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Case Report

Non-surgical management of bilateral condylar fracture with application of customized 3D printed hypomochlion splint a case report

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ABSTRACT

Posttraumatic malocclusion is one of the most serious complications of condylar fracture responsible for mandibular functional impairment. Depending on the severity, it is imperative to resolve this complication through the surgical or nonsurgical mode of treatment. This report presents a scenario of a 21-year-old male patient with post-traumatic occlusal derangement due to the fracture of the bilateral condylar process and left parasymphysis mandible. The treatment protocol combined an open reduction and internal fixation for parasymphysis mandibular fracture and a closed approach using customized 3D printed hypomochlion splint and intermaxillary fixation in moderately displaced bilateral condylar fracture. No postoperative complication espied in a month follow-up period. Outcome in this case is, hypomochlion splint is effective in treating the post-traumatic occlusal discrepancy with the added advantage of accuracy of 3D printed splints that did not require intraoral manipulation and had better patient compliance.

Keywords: Condylar fracture, Post traumatic malocclusion, Nonsurgical, splint, 3D printing

INTRODUCTION

Mandibular condylar fractures (MCF) are the most commonly diagnosed fracture accounting for 29-52% of all mandibular fractures.[1] These fractures can be unilateral, bilateral, displaced, nondisplaced, deviated or dislocated based on location and involvement. Several consequences of condylar injuries include reduced posterior facial height, limited mobility, facial asymmetry, reduced masticatory ability, temporomandibular joint (TMJ) dysfunction, and malocclusion.[2] Despite its high incidence, management of these fractures has always been controversial and a point of debate among Oro maxillofacial surgeons regarding non-surgical via Maxillomandibular fixation (MMF) and surgical procedures, including open reduction and internal fixation (ORIF). Therefore, adequate knowledge, experience, technique, technology, and timely intervention are essential requisites for optimal treatment of condylar fractures.

The nonsurgical or closed treatment approach is often preferred over surgical for the management of condylar fractures owing to inherent anatomical hazard associated with the latter.[3] Studies have reported that nonsurgical management of MCF using a hypomochlion (hypo–small; mochlos-lever) splint along with Maxillomandibular fixation (MMF) and adequate physiotherapy can yield satisfactory results.[4,5] This treatment protocol does not attempt the anatomical reduction of the condyle but focuses on re-establishing a functional occlusion and acceptable range of motion by resetting the

neuromuscular adaptation of the mandible condyle complex.[5] With this concept, the present case report aims to assess the use and potency of a customized 3D-printed hypomochlion splint in the non-surgical management of bilateral condylar fracture.

CASE REPORT

A 21-year-old male patient reported to our hospital with a chief complaint of difficulty during biting and chewing. Patient had a history of facial injury, a fractured rib, and lung perforation in a road traffic accident six weeks back.

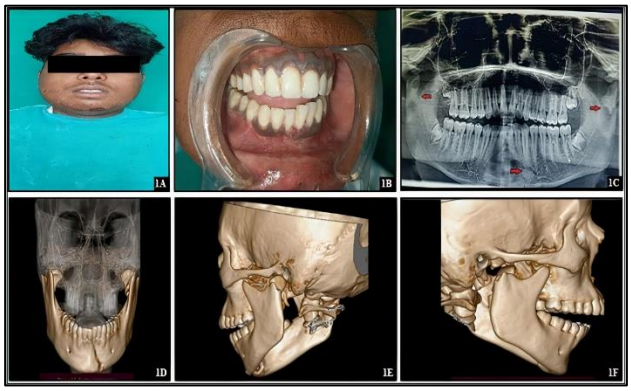

Figure 1: (A and B) Pre operative extraoral and intraoral view of patient. C) Preoperative OPG revealing fracture of left parasymphysis and left and right condylar process of mandible (red arrows). D) Preoperative frontal view of CT scan showing left parasymphyseal fracture. E, F) Preoperative lateral view of CT scan exhibiting left and right displaced fracture of condylar process.

