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Case Series

Comparative evaluation of open reduction and internal fixation using delta plate versus conservative treatment in management of mandibular subcondylar fractures in adults

Bijal Chetas Bhavsar[1,*], Hiren Dharmendra Patel[1], Haren Bharat Pandya[1], Hitesh Sudarshan Dewan[1], Urvi Hiren Shah[1], Hirak Biraj Patel[1], Harsh Manoj Dave[1], Chirag Prahlad Raval[1]

[1] *Dept. of Oral and Maxillofacial Surgery, Faculty of Dental Science, Dharmsinh Desai University, Nadiad, Gujarat, India*

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ABSTRACT

Purpose: The aim of the evaluative study was to compare the efficacy of standard conservative treatment and the open reduction internal fixation (ORIF) using the delta titanium plates in the mandibular subcondylar fractures in adults.

Materials and Methods: Patients who diagnosed with mandibular subcondylar fracture in the department from January 2018 up to September 2019 were recruited into the study. The patients satisfying the inclusion criteria were randomly assigned to two groups in a 1:1 ratio (10 in each group). Group A comprised patients treated using delta titanium plates through open reduction and internal fixation and Group B comprised patients treated with closed reduction. Informed consent was taken for all the patients. All the patients of Group A underwent ORIF under GA via retromandibular approach.

Results: Pain was significantly higher in 1^{st} and 3^{rd} month follow up in group B compared to group A. Comparison of mouth opening in both the groups show statistically significant difference at 3^{rd} and 6^{th} month compared to baseline mouth opening. Deviation was more prevalent at 1^{st} and 3^{rd} month follow up in group B compared to group A. Presence of mandibular deviation at 1^{st}, 3^{rd} and 6^{th} month was statistically insignificant for both the groups.

Conclusion: Our experience with 3D stable delta plate provides better treatment outcomes in terms of easy adaptation to the anatomy of the fracture site, better 3D stability and functional osteosynthesis.

1. Introduction

Condylar fracture is not an uncommon site for mandibular fracture as it constitutes about one-third of all mandibular fractures.[1] Signs and symptoms associated with condylar fracture are pain, reduction in mouth opening, mandibular deviation; may worsen with suboptimal treatment leading to temporomandibular joint (TMJ) ankylosis; and internal derangement may occur.[2]

There are various guidelines regarding the management of condylar fractures of the mandible by open or closed treatment. Yet how to best manage this type of fractures has been the question of debates all around. For decades closed reduction has been the preferred treatment,[3] which requires varying periods of maxillomandibular fixation (MMF) (0 to 4 weeks) followed by aggressive physiotherapy.[4] It comes with long-term complications like pain, arthritis, open bite, deviation of the mandible on opening and closing movement, inadequate restoration of vertical height of the ramus leading to malocclusion, and ankylosis

* *Corresponding author.*
E-mail address: bijalbhavsar108@gmail.com (B. C. Bhavsar).

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do exist with the closed reduction method. Surgical management is preferred in cases with severe displacement or dislocation.[5–7] Open reduction allows good anatomical repositioning and immediate functional movement of the jaw.[8] There is consensus that reconstruction of the condylar process in the correct anatomical position is an important prerequisite for re-establishing function.[9] In recent times, attitude towards treatment of a condylar fractures has changed from an exclusively nonsurgical approach to an operative treatment with open reduction in selected cases.

The most used incisions to expose the condyle are: intraoral, coronal, preauricular, postauricular, endaural, endoscopic, rhytidectomy, trans parotid, submandibular, and retromandibular approach.[10] In 1967, retromandibular approach was described by Hinds and Girotti, which later was modified by Koberg and Momma in 1978.[11,12] This approach allows direct access to the posterior surface of the ramus of the mandible and its short distance from the condyle and sigmoid notch is an added benefit. Also, it leaves an acceptable scar.

Nowadays, retromandibular incision is adopted by most oral and maxillofacial surgeons.

