



CASE REPORT

Clinical Experience with Osteosynthesis of Subcondylar Fractures of the Mandible using Delta Plate

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ABSTRACT

Mandibular condyle fractures are one of the most frequent injuries of the facial skeleton. The option for open treatment of mandibular condyle fractures has become more favorable since osteosynthesis materials were developed in the past few decades. However, the rigid fixation techniques of treating condyle fractures remain one of the controversial issues in maxillofacial trauma. Several techniques and plate types such as adaption miniplates, minidynamic compression plates, resorbable plates, and double plates have been evaluated biomechanically in various experimental and clinical studies. The present case report is to evaluate the clinical use of indigenously developed titanium delta-shaped miniplate in open reduction and internal fixation of subcondylar fracture.

Keywords: Delta plate, Osteosynthesis of condyle, Subcondylar fracture.

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INTRODUCTION

Fractures of the condylar region are frequent, with clinical studies reporting 25 to 45% of all mandibular fractures.^{1,2} Open reduction and rigid internal fixation (ORIF) of condylar base and neck fractures has become the surgical standard. The debate continues over how to best manage subcondylar fractures and the question of which fractures should be treated surgically has yet to be answered. However, in recent years, due to the enormous development of the osteosynthesis technique and the

refinement of surgical techniques, the attitude toward the treatment of a condylar neck fracture has changed from an exclusively nonsurgical approach toward surgical treatment. To reach the condyle area, different approaches are used, e.g., the transoral approach or different extraoral approaches, such as the periangular, preauricular, retro-mandibular, transparotid and retroauricular.³⁻⁶ The goals of ORIF in condyle fracture management are to restore function, re-establish premorbid anatomy, and provide fracture stability. The latter can be achieved by different fixation techniques. Two miniplates (double-plate technique) are the most reliable because these neutralize tension and pressure forces best and produce greater stability.^{7,8} Their application may require an extraoral surgical approach, with disadvantages, such as risk of facial nerve injury and visible scarring. The intraoral approach with endoscopic control offers an alternative; however, because of the limited space, two miniplates may be difficult to apply.^{9,10}

As an alternative to the modified two-miniplate technique, specially designed plates, such as the delta plate are available, and biomechanical and clinical studies have confirmed that these plates allow for sufficient neutralization of strains. Therefore, these plates provide sufficient stabilization for ORIF of subcondylar and condylar neck fractures combined with the advantage of a smaller plate.¹¹⁻¹³

The present case report is to evaluate the clinical use of indigenously developed titanium delta-shaped miniplate in open reduction and internal fixation of subcondylar fracture.

CASE REPORT

A 24-year-old female reported with a complaint of swelling and pain with left side of the face since 1 day with a history of road traffic accident 1 day back. Her general health conditions were good, but she referred pain in the left temporomandibular joint (TMJ) region. The extraoral evaluation revealed asymmetry of the face, with deviation of the chin toward the left side, bruises present with right side of the chin, wherein the traumatic impact occurred. The TMJ evaluation showed functional reduction in mouth opening (16 mm between the edges of the upper and lower incisors), with deviation of the midline toward the left, with restricted TMJ movements. On palpation,

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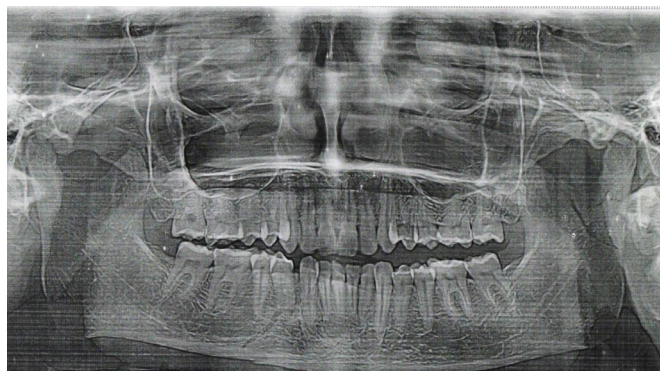


Fig. 1: Orthopantomography showing right mandibular parasymphysis fracture and left mandibular suncondylar fracture

