clinical use. One of the significant advantages of this wafer is the integration of a power chain, which facilitates easy positioning and secure attachment to the maxillary teeth. This feature is particularly beneficial during inter-maxillary fixation, as it completely eliminates the need for wires, thereby reducing the risk of glove perforation during surgical procedures.

Moreover, certain designs of the wafer can be customized to include the patient's name and an orientation arrow, enhancing usability for clinical teams. However, while the advantages are substantial, it is essential to consider the wafer's potential disadvantages. The material's brittleness poses a risk, as it may break if accidentally dropped on a hard surface, which could lead to complications during treatment. Overall, the acrylic resin wafer represents a significant advancement in surgical aids for managing severe malocclusion associated with mandibular fractures, balancing efficiency with patient safety.[10]

The study highlights several strengths in the use of occlusal wafers for correcting severe malocclusion in patients with mandibular fractures. One key advantage is the effective restoration of dental alignment post-surgery, showcasing a reliable method for improving patient outcomes. Additionally, the introduction of light-cured acrylic resin for wafer fabrication simplifies the process, allowing for quick production—taking just 15 minutes—while ensuring a precise fit. This innovative approach not only enhances stability and accuracy during surgical procedures but also reduces the risk of complications, such as glove perforation, by eliminating the need for wires.

However, there are some limitations to consider. The wafers can be brittle, posing a risk of breaking if dropped, and patients may experience initial discomfort as they adjust to wearing them. Moreover, the success of the wafers heavily relies on the accuracy of the initial models; any flaws in construction can lead to improper positioning during surgery. Despite these challenges, the study introduces a novel approach by combining orthodontic therapy with the use of occlusal wafers, offering a more comprehensive treatment strategy for severe malocclusion. The customizable design, which can include patient-specific features like names and orientation markers, represents a significant advancement in surgical aids.

Overall, this research addresses common issues faced with traditional wafers, providing an efficient and effective solution for improving patient care in the management of mandibular fractures.

CONCLUSION

The application of an occlusal wafer facilitates optimal occlusion, reduces surgical duration, and streamlines postoperative monitoring, presenting itself as an effective option in cases where ORIF plating has been completed without achieving ideal occlusion. Furthermore, the wafer serves as an effective tool for postoperative proprioceptive guidance. The use of an acrylic resin wafer provides additional benefits, including enhanced dimensional stability and precise occlusal alignment.

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CONFLICT OF INTEREST

This study does not involve any conflicts of interest.

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This study was not funded by any party.

AUTHOR CONTRIBUTION

CAP conceptualized the study, gathered patient data, and drafted the manuscript. MA contributed to the clinical management of the cases, reviewed the literature, and provided critical revisions to the manuscript. TNP performed data analysis, assisted in drafting figures, and contributed to the final edits of the manuscript. All authors approved the final version of this paper for publication.

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