



**DELTA PLATE- A BETTER OPTION FOR MANAGEMENT OF CONDYLAR FRACTURE OF MANDIBLE**

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**ABSTRACT**

Management of mandibular condylar fracture is one of the most controversial topic in maxillofacial surgery. For rigid internal fixation of mandibular condylar fracture, a single miniplate is commonly used. Placement of two miniplates has been known to give better results but it is difficult to place two miniplates in such smaller area and procedure is traumatic also. Hence there is need to explore the use of suitable device for fixation of mandibular condylar fracture. 20 patients with condylar fracture were included in the study. Patients were divided into two equal groups for comparative evaluation of open reduction of mandibular condylar fracture with delta plate and single miniplate and evaluated post operatively by using various predetermined parameters. This clinical study concluded that the Delta plate is better for the internal fixation of mandibular condylar fractures.

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**INTRODUCTION**

About 19–52% of mandibular fractures involve fracture of condylar process.<sup>1</sup> TMJ is unique as it transfers forces through a simple class III lever but with complex system of vectors.<sup>2</sup> The anatomical basis of the mandible ensures the dissipation of forces allowing the weakest part of the condylar neck to fracture, thus preventing transfer of forces to the cranium. This is the reason for the high incidence of condylar fractures.<sup>3</sup> Besides complexity of multiple muscular forces, the neurovascular anatomy of the region also adds to the complications. TMJ also plays a role in controlling jaw movements.<sup>2</sup> The complications of condylar fracture includes disturbances of occlusion, deviation of mandible, internal derangement of TMJ, pain, muscle spasm and ankylosis, etc.<sup>1,2</sup>

Single miniplate is most commonly used for open reduction and internal fixation of mandibular condylar fracture. However better results are obtained with two miniplates. But sometimes it is very difficult and traumatic to place two miniplates in the narrow condylar region.<sup>4</sup> The 3-dimensional osteosynthesis plates were introduced as an alternative to the modified 2-miniplate technique.<sup>5</sup> Aim of this study was to compare the efficacy of Delta Plate versus Conventional Single miniplate in the fixation of condylar fracture of mandible. Objectives were to compare the functional results of occlusion, Inter-Incisor distance, mandibular deviation, radiographic evaluation and complications.

A randomised controlled study was carried out at our institute. 20 patients having unilateral mandibular condylar fractures with or without fracture in the other regions of the mandible were selected. The institutional ethical committee approved the clinical trial. The procedure to be performed was explained to the patients and all subjects gave informed written consent.

Inclusion criteria were, adult patients with displaced subcondylar fracture leading to shortening of ramus and impaired dental occlusion. Condylar head fractures, undisplaced fractures and/or fractures leading to undisturbed dental occlusion, paediatric patients, patients who did not consent to the procedure, and patients who could not be followed up postoperatively over a minimum period of 6 months were excluded. Patients were randomly divided into two groups, each with 10 patients and fractures were reduced with delta plate and single 4-hole miniplate respectively in each group.

**Materials used in study (plates)**

**3- Dimensional Titanium Delta Plate**

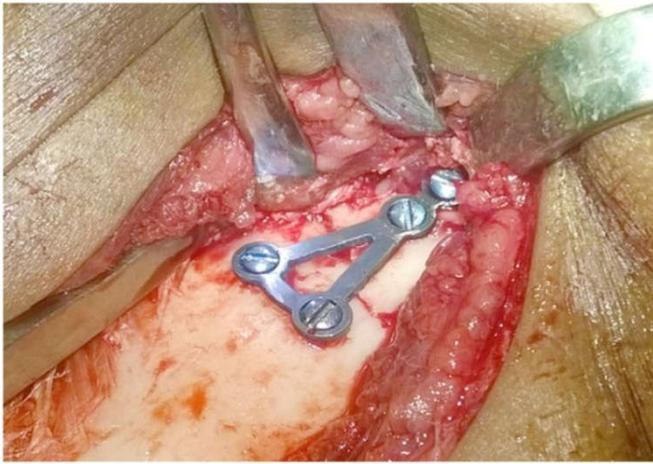
The delta plate was triangular in shape with base oriented towards the angle of the Mandible. At the top of the plate was an arm with two longitudinally arranged holes and two more holes form the 2 corners of the base of the plate.<sup>4,6</sup> (Fig. 1)

Single 4 hole titanium miniplate.

Non-compression, monocortical titanium screws.

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**Fig 1** Reduction and fixation of subcondylar fracture by Delta plate

Condylar fractures were classified according to Spiessl and Schroll classification.<sup>7</sup> Risdon's modification of Submandibular surgical incision was used for all cases.<sup>8</sup> Additional mandibular fractures were operated on during the same surgical procedure. A soft diet was started on the 1st postoperative day. No active physiotherapy was given. Postoperative clinical examinations were carried out on the 1<sup>st</sup> week, 1<sup>st</sup> month and 6<sup>th</sup> month respectively. Patients were evaluated for the Maximum Inter Incisal Distance<sup>9</sup>, Mandibular Deviation<sup>10</sup>, Postoperative Occlusion, need for Inter Maxillary Fixation, and Post operative complications like infection, plate bending/fracture, screw loosening, inadequate reduction, plate removal, etc<sup>11</sup>.