2. Materials and Methods

The study was conducted on patients visiting the Department of Oral and Maxillofacial Surgery, Faculty of Dental Science, Dharmsinh Desai University, Nadiad, Gujarat, India, with clinical and radiographic diagnosis of mandibular subcondylar fractures during the period of January 2018 and September 2019. Approval for the comparative study was obtained from our Institutional Review Board, and informed consent was provided by all patients. Patients of both sexes who were 18 years and older, with non-comminuted subcondylar fractures who required management and who had given signed consent were included for the study. Patients who were edentulous, with history of temporomandibular joint dysfunction, had comminuted subcondylar fractures or high condylar fractures and/or had infection of the fracture site on initial presentation were excluded. Details of individual cases were maintained in the pro forma. Panoramic radiographs were taken for all patients as it is an essential diagnostic aid for this study. Patient were explained in their native language regarding the treatment procedures and were randomly assigned into two groups using random sequence allocation in 1:1 ratio, as follows: Group A: ORIF using 3D Delta plate (Figure 1); Group B: closed reduction. (Figure 2)

2.1. Surgical protocol

For Group A: Patient preparation was done strictly according to the standard protocols. Open reduction internal fixation under general anaesthesia via nasal intubation was performed in each patient in group A. A retromandibular approach was used in all cases. Fracture reduction was done after establishment of the ideal occlusion with the help of intraoperative intermaxillary fixation. ORIF was done using 3D Delta plate (Figure 3). There was copious irrigation with saline solution in the surgical site. Layer-wise suturing was performed using 4-0 Vicryl sutures and 5-0 ethilon for closure of the surgical site. Pressure dressing to prevent hematoma and to maintain the position of the repositioned facial muscles, was given and removed post 24 hours. All patients were prescribed a regular antibiotic protocol. Suture removal was done on the post-operative day 7.

Fig. 1: Preoperative OPG

Fig. 2: Postoperative OPG

For Group B: All cases were treated under local anesthesia. Oral prophylaxis was given, Erich's arch bars were placed, and occlusion was achieved through MMF. MMF was given for 21 days which was followed by aggressive physiotherapy.

2.2. Follow-up

Clinical assessment, radiographic assessment, comparative analysis and evaluation were done between Group A and Group B patients post-operatively based on the following criteria at 1 month, 3 months and 6 months for pain (using a Visual Analog Scale), malocclusion, mouth opening (in millimeters) and lateral deviation.

2.3. Statistical analysis

Data collection and tabulation were done using Microsoft Excel (Microsoft Corp., Redmond, WA). Data analysis was

Fig. 3: Preoperative (Mouth Opening: 18.91mm)

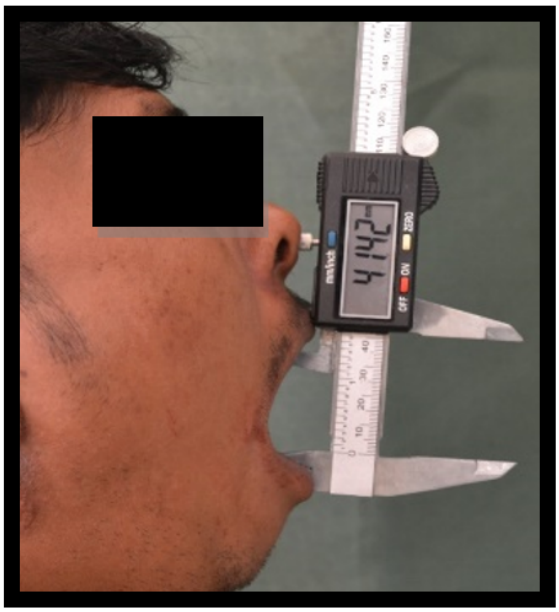

Fig. 4: Post-operative (Mouth Opening: 41.42mm)

done by the Statistical Package Software for Social Sciences v22 (SPSS Inc., Chicago, IL). Descriptive statistical entities such as mean, standard deviation, and percentage were used. Comparison of variables between the groups with normal distribution was carried out using a chi-square test. Any p-value < 0.05 was considered significant.

