

# Management of Condylar Fractures; Open Reduction Versus Conservative Management

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## Abstract

### Background and Objectives:

There are indications and contraindications for the treatment of condylar fractures. Most of the time fractures are managed by closed reduction depending on the nature of fracture pattern and open reductions are done during absolute indications. Open reduction international fixation and closed deductions have their own advantages and disadvantages. This study was done with the aim of comparing the outcomes of open reduction international fixation versus closed reduction by inter-maxillary fixation.

### Materials and Methods:

The present study included a total of 20 patients with moderately displaced condylar fractures in patients > 18 years of age who were randomly divided into nonsurgical and surgical group and were managed accordingly. In the present study, the outcomes of conservative versus surgical management of subcondylar and condylar neck fractures were discussed in terms of seven parameters, including the maximal interincisal mouth opening, protrusive and lateral excursive movements of the mandible, status of occlusion, deviation of mandible during mouth opening, pain (in terms of visual analog scale) and the height of ascending ramus (radiographically) which were measured and evaluated pre- and post-operatively at different intervals of time. The follow-up was done for a period of up to 6 weeks postoperatively.

### Statistical Analysis Used:

Descriptive and analytical statistics were calculated using the Statistical Package for Social Sciences version 19. The Mann-Whitney U-test was used to assess the significance of the difference between the groups, whereas the Wilcoxon signed-rank test was used to assess the significance of the difference between the paired observations in each group.

### Results:

Patients treated surgically showed better improvement in maximal interincisal mouth opening, lateral excursions with minimal deviation, early relief from pain, and restoration of height of the ramus with symmetry in comparison with the patients managed conservatively where prolonged periods of pain apart from obvious deviation and minimal restoration of height of the ramus was observed over a follow-up period of 6 weeks postoperatively. The results were also found to be statistically significant with the value of  $P < 0.05$ .

### Interpretation and Conclusion:

Surgery is inarguably preferred over conservative management of moderately displaced condylar fractures as per the results of the present study. The present study provided valuable information and mandated further studies with larger sample sizes to come to definitive conclusions.

**Key Words:** deviation; height of ramus; moderately displaced condylar fractures; nonsurgical/conservative management; subcondylar and condylar neck fractures; surgical management; symmetry

## Introduction

Mandibular condylar fractures are the most common that account for nearly 20%–62% of all the mandibular fractures.[1] The main causes of condylar fractures include road traffic accidents (approximately 50%), falls (30%), and interpersonal violence (20%).[2] The commonly accepted and generally agreed upon aim of treatment is the restoration of the pretraumatic function of the masticatory system. This restoration usually involves the re-establishment of the pretraumatic relationship of the fractured segments, the occlusion and the maxillofacial symmetry. Condylar fractures can be treated with one of two methods including conservative (closed reduction + immobilization) and/or surgical (open reduction + internal fixation) methods. Both these modalities of treatment have their indications and contraindications and merits and demerits.[3] In 1983, Zide and Kent proposed both the absolute and relative indications for open reduction of the condyle. A gradual transition can be observed in the absolute, relative, and possible indications of Zide and Kent. Several studies have shown favorable clinical results with conservative treatment of condylar fractures. However, numerous studies have also shown signs of dysfunction with conservative treatment. Open reduction and internal fixation (ORIF) of the condylar fractures have been recommended in selected cases and various indications have been proposed for the same.[1] Earlier, the majority of maxillofacial surgeons seemed to favor conservative treatment of condylar fractures. This preference was largely dependent on the result of three main factors leading to “satisfactory” results in a majority of cases. There are no large series of cases reported in the literature that have been reviewed and followed up after surgical treatment because the management of condylar fractures has historically been with nonsurgical means. The surgery of condylar fractures is difficult and risky because of the inherent anatomical hazards, including the possibility of damage to the facial nerve.[4] Conservative technique (nonsurgical) maintains normal occlusion with less morbidity producing satisfactory results because of the immediate or early mobilization of the jaws and maintaining occlusion with the help of the arch bars and elastics. Functional recovery is achieved in the earlier stages and union always occurs with less complications. However, the nonsurgical technique is frequently associated with poor long-term function, i.e., reduced mouth opening, malocclusion, and deviation on opening.[4] Conservative reduction, on the other hand, has its own disadvantages and can prove to be uncomfortable for the patient along with a compromised airway, poor oral hygiene, speech difficulties, impaired nutritional intake with weight loss, and disuse atrophy of the masticatory muscles.[3] In recent years, open treatment of condylar fractures has become more common mostly because of the better understanding of anatomy along with the advent of newer instruments and techniques. Open reduction and rigid internal fixation of condylar fractures ideally give the condylar process its pretraumatic position or close to the position restoring skeletal continuity re-establishing the normal mandibular position and bringing the teeth into a proper occlusal relationship. Regardless of any type of the treatment modality used, the teeth in occlusion seem to be the most important goal along with early functional recovery.[3] As per the literature, condylar fractures with  $>35^{\circ}$ – $45^{\circ}$  of displacement in the coronal or sagittal plane with/without shortening of the height of ramus  $>5$  mm are to be considered for the surgical approach of the treatment.[5,6,7] There still has been no clear criteria for which modality of treatment, open or closed, should be followed for condylar fractures. Hence, the present study was designed with the purpose of comparing the outcomes of surgical versus conservative management of moderately displaced subcondylar and condylar neck fractures.

