

Treatment Of Mandibular Fracture With Titanium 3-Dimensional Mini-Plates: A Historical Review And Case Report

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Abstract:-

Mandible is one of those facial bones which is more prone to fractures during trauma. The treatment of such fractures is necessary to prevent functional complications like malocclusion. As history has witnessed a leap in the treatment options for mandibular fractures, here we report a case of left parasymphysis and right Angle of mandible fracture treated with a straight 6 holed with gap titanium mini-plate at the right angle and a 3D titanium mini-plate at the parasymphysis, as these are best available options in recent times. The patient presented with swelling on the right lower half of the face for 2 days with a positive history of road traffic accident two days back. After thorough clinical evaluation and radiographic investigations a final diagnosis of left side parasymphysis fracture along with contra-lateral angle fracture was established. The patient was treated with the open reduction and internal fixation for both the fractures. Along with the case report we also present a brief historical review of treatment options for mandibular fractures.

Keywords: mandibular fracture, maxillo-mandibular fixation, 3d plates, mini-plate fixation, history of mandibular fracture treatment

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I. Introduction

The anatomical position of the mandible makes it prone to fractures during road traffic accidents, interpersonal violence, gunshots and sports. Such fractures need prompt treatment to restore functions like speech, sleep, breathing and mastication. The treatment of mandibular fractures ranges from simple Intermaxillary fixation to complicated mini-plate fixations.

II. Historical Review

The writings of mandibular fractures appeared as early as 1650 BC, when an Egyptian papyrus described the examination, diagnosis and treatment of mandibular fracture as bandages soaked in honey and white egg and the wounds were treated by the application of fresh meat on the first day. Later Hippocrates, an Asklepiadae in the 470 BC, introduced a technique of reducing the mandible by hand and was immobilized by gold or linen threads tied around the adjacent teeth. He also recommended extra oral fixation by the use of strips of Carthaginian leather glue to skin. During the Roman Empire (23 BC-410 AD) Aulus Cornelius Celsus advocated a ligature for fixation of the fracture.^[1] He forbade his patients to speak and they were kept exclusively on liquid diet for several days. In 500 AD the Indian surgeon, Sushruta recommended treating fractures by using complicated bandaging and bamboo splints covered with a mixture of flour and glue which were applied under the chin to immobilize the fracture.^[2] From the early 1700s, dental treatment was provided by "barber surgeons", they used the traditional method like reducing the fracture and by joining of teeth adjacent to fracture line by the ligatures and then immobilizing the mandible with the help of bandages.^[3]

In 1743, Bunon carved an ivory block as a dental split and tied all the mandibular teeth by threads. In 1779, Chopart and Desault described another dental splint; a shallow trough of iron was laid over the lower teeth which was then clamped down to the lower border of the mandible by an external screw device. In 1799, a German surgeon named Rutenick introduced a variation in this technique by stabilizing the head harness attached to a helmet by ribbons.^[1] The 19th century saw a gradual shift in the management of the fractures of the jaw as it was now. The dental surgeons focused on establishing the occlusion and many refinements were

introduced to improve extra oral fixation by the use of trans-mandibular or circum-mandibular wire fixation to immobilize the mandibular fracture directly or indirectly. Rodgers in the year 1826 was the first scientist to do an open reduction. In 1840, Baudens used circumferential wires to immobilize an oblique fracture of the mandible. Nowadays, the fractures are best treated with titanium mini-plates and screws.^[1] The principles for use of such mini plates were laid down by AO Foundation based in Switzerland.

III. Case Report:-

An 18 year old male patient reported to our department with the chief complaint of pain and swelling over the right lower half of the face along with difficulty in chewing for two days. Patient allegedly had a road traffic accident two days back where he suffered from oral bleeding but there was no loss of consciousness and the patient was oriented to time, place and person when he reported for first aid to a local dentist from where he was referred to our department.

On the extra oral examination, gross facial asymmetry was noticed on the right lower half of the face. On inspection, the swelling measuring 5 x 3 cm extending from the corner of the mouth to the posterior border of the ramus anteroposteriorly and starting from 1 cm below the Ala tragus line to 1 cm below the inferior border of the mandible superoinferiorly was noted. Mouth opening was reduced measuring inter-incisal distance about 20mm. On palpation, the swelling was soft and tender with crepitation over the right angle of the mandible region with a step deformity felt at the lower border of the mandible in the same area. Another step deformity and tenderness was felt at the left parasymphysis region. The lymph nodes were non palpable.