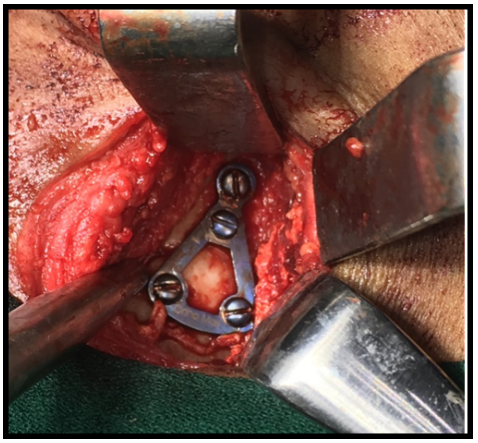

Fig. 5: 3D delta plate fixed

3. Results

Pain was measured using the VAS scores post-operatively. All the patients reported pain (3-5 VAS Scores) for 1 week. Group B patients showed a slightly longer duration of pain, which was easily managed with oral analgesics. No patient had post-operative pain after 6 months. Comparison of postoperative pain after 1 month and 3 months using chi square test showed statistically significant difference between both the groups for postoperative pain with p value <0.05.

Malocclusion was observed in 1 patient (10%) in Group A and 5 patients (50%) in group B at 1 month follow-up. At 3 months follow up 1 patient (10%) in Group A and 2 patients (20%) in Group B had malocclusion. Presence of malocclusion was compared between the groups after 1 month and 3 months using chi square test and it was statistically significant with p value <0.05. However, after 6 months there was no significant difference between both the groups with p value >0.05.

Lateral deviation on mouth opening was present in 2 patients (20%) in Group A and 3 patients (30%) in group B at 1 month follow-up. Mandibular deviation was compared between both the groups at interval of 1 month, 3 months and 6 months using chi square test and no statistically significant difference was found with p value >0.05.

The mean preoperative maximal interincisal opening was 26.84 mm (±8.04) and 29.79mm (±8.47) for group A and B respectively. The mean postoperative maximal interincisal opening after 1 month reduced to 19.69 mm (±6.26) for group A and 18.26 mm (±3.50) for group B. It increased to 37.26 mm (±6.56) and 34.83 mm (±4.84) after 6 months for group A and B respectively. Comparison of mouth opening between two groups from baseline, after 3 months and 6 months using independent T – test shows that there was no statistically significant difference was found with p value >0.05.

4. Discussion

In the field of maxillofacial trauma, the management of condylar fracture is still under debate for almost six decades without any general agreement yet. There are two principal management procedures for condylar fractures: (a) conservative treatment by giving intermaxillary fixation and (b) surgical treatment using open reduction and internal fixation. The conservative treatment is described as safe, non-invasive, easy, and low cost, but they have also reported many complications including poor oral hygiene, gingivitis, facial deformity, TMJ dysfunction, and even TMJ ankylosis.[13–16] Surgical treatment also has disadvantages such as its high cost, intraoperative hemorrhage, facial nerve injury, and other surgical complications along with post-operative scar formation.[13] The literature on condylar fractures has reported good outcomes for both open and closed treatment methods.[14–16]

In our prospective clinical trial, we compared the outcome of open reduction with rigid internal fixation using delta plates versus conservative treatment of mandibular subcondylar fracture in adults and following parameters were measured. The sample size was of 20 patients, 10 in each group. Following parameters observed in our study, namely (1) mouth opening, (2) mandibular deviation, (3) post-operative pain, (4) occlusal discrepancy, (5) facial nerve injury, (6) scar and

5. Stability of fractured fragment and osteosynthesis device

In our study only one patient had single isolated mandibular subcondylar fracture without any associated fractures, 50% of fractures are subcondylar fracture and others are condylar neck fracture along with most common associated parasymphysis fracture. Among these fractures

80% of the cases had unilateral condylar fracture whereas only 20% of the cases had bilateral fracture. The most common cause for the fracture was Road Traffic Accidents, similar to that published by other papers.[1,17]

In our study for conservative treatment all the patients were treated under Local anaesthesia. For conservative treatment arch bars, Ivy loops were used. Arch bars are applied to the upper and lower jaws with Ivy loops. The patients were kept under IMF for 21 days followed by active physiotherapy exercises.