## Materials And Methods

The present prospective cohort study was carried out on 20 patients with condylar fractures selected from the Outpatient Department over a period of 2½ years starting from May 2013 undergoing extraction of maxillary or mandibular teeth simultaneously to conduct a split-mouth study. The

research protocol was approved by the Institutional Ethics Committee governing the use of human participants in clinical experimentation.

### Inclusion criteria

1. Age of the patients:  $>18$  years
2. Condylar fractures with or without associated mandibular body and ramus fractures
3. Location of the fracture line in the condylar neck or the subcondylar level
4.  $10^{\circ}$ – $45^{\circ}$  of displacement of the condylar fragment in the frontal or sagittal plane: and/or
5. Shortening of the height of the ascending ramus of the mandible  $\geq 2$  mm.

### Exclusion criteria

1. Condylar head fractures;
2. Insufficient dentition to restore normal occlusion;
3. Patients not fit to undergo surgical procedure under general anesthesia;
4. Any associated mid-face fractures; and
5. Patients with a history of temporomandibular joint (TMJ) dysfunction.

Patients were asked to sign a written informed consent form which explained the procedure and also any complications that might have resulted as a result of the surgery or intermaxillary fixation (IMF) procedure done for all the patients allotted for surgical and conservative management. A detailed case history, including the past exposure to anesthetics, sedatives, and previous surgical procedures, if any, and/or hospital admission were recorded. General physical examination, routine hematological investigations, and HIV and Hepatitis B surface antigen testing were done for all the patients. In addition, a chest X-ray and electrocardiogram evaluation was performed for all the patients allotted for surgical management. Any additional investigations, when required, as per the systemic condition of the patients was carried out. Preoperative photographs and relevant radiographs, including the orthopantomographs (OPGs) and computed tomography (CT) scans were taken for all the patients. For the patients who were treated by open reduction, surgery was performed under general anesthesia with endotracheal intubation in a standardized manner. Clinical and radiological parameters were evaluated during the follow-up visits:

1. Maximal interincisal mouth opening
2. Protrusive and lateral excursive movements of the mandible
3. Occlusal discrepancy as revealed by the improper intercuspation of the 1st molars on either side of the jaws
4. Pain
5. Deviation during opening and
6. The height of the ascending ramus of the mandible.

Parameters of maximal interincisal mouth opening and protrusive movements were measured from the incisal edges of the upper and lower anterior teeth while lateral movements and deviation of the mandible on mouth opening were assessed and measured with reference to the dental midline using a metallic scale. All the above parameters were assessed preoperatively and at an interval of day 3 and weeks 1, 2, 4, and 6 postoperatively for the surgical group. For the conservative group, parameters were assessed and measured preoperatively with follow-up at an interval of 2, 4, and 6 weeks postoperatively. The pain was measured using the visual analog scale (VAS) [Figure 1] based on the patient perception of

pain preoperatively and at an interval of day 1, day 3, and weeks 1, 2, 4, and 6 postoperatively for both surgical and conservative groups. The height of the ascending ramus was measured on the OPG from the superior-most point of condyle to the inferior-most point of the angle of the mandible on the affected side radiographically using the ADOBE Photoshop software

preoperatively and at an interval of day 3 and 6 weeks postoperatively for both surgical and conservative groups. In addition, the degree of displacement of the condyle was assessed and measured using cone-beam CT for every case to be selected for the study.