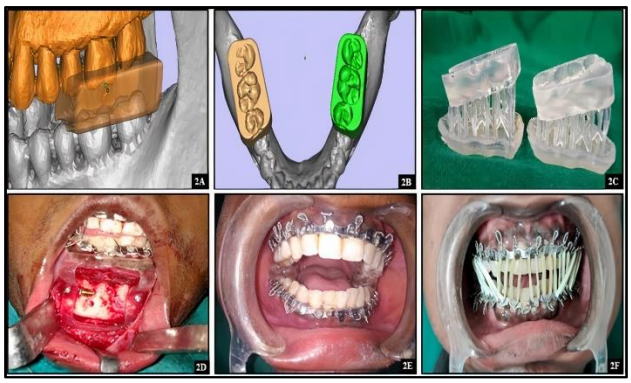

Figure 2: (A) Virtual planning for the specific shape of customized hypomochlion splint on a maxillomandibular model by analyzing surface data of the occlusal surface of the posterior teeth. (B) 3D computed tomography showing virtual design of the splint on the left and right posterior segment. (C) Customized 3D printed hypomochlion splint fabricated using biocompatible resin with vertical dimension of 3mm and 1mm respectively. (D) Intraoperative ORIF of left parasympysis fracture using lagscrew.

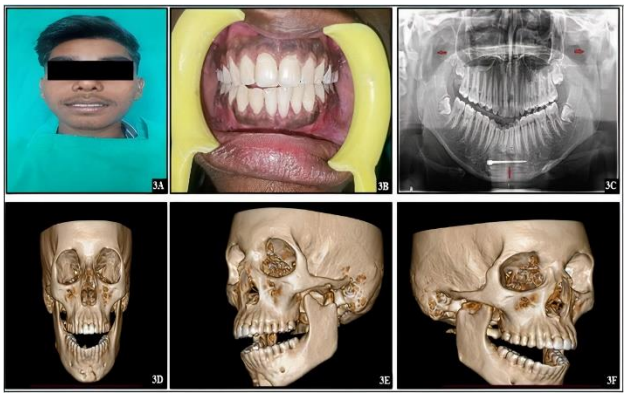

Figure 3: A and B: Postoperative assessment showing improved facial lower third height and symmetry with stable normal occlusion. (C) Postoperative OPG after a month showing lag screw in position and functional remodelling of the condylar process. (D) Postoperative CT scan showing lag screw in place. (E and F) Left and right CT scan showing remodelling of condylar process of mandible.

Extra and Intraoral examination revealed facial swelling, a sutured lacerated wound at the mentum, occlusal derangement with premature contact on the molars bilaterally, and an anterior open bite with a mouth opening of about 15 mm. He also expressed concern about compromised masticatory efficiency and esthetics associated with post-traumatic malocclusion. Panoramic radiography (OPG) and 3-dimensional Computed tomography (CT) were taken for preoperative diagnosis, which exhibited left parasymphysis and bilateral displaced condylar fractures.

Before initiation of treatment, the patient was explained about the procedure, and informed consent was taken. Due to the delay in fracture management and a history of lung perforation, surgical reduction and fixation of parasymphysis fracture were performed using 2×22 mm lag screws (SK Surgicals) via intraoral approach, while the condylar fractures were managed conservatively. However, due to interceptive occlusal contact on posterior teeth and persistent anterior open bite, occlusal correction via MMF was questionable. Therefore, a customized 3D-printed hypomochlion splint was fabricated, with its vertical dimension calculated to the anterior open bite present.

The fabrication of the customized 3D splint began with a CT scan of the mandible and maxilla, along with 3D imaging of the patient's dentition. For virtual reconstruction, the images from the patient's CT scan (Ingenuity core 128–Phillips multislice CT) were imported as data files in the Digital Imaging and Communication in Medicine (DICOM) format. The DICOM data was used to generate Standard Tessellation Language (Stl) file, and two 3D-printed hypomochlion splints were designed with different vertical dimensions

of 3mm and 1 mm, respectively. Pre operatively, Ramal length was measured through linear distance between condylion and gonion which was 4.55 cm. The surface data of the occlusal surfaces of the posterior teeth were analyzed using a Boolean operation which is a computer aided design used for intersection, union and substraction between two fracture segments which is important in performing accurate and reproducible virtual surgical planning to achieve a specific shape of the customized splint on the maxillomandibular model and eliminate interference. The digital designs were then exported to a 3D resin printer (ProJet MJP 2500W) and fabricated using biocompatible SLA resin (Formlabs, Form 2).

