Original Article

Comparative evaluation of post treatment CT scan and clinical parameters in open reduction and closed reduction treatment of condylar fractures

ABSTRACT

Background: Mandibular fracture is the second most common fracture of facial bone, next to nasal bone. Twenty-five to forty percent of mandibular fractures involve the condyle. In the literature, there exists no consensus "gold standard" treatment for mandibular condylar fractures, and there is a continuing debate on whether condylar fractures should undergo closed or open reduction.

Materials and Method: Twenty patients who had undergone open reduction and closed reduction treatment were included in the study. Clinically maximal interincisal opening, laterotrusive and protrusive movements, pain on mouth opening, malocclusion, chin deviation on mouth opening, facial nerve palsy, hematoma, infected implant, and bite force were evaluated after a minimum of 3 months postoperatively. Also, a postoperative CT is done to evaluate the anatomical position of fragment.

Results: On evaluation of clinical parameters, both groups had comparable results. However, none of the patients in open reduction group had deviation of mandible from midline on mouth opening. Also, better anatomical repositioning is obtained in open reduction group.

Conclusion: The results of this study suggest that the open reduction method is a better alternative to closed reduction in treatment of mandibular condylar fractures.

Keywords: Closed reduction, computed tomography, condylar fracture, maxillomandibular fixation, open reduction

INTRODUCTION

Condylar fractures account for 7.5 to 52% of all mandibular fractures.[1,2] Various treatment modalities are advocated for the same, but no consistent treatment has gained universal acceptance. Still controversies exist as to whether, when, and how fractures of the mandibular condyle should be treated.[1,3] Two principal therapeutic approaches were described in the literature favoring the treatment of these fractures: (1) open reduction and (2) closed reduction.[1,4]

Open reduction modality of treatment is gaining popularity in the recent times due to intense development in the field of surgical instruments and techniques that can accurately reposition and fix the condyle to the best anatomic position possible.

Both open reduction and closed reduction has its own advantages and disadvantages. The obvious advantage of closed reduction is the avoidance of morbidity and complications associated with surgery.[5] Nevertheless, closed reduction can result in chin deviation, trismus, malocclusion, and temporomandibular joint discomforts.[6]

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Though excellent anatomical reduction can be obtained with open reduction, difficult surgical access to the condylar area, frequently difficult repositioning of proximal fragment, facial scar caused by extraoral approach, and injury to facial nerve makes open reduction and internal fixation more challenging in condylar fractures.[5,6]

Open reduction method of treatment has gained popularity in the recent times due to developments in surgical expertise, precise surgical instruments, and access to difficult areas via endoscope that had made open reduction less complicated and more precise. However, the results obtained with closed reduction should be compared with open reduction before concluding whether the risk taken for surgical exposure outrun the benefits obtained with closed reduction.

In the literature, not many studies were carried out correlating clinical and radiographic outcomes using computed tomography to evaluate the results obtained with open and closed reduction of condylar fractures. This study correlates both objective and subjective outcomes, also computed tomography images and digital bite force measurement to evaluate the results obtained following treatment of condylar fractures.

MATERIALS AND METHODS

A retrospective study was carried out in the Department of Oral and Maxillofacial Surgery. Twenty patients were included in the study – Two groups comprising of 10 patients each. Group A comprising 10 patients who had undergone open reduction and internal fixation for treatment of condylar fractures and Group B comprising 10 patients who had undergone closed reduction using maxillomandibular fixation were included in the study. The study was approved from -Institutional ethical committee with reference no 1543 and dated 05.11.2018.

Medically fit patients with Unilateral mandibular condylar fractures, age above 18 years with no history of previous temporomandibular joint disorders were included. Patients with insufficient dentition to reproduce normal dentition, patients who are having concomitant other facial fractures and those who are unwilling for the study are excluded.

Preoperative clinical data of all twenty patients were recovered. Data regarding maximal interincisal opening, Lateral Excursion movements, protrusive movements, pain on mouth opening, malocclusion, bite force, hematoma, facial nerve injury etc., were collected.

Also, preoperative computed tomography images – coronal, axial, and sagittal sections with three-dimensional reconstruction is collected in all 20 patients to evaluate the preoperative condition of the fractured condyle.

The Group A patients had undergone Open reduction and internal fixation under General Anesthesia. In all the cases included in this study, condyle was approached through submandibular incision. The fracture site was exposed, reduced and fixed with plate and screws [Figure 1]. Closure was done in layers with 3–0 vicryl and 4–0 ethilon. Pressure pack was given following which the patient was extubated and shifted to surgical intensive care unit for recovery.

The Group B patients had undergone closed reduction using arch bar and wires. Ehrich's arch bar was placed and intermaxillary fixation was done with elastics for 21 days.