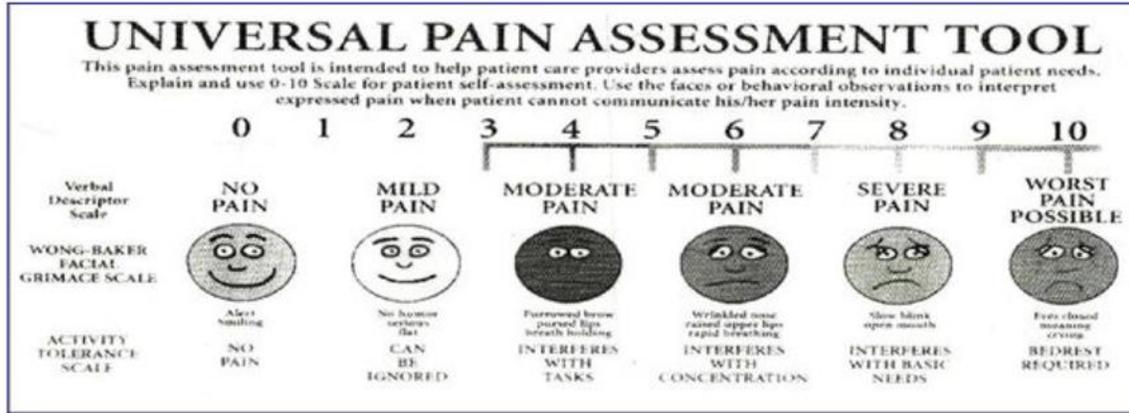


Figure 1: Visual analog scale for pain assessment

**Procedures**

**Closed reduction**

For all the patients who were considered for the said method, arch bar splinting of the maxilla and mandible and intermaxillary fixation was done

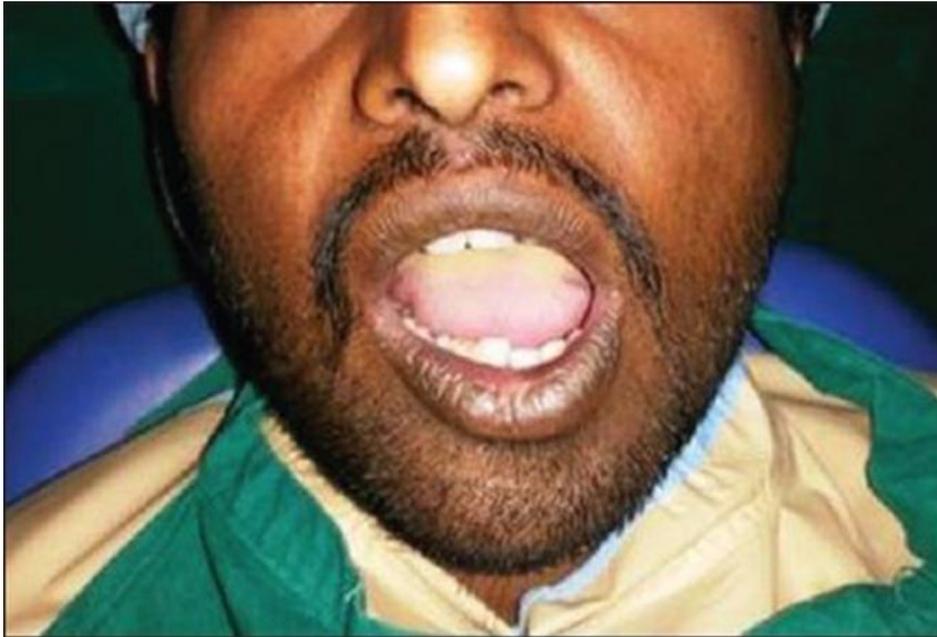
with teeth in occlusion with the help of guiding elastics. Patients were systematically followed up at an interval of day 1, day 3, and weeks 1, 2, 4, and 6 postoperatively [Figures 2-7].



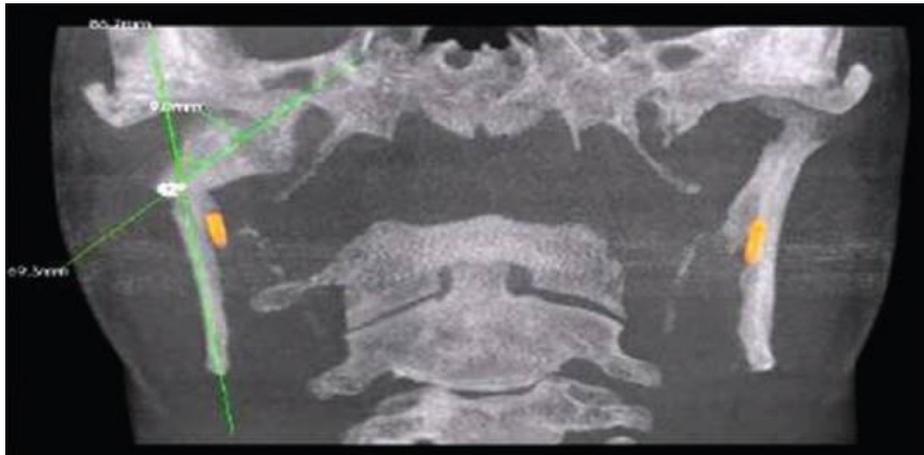
Figure 2: Preoperative orthopantomography