For open reduction all our patients were treated under General anaesthesia. Oral prophylaxis was given, and Erich's arch bars were placed, and occlusion was achieved through MMF intraoperatively. The retromandibular approach provides a very satisfactory exposure for most condylar fractures.[1,13,18] Retromandibular approach was the choice of approach in our study as operating site is at a much shorter distance from the incision to the condyle. We found this approach to be more suitable to other approaches (preauricular, submandibular, intraoral, and rhytidectomy) due to following reasons: shorter working distance from the incision to the condylar region, greater access availability as the tissue can be retracted till the level of sigmoid ach, excellent exposure even on a face with marked edema, negligible chances of damage to the TMJ capsule, and the facial scar in less conspicuous location. In our study incision was placed 0.5 cm below the earlobe and continued inferiorly for 5cm. Most of the limitations for open reduction addressed by this incision.

Facial nerve paralysis, salivary fistulae, sialocoele, and visible scars are the possible complications associated with this technique. Facial expression weakness occurs in patients treated via this approach, which may be due to trauma during retraction rather than nerve damage.[13,19] In our study none of the patient observed with facial nerve palsy in open reduction group.

In retromandibular approach, meticulous closure of parotid capsule is of paramount importance to avoid fistula or sialocoele complication.[20–22] In our study none of the patient had developed sialocoele. Salivary fistula is a potential complication which can be prevented by watertight closure of the parotid capsule.[23] In our study, in 2 cases salivary fistula was observed which was treated by anti-sialagogues (Tab. Glycopyrrolate 1 mg, BD) for 7 days.

The resultant scar of a retromandibular approach is quite inconspicuous and almost always hidden in the retromandibular shadow. In our study 5 patient had conspicuous scar after I month, which was persistent after 2 months in 3 patients. In 4 patients scar was inconspicuous after 3 months. Hypertrophic type of scar was present only in one patient after 3 months.

In terms of mouth opening, patients treated with open reduction the mean interincisal mouth opening was 37.26mm & 34.83mm for conservative treatment after 6 months. The open reduction group showed significantly better early return to function of mandible than closed treatment. The P value is < 0.001 which indicated highly significant difference between both the groups. In open reduction group Similar results were achieved by Prakash R Sr et al.[24] over 6 months after the surgery (37.36mm). Thus, major concern after conservative treatment is restricted mouth opening. Inadequate physiotherapy during the recovery period can be a reason for reduced amount of mouth opening. Patients should be highly motivated towards physiotherapy in the recovery period so that acceptable mouth opening can be achieved.[25]

Deviation of mouth opening is a sign of compensatory movements of the contralateral joint due to shortening of the height of ascending ramus on the affected side. It is a sign of a reduced translator capacity of the affected joint because of an intracapsular fracture.[25] After a trauma, if one side is fractured, the nonfractured contralateral joint may also suffer from trauma due to imbalanced joint

movements, reducing translator capacity of that side as well. This reduced translator capacity may even be more than that of the fractured side. Varying degree of limited mandibular movements due to muscle spasm, oedema and hemarthrosis are the factors which predispose to mandibular deviation to the injured side on mouth opening. In our study 20% patients in the open reduction group had mandibular deviation after 1 month which was corrected by physiotherapy exercise at the end of 3 months except for one case in which the cause for mandibular deviation was loose osteosynthesis device in right side of mandibular angle region which was corrected by resurgery for plate removal followed by elastic therapy of 3-4 weeks. In the closed treatment group 30% patients developed deviation of mandible after 1 month which was corrected by elastic as well as physiotherapy at end of 3 months. Deviation on mouth opening towards the fractured side was lower in the ORIF group than in patients treated with conservative treatment. This indicates that the mobility of the condyle on the fractured side is better in patients treated with open reduction. The P value is > 0.05 which indicates that there is no significant difference between both the groups. This was explained by restitutional remodeling theory, indicating that a completely new condyle process of normal morphology was re-created by Lindahl and Hollender.[26] Similar results were observed by other authors.[13,27,28]