All the patients of Groups A and B were followed up after a minimum of 3 months. They were assessed by clinical examination for Maximal interincisal opening, Laterotrusive movement, Protrusive movement, deviation of mandible on mouth opening, malocclusion, facial nerve palsy, hematoma, infected implant, and bite force [Figure 2].

Also, a 3D CT face was carried out post 3 months to evaluate radiographically the exact position of condyle and to compare and evaluate radiographically the changes happened in the condyle.

Comparison of preoperative and postoperative 3D CT face is carried out with respect to direction of displacement, complications/infected implant, vertical ramal height in coronal sections, angulation of displaced condyle in coronal sections, distance of fractured condylar head from glenoid fossa in coronal section [Figure 3].

Figure 1: Intraoperative photograph

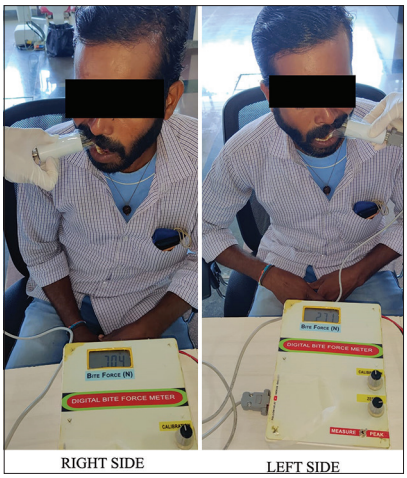

Figure 2: Bite force evaluation

Also, subjective evaluation is done with the help of visual analogue scale for evaluation of Pain and Overall satisfaction of treatment post treatment after 3 months.

RESULTS

Comparison of the Maximum interincisal opening difference (post and pre-operative) between the two groups shows that difference is higher in open Reduction group with a mean value of 19.50 mm and SD of 6.31 mm [Table 1].

Comparison of the Lateral excursion movements difference (pre and post op) on fractured side and nonfractured side between the two groups shows that the difference is higher in open reduction group with a mean value of 4.50 mm and SD of 1.96 mm [Table 1].

Comparison of the protrusive movements difference (pre and post op) between the two groups shows that difference is higher in open reduction group with a mean of 3.0 mm and SD of 1.56 mm [Table 1].

In the study, bite force difference (pre and post op) between the two groups shows that bite force difference is higher in open reduction group with a mean value of 245.50N and SD of 83.94N [Table 2].

None of the patients in open reduction group had deviation, however, in closed reduction group, 70% of cases had deviation.

When evaluated based on pain score using visual analogue scale in Group I, 40% of patients had no pain, 30% had mild pain, and 30% had moderate pain. While in Group II, 70% had no pain, 30% had mild pain, and 0% had moderate pain.

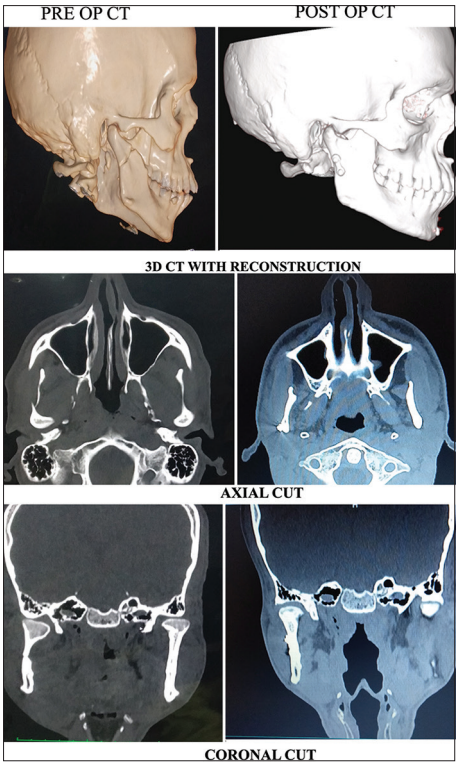

Figure 3: Pre and post operative evaluation with 3D CT face

Radiographic evaluation showed that, in the study, 30% of cases had lateral displacement of fractured condyle and 70% had medial displacement.

The coronal cut difference between pre and post op vertical ramal height (mm) between the two groups shows that the difference is higher in open reduction group with a mean value of 2.29 and SD of 4.21 [Table 3].

In the study, coronal cut difference between pre and post op distance of fractured condylar head from glenoid fossa between the two groups shows that considerable difference is obtained in open reduction group with a mean value of − 2.37 and SD 4.74 [Table 3].

In our study, comparison of the coronal cut difference between pre and post op angulation between the two groups shows that the difference is higher in open reduction group with a mean value of –14.80 and SD of 9.75 [Table 3].