Figure 3: Measurement of the height of ramus using orthopantomograph with Adobe Photoshop software



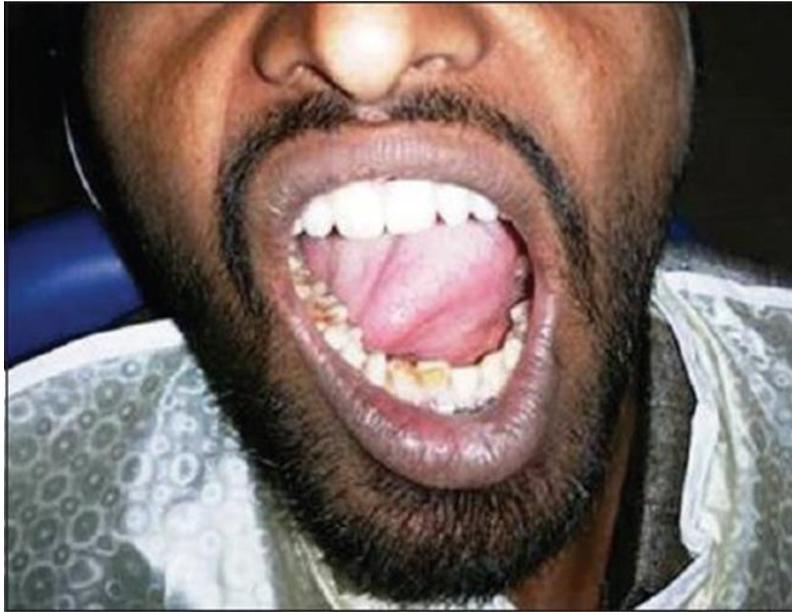
**Figure 4:** Preoperative mouth opening



**Figure 5:** Measurement of degree of displacement of condyle using cone-beam computed tomography



**Figure 6:** Postoperative orthopantomograph



**Figure 7:** Postoperative mouth opening with deviation

### Open reduction

For all the patients who were considered for surgical intervention, the retromandibular approach was chosen. Condylar fracture reduction was done

with the teeth in occlusion, and fixation was done with the use of suitable titanium miniplates and screws. Patients were systematically followed up similarly at an interval of day 1, day 3, and weeks 1, 2, 4, and 6 postoperatively [Figures 8-14].



**Figure 8:** Preoperative orthopantomography



**Figure 9:** Preoperative mouth opening



**Figure 10:** Intra-operative incision marking



**Figure 11:** Closure with vicryl 3-0



**Figure 12:** Postoperative measurement of mouth opening with deviation



**Figure 13:** Postoperative measurement of lateral movement and deviation



**Figure 14:** Postoperative healing

### Statistical analysis used

Descriptive and analytical statistics were calculated using Statistical Package for Social Sciences (SPSS) version 19 (SPSS Inc., Chicago, IL, USA). The Mann–Whitney U-test was used to assess the significance of the difference between the groups, whereas the Wilcoxon signed-rank test was used to assess the significance of the difference between the paired observations in each group.

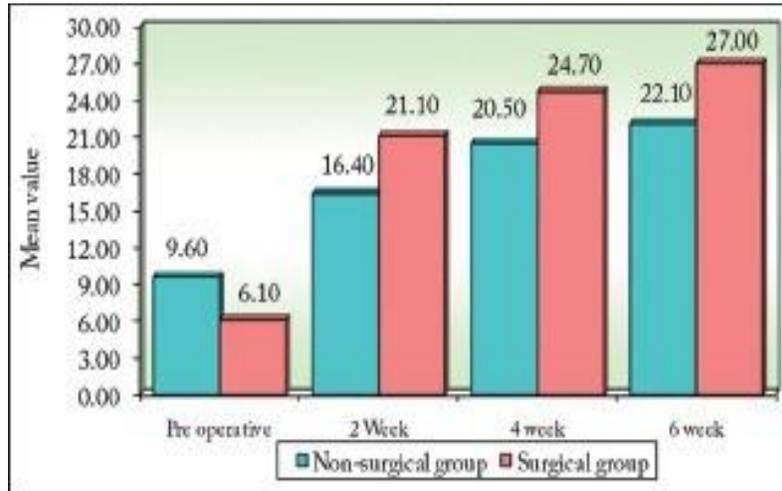
### Results

The present study included 20 patients with condylar fractures, of which 10 patients were managed conservatively and 10 patients were managed with a