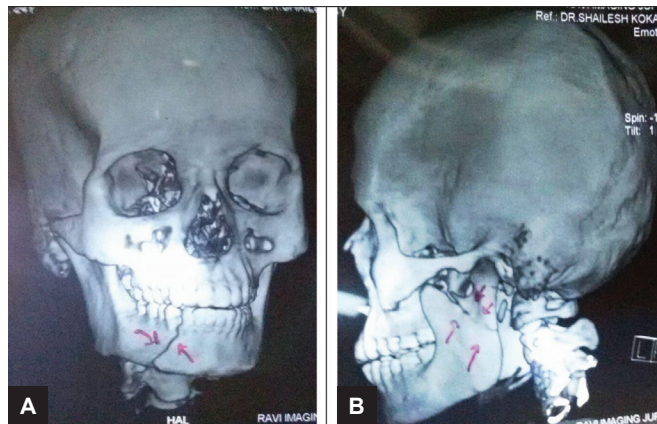
step deformity was present along the inferior border of the mandible in the right parasymphysis region and tenderness elicited on palpation of left TMJ. The oral evaluation revealed a malocclusion: The lower midline was deviated toward the left, with ipsilateral crossbite and contralateral open bite.

The radiological evaluation panoramic radiograph (Fig. 1) and computed tomography (CT) scans (Figs 2A and B) were done and depicted right mandibular parasymphysis fracture with left mandibular subcondylar fracture. After confirming the diagnosis, open reduction and internal fixation was planned.

General anesthesia was administered through nasotracheal intubation. Transparotid approach was used for fracture reduction of the condyle. The skin is incised; the subcutaneous tissues are dissected superficial to the superficial muscular aponeurotic system in an anterosuperior direction using blunt and sharp dissection until masseter muscle fibers appear. Facial nerve fibers are not always visible, but should be preserved carefully and protected with a retractor when they are detected. The deeper muscle fibers lying underneath the facial nerve can be transected safely if necessary. The pterygomasseteric sling that is divided along with the periosteum and



Fig. 3: Subcondylar fracture is reduced and rigid fixation done using delta plate



Figs 2A and B: Three-dimensional reconstruction of CT face fracture lines marked by arrows

the fracture is identified and reduced. Once the fracture is reduced, rigid plate osteosyntheses are performed using delta plate (Fig. 3). Double-layered closure is done and hemostasis is achieved. Parasymphysis fracture was accessed via intraoral circumvestibular incision and ORIF was done with two 2 mm four-hole plates (Fig. 4). A postoperative OPG was taken to confirm the position of the condyle and stability of fixation (Fig. 5).¹¹ Postoperative



Fig. 4: Parasymphysis fracture accessed via intraoral circumvestibular incision and ORIF done with two 2 mm four-hole plates

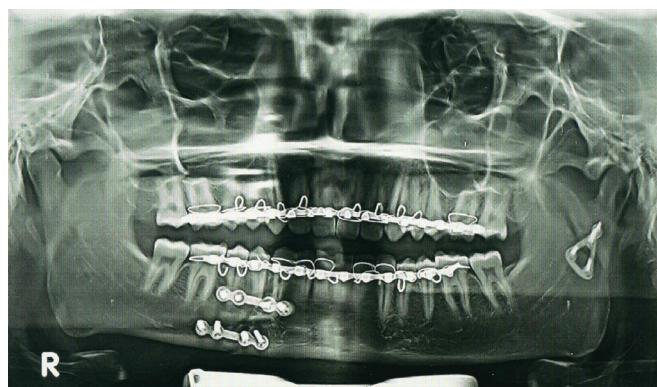


Fig. 5: A postoperative orthopantomography showing fixation of right mandibular parasymphysis fracture with mini plates and that of left mandibular suncondylar fracture by delta Plate

mouth opening was 38 mm and satisfactory occlusion was achieved, and thus no intermaxillary fixation was required. Patient was followed up for 6 months and no complications, such as facial nerve palsy, plate bending, plate fracture, screw loosening were encountered.