Pain is a subjective experience reported by the patients. Postoperative pain was assessed by VAS scale. In our study as comparison between two groups 20% of patients had mild and moderate type of pain in ORIF group while in conservative treatment 60% of patients had mild pain, 40% patients had moderate pain after 1 month, which was reduced over a period in both the groups. Slightly higher pain was present in conservative treatment group. The P value is <0.05 showing significant difference between both the groups. The presence of pain could be because of spasm or oedema following trauma, which resolved over a period. Similar results were found in other studies.[29,30]

In our study, 50% patients had occlusal discrepancy in closed reduction group at the end of 1 month which was corrected by elastic therapy of 3-4 weeks in 30% patients. Remaining 20% patient was corrected by elastic therapy as well as physiotherapy for 3-4 weeks. In ORIF group 10% patients had occlusal discrepancy at the end of 1 month which was attempted to correct by elastic therapy as well as physiotherapy exercise of 3-4 weeks, but it was not corrected because in that one case in which we have found the failure of osteosynthesis device in right side angle region which was corrected after 3 months by re surgery. The p value is < 0.05 showing significant difference between both the groups. In one patient from ORIF group had pain, secondary infection, reduced mouth opening was also present. So, for that patient resurgery was planned and occlusion was achieved. The reason for the failure was loose osteosynthesis device which was used for the right-angle fracture present in the same case. Patients treated by conservative treatment had significantly greater percentage of malocclusion when compared with the patients treated by open reduction method. Similar results were observed by Ellis et al. in their two studies.[31,32]

6. Conclusion

A thorough understanding of the masticatory system is essential in understanding and treating fracture of condyle and subcondylar region. The risk of wound infection in the pre antibiotic era, the proximity of nerves and vessels and the absence of sophisticated osteosynthesis material were the reason to opt for the conservative management of condylar fracture. However, with the advent of better anesthetic procedures and techniques, surgery with repositioning has increasingly been performed. Our experience with 3D stable delta plate provides better treatment outcomes in terms of easy adaptation to the anatomy of the fracture site, better 3D stability and functional osteosynthesis. No special armamentarium has been required as only the shape differs, but the screw and screw holes are the same as the routine mini plating system. There is no risk even if the plate breaks, and failure in the form of screw loosening are very rare. No significant disturbance in the fracture healing process has been reported. ORIF provides an individual with faster and better recovery rates, with shorter duration of MMF period and easy adaptation of masticatory system than closed reduction.

The limited sample size and limited follow ups can be considered as the limitations of this study. Clinical trials with large sample size and long term follow up should be carried out for better and accurate treatment outcomes in the condylar trauma.

7. Source of Funding

No financial support or sponsorship has been taken.

8. Conflicts of Interest

None.

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Author biography

Bijal Chetas Bhavsar, Associate Professor https://orcid.org/0000-0003-1093-0722

Hiren Dharmendra Patel, Dean, Professor and Head https://orcid.org/0000-0002-6499-1494

Haren Bharat Pandya, Professor and Head

Hitesh Sudarshan Dewan, Professor https://orcid.org/0000-0004-6979-7695

Urvi Hiren Shah, Associate Professor https://orcid.org/0000-0002-4951-0322

Hirak Biraj Patel, Senior Lecturer https://orcid.org/0000-0002-3756-3988

Harsh Manoj Dave, Postgraduate Trainee https://orcid.org/0000-0002-8259-3393

Chirag Prahlad Raval, Consultant https://orcid.org/0000-0002-8515-6463

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