surgical procedure. Of these 20 patients, 80% (16) were male and 20% (04) were female with the mean age of 33 years and all were > 18 years of age. In the present study, preoperatively, maximal interincisal opening recorded was 9.60 mm and 6.10 mm in the nonsurgical and surgical groups, respectively. By the 2nd, 4th, and 6th week, the mean of increase in the maximal interincisal opening was 6.80 mm, 9.90 mm, and 12.50 mm in the nonsurgical group, whereas in the surgical group, it was found to be 15 mm, 18.60 mm, and 20.90 mm, respectively [Graph 1]. In conservative management patients, another advantage seen was the immediate anatomic restoration of the height of the ramus along with symmetry. Protrusive and lateral excursive movements were also compared in the two groups. For

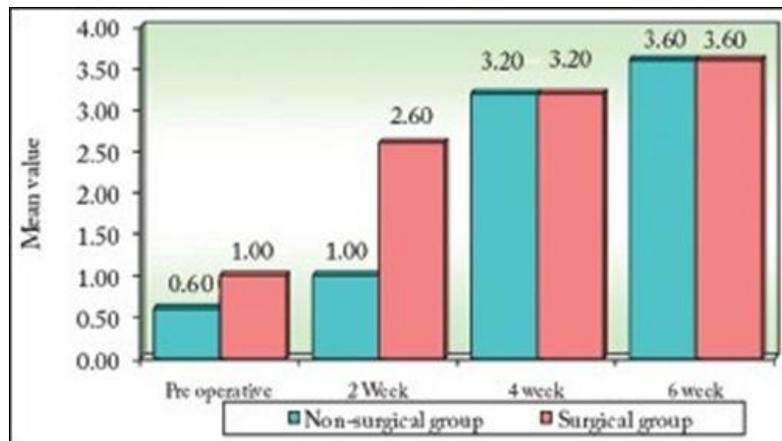
protrusive movements, the mean increase of movement by the 2nd, 4th, and 6th week were 0.40 mm, 2.60 mm, and 3 mm in the nonsurgical group and 1.60 mm, 2.20 mm, and 2.60 mm in the surgical group, respectively [Graph 2]. The mean increase in lateral excursive movement by the 2nd, 4th, and 6th week were 0.90 mm, 4.60 mm, and 5.30 mm in the nonsurgical group, whereas in the surgical group, these values came out to be 2.80 mm, 6.60 mm, and 8.90 mm, respectively [Graph 3] showing an early and certain benefit of surgery over conservative management on restoration of the functional lateral movements by the end of 6 weeks. It was, however, difficult to assess the protrusive and lateral excursive movements in the IMF group at the 2nd and 4th week postoperatively. In the nonsurgical group, preoperatively, six cases had deranged occlusion, of which two came to normal in 2 weeks' time, while three were satisfactory. By the end of 6 weeks, all 10 cases attained normal occlusion. In the surgical group, seven cases had deranged occlusion by the 2nd week, however, all seven cases attained normal occlusion and by the end of 6 weeks, all 10 cases had normal occlusion [Graph 4] indicating normal occlusion achieved in 2 weeks by the surgical repositioning of the condyles. In the present study, the deviation of the mandible during mouth opening was assessed and measured pre- as well as post-operatively by 2nd, 4th, and 6th week for surgical and the conservative groups. Preoperatively, the mean deviation of mandible was 1.20 mm and 1.50 mm for the nonsurgical and surgical groups, respectively. By the 2nd week, the mean value of deviation became 1.10 mm and 0.10 mm

for the two groups, respectively [Graph 5] and the results seen were found to be statistically significant ( $P = 0.0173$ ). The present study assessed the pain perception of the patients as per VAS pre- and post-operatively at day 1 and day 3 and weeks 1, 2, 4, and 6, respectively for the surgical and conservative treatment groups who were treated for condylar fractures, and comparison was done between the groups. Preoperatively, the mean of pain (VAS score) for the nonsurgical group came out to be 5.60, while for the surgical group, it was found to be 4.10. Pain perception of patients in the nonsurgical and surgical treatment groups was comparable postoperatively at day 1 and weeks 2, 4, and 6, respectively, and hence, the results were found to be statistically insignificant. However, postoperatively at day 3 and week 1, the mean of pain (VAS score) for conservative treatment group was found to be 5.70 and 3.60, respectively, whereas for the surgical treatment group, was 2.70 and 0.90, respectively, [Graph 6] which was statistically significant with  $P = 0.0082$  and  $0.0376$ , respectively. In the present study, the height of the ascending ramus (radiographically) was measured on the fractured condyle side preoperatively and postoperatively at day 3rd and 6th week for both the conservative and surgical treatment groups and restoration of the height was assessed postoperatively at different time intervals. For conservatively managed patients, the mean of the restoration of the height of ascending ramus by day 3 was 0 mm, whereas for the sample of patients managed surgically, it was found to be 2.40 mm [Graph 7] with statistically significant results ( $P = 0.0002$ ).