DISCUSSION

The method of fixing the condylar fracture is either by open reduction or by closed reduction, which has always evoked controversies. Although many systems of rigid fixation have been described, the one with miniplates is the preferred technique today. The three-dimensional (3D) osteosynthesis plates were introduced into maxillofacial surgery in the early 1990s. Advantages are the smaller size combined with greater stiffness of the plates. As an alternative to the modified two-miniplate technique, specially designed plates such as the delta plate or the trapezoid plate are available, and biomechanical and clinical studies have confirmed that these plates allow for sufficient neutralization of strains. Therefore, these plates provide sufficient stabilization for open reduction and internal fixation of subcondylar and condylar neck fractures combined with the advantage of a smaller plate.¹⁴ The design of the new delta-shaped miniplate takes into account previous *in vitro* analysis on load, strain, and bone deformation at the condylar neck region, as well as finite-element analysis. Tensile strains occur mainly at the anterior and lateral borders of the condyle, and compressive strains at the posterior and medial borders.^{8,15,16} Due to the permanent mediolateral bending of the condyle during function, a certain stiffness of the plate, a stronger plate, or two plates are recommended.^{17,18} The two plates are usually placed along the tensile stress lines. In the delta-shaped plate, the base is oriented toward the angle of the mandible; thus, the lines of tensile and compressive stress distribution run parallel to both sides of the plate. The plate is 1 mm thick, 20 mm long, and 5 mm wide at the top and 12 mm wide at the base. At the top of the plate is an arm with two longitudinally arranged holes; two more holes form the two corners of the base of the plate.¹¹ Using the new delta-shaped plate for condylar neck fractures has three main advantages: (1) neutralization of changing strains at the anterior, lateral, and posterior borders; (2) the additional stabilization provided by a compression miniplate; and (3) a small osteosynthesis plate.¹¹ Delta plating system can transmit the demanded loads in all directions of movement. This plate allows a functionally stable osteosynthesis in the condylar neck region of the mandible and that this type of osteosynthesis can resist physiologic strains in the injured TMJ as described by Lauer et al.¹¹

The condyle is subject to forces in five different directions: Posterior to anterior, anterior to posterior, medial to lateral, lateral to medial, and torsion. Under these conditions, the 3D nature of the plate due to its triangular shape provides internal stability, as well as more optimal leverage. To counteract posterior or anterior loads onto the proximal fragment, the base of the plate is safely fastened in the distal fragment with two screws set apart at a distance to provide optimal leverage. Furthermore, the sides of the triangle act alternately as a tension band depending on load direction. Against torsion forces, the plate is more resistant because the two sides of the triangle and the anchoring screws have a distance in the horizontal; consequently, lower loads are transmitted into the bone due to better leverage. For medial tilt, tension forces are applied on the plate. No particular thickness of the plate is required if the surfaces of the reduced bone fragments support each other. If there is an interfragmentary gap after osteosynthesis, the thickness of the plate is important, because the plate must withstand bending forces. Independent of reduction result, plate stiffness is also important to resist lateral tilting. A biomechanical model¹⁷ has demonstrated a thickness of less than 1 mm to be insufficient to resist plate bending or fracture.

In summary, the design of the newly developed plate allows for treatment of even high condylar neck fractures. The plate's delta shape can handle changing loads, with the highest tensile strain occurring at the anterior and lateral surfaces and the highest compressive strains on the posterior surface.^{8,16-18} The plate can be easily placed in the confined space at the condylar neck by an experienced surgeon.

CONCLUSION

Fixation of subcondylar fracture with delta plate was easy even in the confined space of the condylar neck. Radiographic follow-up after 6 months showed that the osteosynthesis was reliably stable, and the functional results are in accordance with other clinical studies on ORIF of fractures of the condylar neck. The surgical ease, comfortable adaptation, and adequate stability were achieved by these plates. The functional and esthetic outcome with this procedure has proved beyond doubt that this plating system is one of the emerging trends in managing subcondylar fractures. No special armamentarium was required, as only the shape of the plate differs and the screw and screw holes are the same as the routine miniplating system.

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