Postoperative radiological examinations were carried out with OPG (Fig.2 and Fig. 3) and Open mouth Reverse Towne's view to examine the progress of bony consolidation, quality of anatomical restoration and mechanical failures of the osteosynthesis material (degree of secondary displacement, loss of ramus height, plate fracture/bending and loosening of the screws).



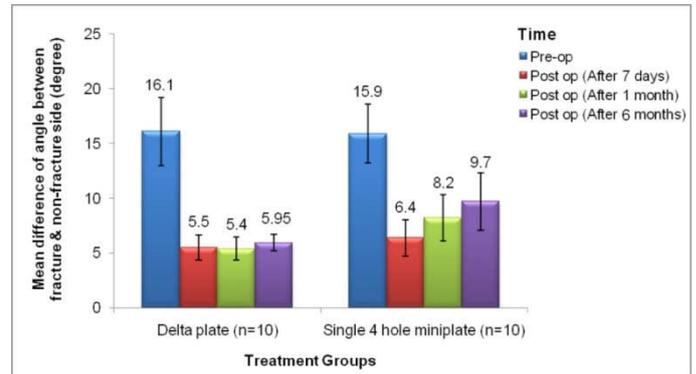
**Fig 2** OPG showing fracture reduction with Delta plate



**Fig.3** OPG showing fracture reduction with Single 4-hole Mini plate

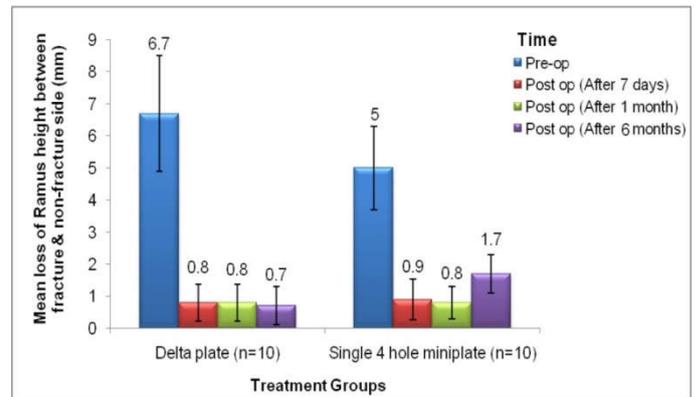
The radiographic evaluation was done as per the procedure given by C. Palmieri *et al.*<sup>12</sup> The coronal displacement of condyle was measured as an angle in the Towne's view. One line was drawn from the medial and lateral poles of the condyle. Another line was drawn tangent to the ramus. The

inner angle formed by the intersection of the two lines was calculated. The difference between the angle on the non-fractured and fractured side was used as a measure of coronal displacement. Displacement of condylar process in coronal direction was measured as an angle in degrees. The scoring of the results were done as mentioned by Lauer *et al.*<sup>6</sup> (Graph 1)



**Graph 1** Means of condyle displacement measured as Condyle/Ramus angle difference between fractured and non fractured side

For measurement of loss of ramus height, a reference line was drawn through both gonial angles. The perpendicular distance between the most superior point on the condyle and the reference line was calculated. The difference between the non fractured and fractured sides was used as a measure of difference in ramus height (loss of ramus height) and is calculated in millimetres. The scoring of the results were done as mentioned by Lauer *et al.*<sup>6</sup>. Score for Loss of Ramus Height Difference, 0 point - 0 to 5%, 1 point - >5% (Graph 2).



**Graph 2** Mean loss of ramus height between fracture and non fracture side

The statistical analysis was performed using SPSS 18.0 (SPSS Inc.) software and the statistical significance was evaluated at 5% level.

## OBSERVATION AND RESULT

90% patients were aged between 18 to 40 years with the mean age of 29.6yrs and with male predominance accounting to 90%. Isolated condyle fracture was present in only 10% cases while in all other cases allied fracture was present of which 60% cases were with fracture of contralateral parasymphysis of mandible. In 85% cases road traffic accident was the cause of injury besides assault in 5% and fall in 10% cases.

About 80% were classified as Spiessl and Schroll's Type II-Low Fracture with Displacement.<sup>7</sup> Both the groups achieved adequate mouth opening (35mm or more)<sup>9,10</sup> with acceptable mandibular deviation(up to 5mm)<sup>10</sup> after 6 months. Mean value of Mandibular deviation post operatively after 6 months

in Delta plate Group was 1.0 mm whereas, it was 2.60 mm in group of patients treated with single miniplate. Deviation was towards fracture side.

Improper occlusion was found in 10% patients in delta plate group immediately postoperatively where as it was 70% in case of single miniplate. They had to be given inter maxillary fixation in the form of heavy elastics for one month. These patients were advised liquid diet during this period. No active physiotherapy was given to any patient.