MMF was done using arch bars to stabilize the bony segments. The 3mm splints were placed bilaterally on the posterior teeth to aid complete intercuspation. Next, the inter-arch traction elastics were applied to the anterior teeth to permit rotation of the mandible along the splints without any resistance. The accuracy and perfect seating of the 3D customized splint allowed easy placement with no further intraoral adjustments and prevented its dislodgement during the procedure. Also, the appliance's surface was smooth and easy to clean, which helped to maintain oral hygiene. After a week, the splint was replaced with one with a smaller vertical dimension.

Every alternate day patient was recalled for a change of intermaxillary elastics and active physiotherapy, including opening, protrusion, and lateral movement exercise of the mandible to obtain maximum results. Antibiotics, Analgesics were prescribed for five days, and oral hygiene instructions were given. After two weeks of follow-up, the hypomochlion splint was removed, and only postoperative physiotherapy exercises were continued. The patient did not report any discomfort with protrusion and lateral excursion of the mandible and had attained complete occlusion giving a perfect molar relation and standard mouth opening of 35 mm, after a month and 2 years follow up showed excellent post operative occlusion. After 3 months follow up, ramal length was calculated (4.78 cm) where there was significant increase in the ramal length post operatively with good range of motion.

DISCUSSION

Postoperative malocclusion is the most common sequlae of displaced condylar fractures and a point of concern, affecting the patient's physiologic function and psychological health. Premature contacts of molars (ipsilateral or bilateral), open bite (contralateral or anterior), loss of vertical height, deviated mandible, difficulty in mouth opening, and tenderness around TMJ determine the severity of this condition. Management of such malocclusion varies from occlusal adjustment and orthodontics in mild to moderate to orthognathic surgery in severe cases.[6]The present case report represents a modification of the classic IMF technique used for the nonsurgical treatment of a bilaterally displaced condylar fracture. The modification incorporated the use of two 3D customized hypomochlion splints for correction of premature contacts on the posterior teeth with one splint made per side. Interarch elastics for the existent anterior bite, and active physiotherapy exercises of the mandible. However, the ORIF was done for parasymphysis fracture prior to treatment of the condylar fracture.

Placing a hypomochlion splint in the molar region with anterior elastics helps to derotate the mandible in a counterclockwise direction while simultaneously distracting the ramus vertically in an inferior direction. It serves as a hypomochlion to allow rotation of the mandible counterclockwise for proper anatomical alignment and avoid overriding the fractured segment to re-establish the original habitual occlusion and normal function.[4,6]

In addition, the use of the rigid arch bar for IMF in the present case distributed pulling force to the entire dental arches, thereby preventing the supra eruption or intrusion of the tooth. After the removal of the splint, physiotherapy exercises were advised for the patient to achieve stable occlusion. The early initiation of physiotherapy exercises could help develop a new motor program by transmodification of the spatial and temporal organization of the contraction pattern of all masticatory muscles, thus guiding the mandible into maximum intercuspation.[7]

Therefore, it is likely to presume that in this case, the combination of the posterior hypomochlion splint with intermaxillary elastics for the open bite and the active physiotherapy sessions provided an optimum stimulus to re-establish the original habitual occlusion and normal symmetric range of motion by resetting the neuromuscular adaptations of the mandible.

CONCLUSION

Various studies have reported using acrylic jigs dental composite occlusal stops etc., as bite-raising appliances for managing post-traumatic malocclusion.[4-6,8] However, the preparation of acrylic jigs used as the splint was time-consuming and required adjustments and periodical trimming for a smooth surface and intraoral fit. In this case report, the 3D-printed customized hypomochlion splint was beneficial, time-saving, and required no intraoral adjustments compared to acrylic jigs, thus simplifying the overall treatment procedure. To best of the author's knowledge, this is the first case report to evaluate 3D-printed customized hypomochlion splint in the nonsurgical management of post-traumatic malocclusion in bilateral MCF.

The outcome in the present case report indicated that the malocclusion correction in mild to moderate condylar fracture with nonsurgical management using a hypomochlion splint could give significant results without any surgical intervention required to restore the

functional occlusion and standard range of motion. However, surgical treatment is desirable in severe cases with a significant reduction in ramus height (>8 mm), TMJ disorders, displaced condylar segment in the middle cranial fossa or any associated facial fracture.[9,10]

In addition, the use of novel 3D printed technology to fabricate customized splints using biocompatible resin was a bonus to the present treatment protocol because of the precision and snug fit of the splint that required no further alteration and allowed more propitious patient oral hygiene maintenance.

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