DISCUSSION

The choice of surgical versus nonsurgical treatment for condylar fractures remains controversial and is open for debate even in the 21st century.[7-9] There is a general lack of data taking into consideration all the aspects – subjective, objective including bite force, radiographic evaluation in three dimension for arriving at a conclusion regarding

Table 1: Comparison of closed reduction cases and open reduction cases with clinical parameters

Parameters	Groups	Mean	SD	SE	*t*	*P*
Maximum interincisal opening (mm)						
Pre operative	Closed reduction cases	15.10	6.77	2.14		
	Open reduction cases	18.50	5.42	1.71	−1.2390	0.2310
Post operative	Closed reduction cases	33.60	7.35	2.32		
	Open reduction cases	38.00	6.34	2.01	−1.4330	0.1690
Difference	Closed reduction cases	18.50	4.67	1.48		
	Open reduction cases	19.50	6.31	2.00	−0.4030	0.6920
Lateral Excursion (Fractured Side) (mm)						
Pre operative	Closed reduction cases	1.00	0.82	0.26		
	Open reduction cases	1.20	1.03	0.33	0.4800	0.6370
Post operative	Closed reduction cases	5.20	1.87	0.59		
	Open reduction cases	5.70	1.49	0.47	0.6600	0.5180
Difference	Closed reduction cases	4.20	1.87	0.59		
	Open reduction cases	4.50	1.96	0.62	0.3500	0.7300
Lateral Excursion (Nonfractured Side)(mm)						
Pre operative	Closed reduction cases	1.60	1.43	0.45		
	Open reduction cases	1.20	0.92	0.29	0.7440	0.4660
Post operative	Closed reduction cases	5.50	2.80	0.89		
	Open reduction cases	5.70	2.36	0.75	−0.1730	0.8650
Difference	Closed reduction cases	3.90	2.81	0.89		
	Open reduction cases	4.50	1.96	0.62	−0.5540	0.5860
Protrusion						
Pre operative	Closed reduction cases	0.30	0.67	0.21		
	Open reduction cases	0.30	0.67	0.21	0.0000	1.0000
Post operative	Closed reduction cases	2.50	1.18	0.37		
	Open reduction cases	3.30	1.16	0.37	−1.5300	0.1430
Difference	Closed reduction cases	2.20	0.92	0.29		
	Open reduction cases	3.00	1.56	0.49	−1.3950	0.1800

Table 2: Comparison of closed reduction cases and open reduction cases with pre and post OP mean bite force by independent *t* test

Parameters	Groups	Mean	SD	SE	*t*	*P*
Pre operative	Closed reduction cases	53.10	11.28	3.57		
	Open reduction cases	59.40	9.56	3.02	−1.3470	0.1950
Post operative	Closed reduction cases	245.40	124.13	39.25		
	Open reduction cases	304.90	87.55	27.69	−1.2390	0.2310
Difference	Closed reduction cases	192.30	118.47	37.46		
	Open reduction cases	245.50	83.94	26.55	−1.1590	0.2620

which treatment modality provides superior results. This study aims to compare and evaluate the open and closed modality of treatment taking into consideration all the possible aspects that can be evaluated clinically and radiographically.

Closed reduction is the most frequently employed method to treat condylar fractures for decades.[8] However, a variety of complaints are now recognized following the conservative approaches (Closed treatment). Limited function of the temporomandibular joint with chronic pain,[4] limited incisal opening, deviation on mouth opening,[10] and habitual luxation of the temporomandibular joint on the contralateral side are some of the shortcomings following closed reduction. Long-term application of intermaxillary fixation not only makes the patient uncomfortable during their postoperative course of healing but also causes nutritional alterations.[11] Shortening of the ascending ramus with open bite deformity and malocclusion add to its disadvantages.[12]

Open reduction–internal fixation allows anatomical repositioning without the use of long-lasting intermaxillary fixation.[8] However it requires good technical skill, expertise and a thorough knowledge of the anatomy.[13] Plating of condylar fractures allow patients to have immediate mobilization, better oral hygiene, improved nutrition and normal speech.[14] This modality of treatment is

Table 3: Comparison of closed reduction cases and open reduction cases based on CT interpretation

Parameters	Groups	Mean	SD	SE	*t*	*P*
Mean Vertical Ramal Height						
Pre operative	Closed reduction cases	56.51	5.61	1.77		
	Open reduction cases	58.28	4.62	1.46	−0.7670	0.4530
Post operative	Closed reduction cases	58.01	5.10	1.61		
	Open reduction cases	60.57	3.83	1.21	−1.2700	0.2200
Difference	Closed reduction cases	1.50	2.21	0.70		
	Open reduction cases	2.29	4.21	1.33	−0.5300	0.6030
Distance of fractured condylar head from glenoid fossa						
Pre operative	Closed reduction cases	10.44	6.11	1.93		
	Open reduction cases	6.77	3.75	1.19	1.6220	0.1220
Post operative	Closed reduction cases	11.64	6.09	1.93		
	Open reduction cases	4.40	1.95	0.62	3.5810	0.0020*
Difference	Closed reduction cases	1.19	1.17	0.37		
	Open reduction cases	−2.37	4.74	1.50	2.3050	0.0330*
Angulation						
Pre operative	Closed reduction cases	52.50	43.23	13.67	2.5530	0.0200*
	Open reduction cases	16.90	8.75	2.77		
Post operative	Closed reduction cases	49.90	42.40	13.41	3.5450	0.0020*
	Open reduction cases	2.10	4.48	1.42		
Difference	Closed reduction cases	−2.60	2.99	0.95	3.7830	0.0010*
	Open reduction cases	−14.80	9.75	3.08		