In this study, radiographic evaluation of post operative cases showed satisfactory consolidation with some displacement of the condylar fragment (difference of up to  $10^0$  was considered acceptable)<sup>6,13</sup>. In cases treated with delta plate, maximum secondary displacement was  $8^0$  with the mean value of  $6^0$  whereas in cases treated with single miniplate 30% patients were having difference of angle more than  $10^0$  with mean value of  $8^0$ . The p-value for difference between the two groups was significant 0.0125.

Loss of ramus height up to 5% of non fractured side was considered as within acceptable limit.<sup>6</sup> Mean loss of ramus height was 0.7mm and 1.7mm in patients treated with delta plate and single miniplate respectively. The difference was found to be significant with p-value 0.0294.

In the Group I there was no evidence of any complications like loosening of screw, bending of plate or fracture of plate etc. Whereas in Group II plate bending was found in 20% patients and plate bending with screw loosening was found in 10% (total 30%) patients. No plate fracture was observed in both the groups.

## DISCUSSION

Controversy existed for decades regarding the management of mandibular condylar process fractures<sup>3</sup>. With the advent of rigid internal fixation of the facial skeleton by small titanium plates and screws, both surgeon's acceptance and patient's expectations had led to a resurgence of interest in the open reduction and internal fixation (ORIF) of mandibular condylar fractures.<sup>14</sup>

Many types of plating systems like compression and non compression, locking and non locking, rigid and semirigid with variation in number and diameter of screws, type of screws like bicortical or monocortical, variation in thickness, number, shape and length of plate have been tried with variable success for open reduction and internal fixation of mandibular condylar fracture. Difficult surgical approach due to complex neurovascular anatomy of the region, difficult placement and fixation due to narrow area and difficulty in maintaining reduced position during consolidation due to complex vector forces are the typical characteristic of the procedure.

Though single miniplate system is most commonly used, better results are seen with two miniplates. Hence two plate system developed as a standard procedure.<sup>11,15</sup> In this, one plate is fixed along the condylar axis retaining the reduced position while second plate is placed parallel to the sigmoid notch along the tensile stress lines protecting the first plate.<sup>5</sup> Various biomechanical studies have also proved the superiority of two miniplates system.<sup>16,17,18</sup>

C.Mayer *et al* performed Photoelastic analysis of mandible. It showed compression pattern along the posterior border of ramus which continued along the lower border of the mandibular body whereas tensile stress pattern seen, along the anterior border of ramus, below and parallel to the mandibular notch and anteriorly along the upper border of mandibular body.<sup>19</sup>

In delta plate the lines of tensile and compressive stress distribution run parallel to both sides of the plate. Each side of the plate has a cross section of 1x2.5mm which is considerably greater than adaptation miniplate. Finite element analysis has shown the distribution of tensile strain particularly along the anterior border.<sup>4,6</sup>

Following trauma, mandibular movements may be affected due to spasm of muscles, specially lateral pterygoid, oedema and haemarthrosis. Additionally shortening of ipsilateral ramus may deviate mandible to the ipsilateral side.<sup>20</sup> Inter incisal distance and mandibular deviation in both groups were essentially within acceptable limit,<sup>9,10</sup> though mandibular deviation was more in patients treated with single miniplate. These findings are consistent with that of Lauer *et al*<sup>6</sup> and Choi *et al*.<sup>11</sup> Choi *et al* in their clinical study observed mandibular deviation in 16% of cases.

Immediate post surgically, normal occlusion was achieved in 90% patients with Delta plate and 30% patients with single miniplate respectively without undertaking any other measures. Hence IMF was applied to the rest of the patients.

The avoidance of intermaxillary fixation was one of the major factors for the preference of open reduction and internal fixation from both patients and surgeon's point of view.<sup>21</sup> This purpose was fulfilled by Delta plate in 90% of cases, where as it was fulfilled in only 30% cases treated with single miniplate.

No complication<sup>11</sup> seen in Group I patients treated with Delta Plate while plate bending was seen in 30% patients treated with single miniplate. Among these patients 10% patient showed signs of screw loosening also. These were same patients in whom there was increase in mandibular deviation, derangement of occlusion, condylar displacement and loss of ramus height. Various studies have reported complications in patients treated with single miniplate. Hammer *et al*<sup>15</sup> found 35% in terms of hardware failure whereas Choi *et al*<sup>11</sup> reported about 47% of complications in cases treated with single miniplate.

## CONCLUSIONS

Through this study it is concluded that in the open reduction and internal fixation of mandibular condylar fracture with Delta condylar plate: Normal mandibular movements and occlusion were achieved. Mandibular deviation was minimal. Inter maxillary fixation was not required post operatively. Stable osteosynthesis was achieved in all cases with restoration of ramus height and condylar position. There were no complications in terms of either soft tissue infection or hardware failure.

The 3 dimensional nature of Delta plate is found to provide internal stability and optimal leverage with minimal thickness of plate. After this clinical study it is concluded that the Delta plate is suitable for the treatment of mandibular condylar fractures.

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