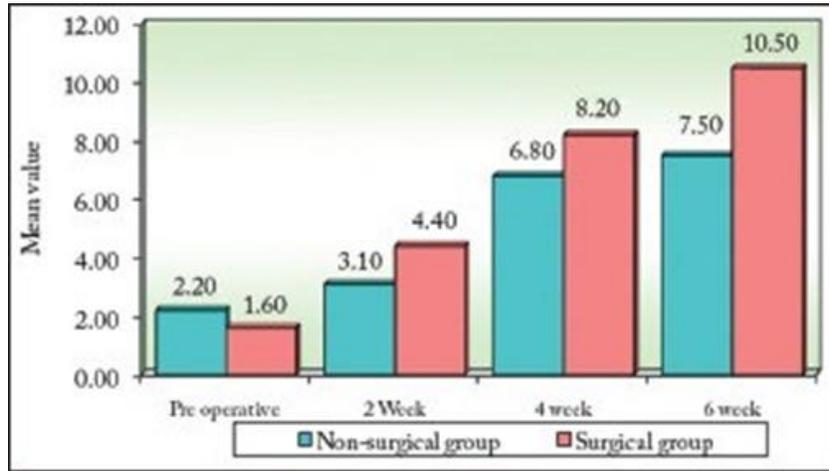
Graph 1: Open in a new tab

Comparison of two groups (nonsurgical and surgical) with maximal interincisal mouth opening (in mm) at different time points



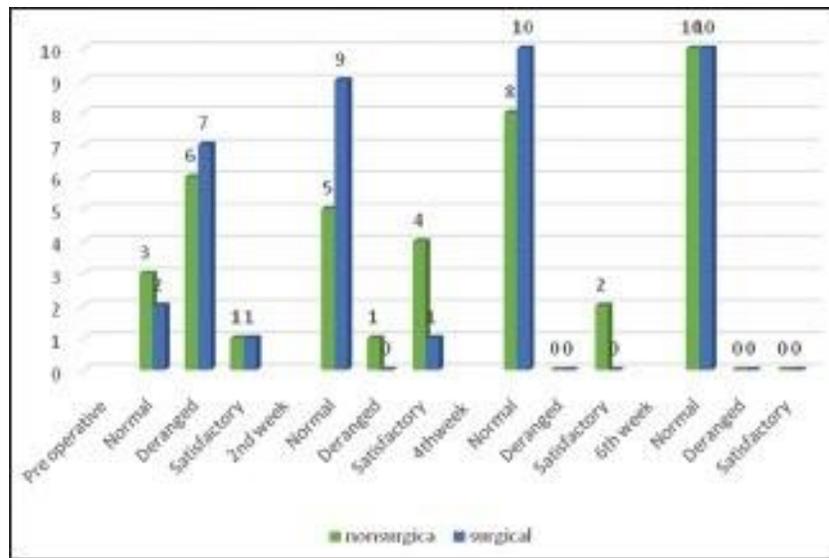
Graph 2: Open in a new tab

Comparison of two groups (nonsurgical and surgical) with protrusive movement (in mm) at different time points