In the intra oral examination, on inspection a laceration in gingiva with slight bleeding was noticed with respect to 32 and 33. A step was noticed in the mandibular occlusal plane in relation to the same teeth with open bite on the right side. On palpation these two teeth were found tender on percussion. The region around an unerupted 48 was also tender on palpation. A slight fracture segment mobility was elicited in the left parasymphysis and right angle region. Coleman's sign was positive i.e. the ecchymosis of the lingual sulcus in relation to 32 and 34. No neurosensory deficit was appreciated.

Based on the chief complaint and clinical finding a provisional diagnosis of left parasymphysis and right angle fracture of mandible was established. The diagnosis was confirmed by orthopantomogram. The patient was planned for ORIF (Open reduction with internal Fixation) in relation to both the fractures under general anesthesia. An informed consent from the patient was taken after describing the complete procedure, benefits and potential risks related to the procedure, administration of general anesthesia and postoperative complications. The required preoperative investigations were carried out, and the patient was posted for surgery. During the procedure, partially erupted 48 was extracted as it was present in the fracture line. The intermaxillary fixation (IMF) was performed using both maxillary and mandibular arch bars to reduce and attain immobilization. The fixation was done using 3D titanium mini plates for left parasymphysis fracture with 4 screws and 2 mm 6 hole with gap titanium mini plate for right angle fracture. After that the fracture site was stabilized, the IMF was released and the occlusion was rechecked before closure with 3-0 vicryl suture.

IV. Discussion:-

Mandible is a tubular long bone which is bent into a blunt U shaped bone leading to a complex biomechanical musculoskeletal system. The weakest part of the mandible is the neck of the condyle followed by angle and then symphysis region. During the road traffic accident severe forces are applied to a small cross section of the mandible leading to fracture at the impact site or the presence of strong muscles.^[4]

The management of mandibular fracture requires reduction, fixation, immobilization and rehabilitation. Reduction of the fracture segments can be done by closed or open technique. Though open reduction might compromise the vascular supply but its advantage lies in direct visualization and fixation of the fracture segments leading to early functional restoration and less healing time over the closed reduction methods which require IMF for prolonged periods of time. The most important factor in the decision making of whether the mandibular fracture requires open reduction surgical or closed is the state of the occlusion.^[5]

The fixation of fracture mandible can be grouped into tension versus compression principle, load bearing versus load sharing principle and the rigid versus semi rigid fixation principle. Fixation along the compression bands gives rapid healing.^{[5],[6]} At any given time forces acting on the mandible are equal but during mastication tension forces exist along the upper border that is the alveolar process and compression forces exist on the lower border of the mandible. In 1979, Champy in his landmark article, suggested that monocortical fixation is sufficient for the management of the mandibular fracture. He stated that the osteosynthesis by plates screwed on the outer cortical plate is solid enough to support the strains developed by masticatory muscles. He also stated that in the case of lower border fixation, the strains are concentrated at the lower border and that the loaded part is weaker than in the case of a fixation with a plate screwed at the upper border. The strain being inversely proportional to the section, we see that the osteosynthesis along the alveolar border is stronger than that at the lower border so he gave the Champy's lines of osteosynthesis where the miniplates should be placed

considering the roots of mandibular teeth and a tension band on the upper border in the form of arch bars. In the end, he concluded that the surgical approach would be simple with reduced side effects.^[7]

Depending on the amount of bone loss, comminution, bone quality and location of the fracture the choice is made for load bearing or load sharing fixation. In load bearing fixation the complete load of the forces is borne by the plate while in load sharing, the load of the forces is shared by the bone and the plate. In cases of comminution and bone loss, load bearing locking reconstruction plates are used with bicortical screws. Load sharing is followed by the miniplates used with the Champy's principle.^{[6],[7]}

The rigid and semi-rigid fixation principle depends on the healing that occurs in the fracture line. Rigid fixation techniques allow healing by primary intention with no callus formation while semi rigid allows contact healing with minimal callus formation allowing micro movements of the fracture segments. The miniplates are a form of semi-rigid fixation whereas lag screws and compression plates are forms of rigid fixation^[6]

The fracture of parasymphysis region of the mandible in our case warranted ORIF as the occlusion was deranged. According to Champy, two miniplates should be used to fixate parasymphysis due to torsional forces that come into play. We used 3 Dimensional miniplates as they provide dual benefits of a single plate acting as two and counters the torsional forces better. Also the 3 Dimensional miniplates have lesser post operative complications.^[8]

At the angle of mandible, Champy suggested one single plate at the superior border , hence we have used a single 6 holed with gap titanium miniplate.^[9] The third molar within the fracture line was extracted as it may cause postoperative complications.^[10]

If the removal of the wisdom tooth becomes an important factor, the tooth which comes in between the fracture line should be removed before reduction. It can be approached intra-orally or extra-orally. The miniplate fixation is placed on the oblique ridge of the mandible as suggested by Champy with or without placement of miniplate along the inferior border.