**P* Value <0.05 not significant

gaining popularity in recent times owing to the immense development in the field of surgical instruments, endoscopes and expertise which helped to reduce the complications and give better stable results.

On clinical evaluation of our patients, there is no statistically significant difference between the two groups (open reduction and closed reduction group) with respect to maximal interincisal opening, range of movements –lateral excursion to nonfractured side, and protrusion which is in accordance to other studies conducted by Shiju *et al.*,[15] Danda *et al.*,[7] Haug and Assael,[16] and Santler *et al*.[12]

However, the study by Ji Lie *et al.*[17] and Al—Moraissi and Ellis III[8] showed that open reduction treatment provides better functional outcomes.

In our study, no statistically significant difference was noted with respect to bite force in closed reduction and open reduction group (192.30N and 245.50N). This were in accordance with the study of Ellis and Throckmorton[18] and Pereira *et al*.[19] Neuromuscular adaptations to the fractured mandibular condylar process occur in both closed and open reduction groups which justify the same.[18]

Open reduction method has the potential complications of damaging facial nerve and of forming visible scars.[4,8,20] The likelihood of facial nerve injury can be evaluated using House-Brackmann facial nerve grading system.[21] In our study using submandibular approach, none of the patients had facial nerve injury. This finding correlate with the study of Eckelt *et al.*[5] and Santler *et al*.[12] However Al—Moraissi and Ellis III in their review article reported 0 to 21% of incidence of facial nerve injury, which was temporary in most patients.

In our study, none of the patients had malocclusion postoperatively. These results were comparable with study conducted by Pereira *et al.*[19] and Karthik Ragupathy.[1] However, the study by Ellis, Simon and Throckmorton[21] reported significantly greater percentage of malocclusion in patients treated by closed reduction.

In our study, 70% of patients treated with closed reduction had deviation on mouth opening while none of the patients treated with open reduction had deviation. Similar results were given by Shiju M *et al.*[15] and Silvennoinen *et al*.[18] Malposition of the condyle causes lateral pterygoid function to diminish on the injured side. This causes the contralateral lateral pterygoid to pull the condylar head anteriorly more vigorously, thus compensating for the injured side and this imbalance causes the chin to deflect to the injured side on mouth opening in closed reduction group.[15]

No significant difference in pain (visual analogue scale) is noted among both groups in our study. These results are comparable with the study of study of Danda *et al*.[7] Shiju *et al*.[15] This observation was contradicting with the study of Naik *et al*.[20]

None of the patients in our study had infected implant at the end of study period postoperatively. This is comparable with the results of study by Karthik Ragupathy.[1] Also none of the patients in our study had hematoma. However, in the study by Kumar S *et al.*, one case had hematoma.[22]

In our study, the patients who had undergone open reduction had better anatomical reduction compared with closed reduction group. That is, there is an increase in vertical ramal height, statistically significant reduction in angulation and the distance of fractured condylar head from glenoid fossa approached more to a normal value in open reduction group. Eckelt *et al.*,[1] Karthik Ragupathy,[3] Shiju *et al.*[15] and Danda *et al.*[7] also reported similar results with statistically significant difference in the anatomical reduction of condyle in open reduction group.

In our study, overall satisfaction of treatment in both the groups were similar. This was contradicted by the study of Chen Ho *et al.*[6] who reported overall satisfactory score to be higher in open reduction group.

CONCLUSION

The results obtained suggested that, both techniques fulfilled the treatment goals in clinical evaluation with respect to maximal interincisal opening, lateral movements to fractured and nonfractured side, protrusive movements, bite force, malocclusion etc., that are the primary goals of treatment. But open reduction method was observed superior as compared with closed reduction method in terms of absence of midline deviation and radiographically in terms of anatomical reduction and proper positioning of fractured fragment.

In our experience, open reduction method of treatment minimizes the drawbacks associated closed reduction treatment, helps in better anatomical repositioning and may be a better alternative to closed reduction treatment.

Ethics approval

Ethical approval taken.

Consent to participate

Taken.

Consent for publication

Taken.

Declaration of patient consent

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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