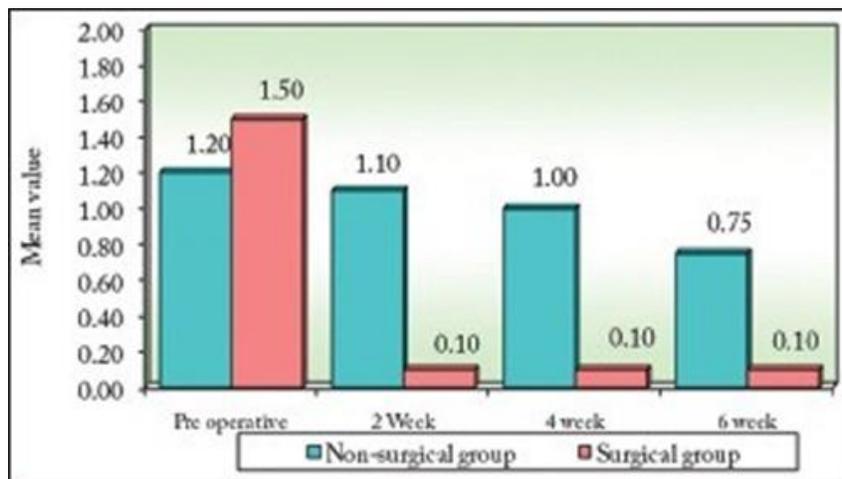
**Graph 3:** Open in a new tab

Comparison of two groups (nonsurgical and surgical) with lateral movement (in mm) at different time points



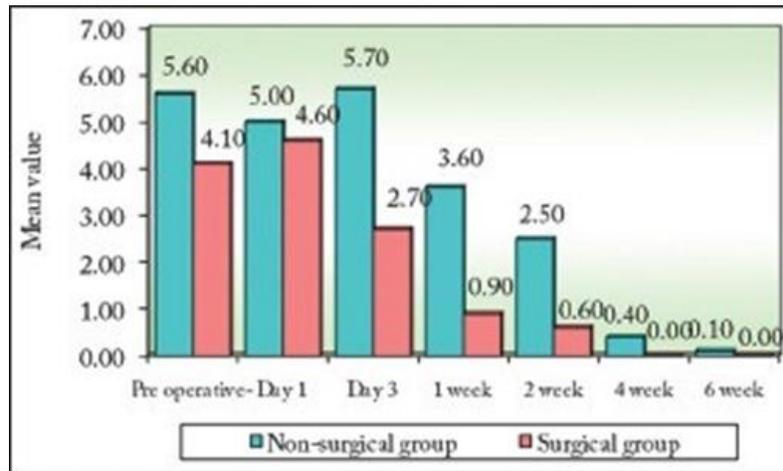
**Graph 4:** Open in a new tab

Comparison of two groups (nonsurgical and surgical) with status of occlusion at different time points



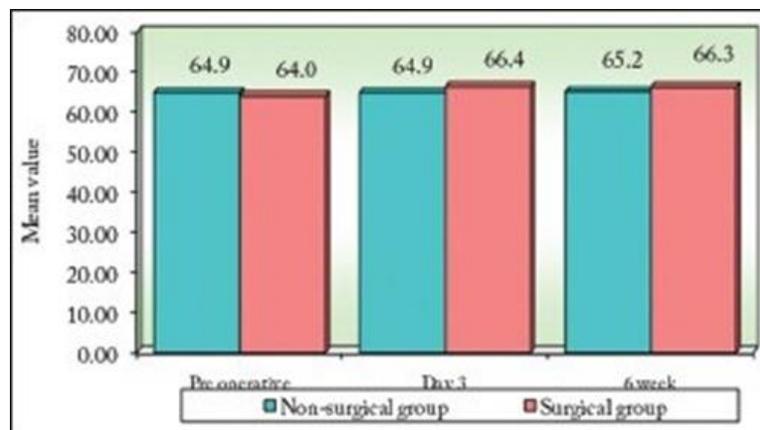
**Graph 5:** Open in a new tab

Comparison of two groups (nonsurgical and surgical) with deviation (in mm) at different time points



Graph 6: Open in a new tab

Comparison of two groups (nonsurgical and surgical) with visual analog scale scores at different time points



Graph 7: Open in a new tab

Comparison of two groups (nonsurgical and surgical) with the height of the ascending ramus (mm) at different time points

## Discussion

Condylar fractures are the most common injuries that are seen with the mandible accounting for approximately 20%–62% of all the mandibular fractures. The choice of surgical versus nonsurgical treatment of the fractures of the condylar process remains controversial. In the past, the risk of wound infection in the preantibiotic era, the proximity of nerves and vessels, and the absence of sophisticated osteosynthesis materials were the reasons to opt for the conservative management of condylar fractures, however, with the advent of better anesthetic procedures and the introduction of antibiotics and better instruments and techniques, surgery with repositioning has increasingly been performed. Teeth in occlusion with proper function seem to be the most important goal in the treatment of any mandibular fracture.[5] In the present scenario, for dislocated fractures, open approaches are considered as the treatment of choice in many centers. The development of stable osteosynthesis modalities with mini-plates (Pape et al., 1980), lag screws (Wackerbauer, 1962; Petzel, 1980; Eckelt and Gerber, 1981; Krenkel, 1992), and the further development of the surgical approaches have made the operative treatment safer and have the functional advantage of earlier mobilization of the traumatized tissues, though, for moderately displaced condylar fractures, open treatment is still considered an option.[8] Several authors have supported surgical management of the condylar fractures in view of the excellent postoperative mouth opening and protrusive and lateral excursive movements (Baker, 1998). Surgical procedures in the condylar

region have become simpler owing to a better understanding of the anatomy and the advances in the instrumentation. However, several authors are of the opinion that conservative management offers good results as it obviates the need for difficult surgical access to the TMJ, repositioning of the fractured condyle and avoiding injury to the facial nerve.[9] In the present study, the outcomes of conservative and surgical management for mandibular condyle fractures were discussed in terms of seven parameters, including the maximal interincisal mouth opening, protrusive and lateral excursive movements of the mandible, status of occlusion, deviation of mandible during mouth opening, pain (in terms of VAS), and height of ascending ramus (radiographically) which were measured and evaluated pre- and post-operatively at different intervals of time. In a prospective study done by Hyde et al.,[6] the mean interincisal opening obtained was found to be 42 mm in the surgical group, while 32 mm in the conservative management group with elastic traction and the results were found to be statistically significant. The results of the present study were in accordance with the results of the above-mentioned study which signified the merit of surgical over conservative management of the condylar fractures. In a study by Eckelt et al.,[8] significant differences were found for the parameters of lateral excursions in the surgical (up to 16 mm) as against the closed (up to 13 mm) groups, and it correlated with the findings of the present study too. Carneiro et al.,[10] however, concluded, from their study, that there was no difference in the protrusive and lateral excursive movements whether condylar fracture was treated by surgical or nonsurgical methods. Ellis et al.[11] concluded from their study that the patients treated by closed techniques had a significantly greater percentage of malocclusion compared with the patients treated by

open-reduction methods in spite of the fact that the initial displacement of the fractures was greater in patients treated by open reduction. Haug and Assael[12] observed no statistical difference between ORIF and closed reduction with maxillo-mandibular fixation (CRMMF) in terms of occlusion. Hyde et al.[6] found that the VAS scoring revealed statistically significant ( $P = 0.03$ ) differences with less pain in the operative treatment group (2.9 open) than in the conservative treatment group (13.5 closed). Another study by Haug and Assael[12] reported statistically significant differences in the patient's perception of pain ( $P < 0.05$ ) with patients treated by CRMMF. The prospective study by Hyde et al.[6] correlated with the same results. The results of the present study were in accordance with the results of the said studies with a significant difference in pain (in terms of VAS) between the surgical and the nonsurgical groups. Danda et al.[1] in their study found four patients (25%) in the conservative while 14 patients (87.5%) in the surgical (ORIF) group having an anatomic reduction of the condyle radiographically. The study by Eckelt et al.[8] showed the correct anatomical position of the fragments that were achieved significantly more often in the operative group in contrast to the closed treatment group. The results of the present study were found to be in accordance with the said studies, again, where good anatomical restoration and symmetry of the height of the ascending ramus was achieved in the surgical group by 6 weeks postoperatively. The results of another study conducted by Ebenezer and Ramalingam[9] showed similar results. The present study clearly suggested and favored surgical management over conservative methods for the treatment, and therefore, gave an adequate insight to maxillofacial surgeons who need to decide whether surgical or, conservative procedures are to be performed for the management of moderately displaced condylar fractures. The limitations of the present study included a relatively smaller sample size and procedures performed by a group of surgeons and not by the same surgeon. Despite the said limitations, the present study recommended for surgical over conservative management of the moderately displaced condylar fractures, however, further studies with larger sample sizes and procedures preferably done by the same surgeon would prove even more constructive as far as definitive conclusions are concerned.

## Conclusion

The present study showed the superiority and merits of surgical management over conservative management of moderately displaced condylar fractures. Out of the seven parameters assessed for the evaluation of outcomes for the two different treatment modalities, five parameters, including maximal interincisal mouth opening, lateral excursions with minimal deviation, early relief from pain, and restoration of height of the ramus with symmetry showed statistically significant difference for the surgical group over the conservative group over a period of 2–6 weeks in follow-up. Although conservative procedures can be considered for the management of condylar fractures as they avoid the need for difficult surgical access, and the possibility of injury to the facial nerve with acceptable results, owing to the advances in the instrumentation and techniques for surgery with the benefits of early and superior functional rehabilitation, comfort and anatomical reduction with symmetry, surgery could be considered as the preferred

modality of treatment over conservative management of moderately displaced condylar fractures as per the results of the present study.

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