

# Comparative Evaluation of Bite Force Recovery in Patients with Mandibular Fractures - An Observational Study

Dr. Aparajita Adurti,<sup>1</sup> Dr. Nishant Gupta,<sup>2</sup> Dr. Yogendra Malviya,<sup>3</sup> Dr. Khrieketuo Kire,<sup>4</sup> Dr. Rakesh Kumar Doodi,<sup>5</sup> Dr. Aabhash Ashok Agrawal<sup>6</sup>

**1. Dr. Aparajita Adurti**

Postgraduate Student, Department of Oral And Maxillofacial Surgery, Jaipur Dental College, Jaipur, Rajasthan, India.

**2. Dr. Nishant Gupta**

Professor and Head , Department of Oral and Maxillofacial Surgery, Jaipur Dental College, Jaipur, Rajasthan, India

**3. Dr. Yogendra Malviya**

Senior Lecturer, Department of Oral and Maxillofacial Surgery, Jaipur Dental College, Jaipur, Rajasthan, India

**4. Dr. Khrieketuo Kire**

Postgraduate Student, Department of Oral And Maxillofacial Surgery, Jaipur Dental College, Jaipur, Rajasthan, India.

**5. Dr. Rakesh Kumar Doodi**

Postgraduate Student, Department of Oral And Maxillofacial Surgery, Jaipur Dental College, Jaipur, Rajasthan, India.

**6. Dr. Aabhash Ashok Agrawal**

Postgraduate Student, Department Of Pedodontics and preventive dentistry, Jaipur Dental College, Jaipur, Rajasthan, India.

## CORRESPONDING AUTHOR

**Dr. Aparajita Adurti**

Postgraduate Student,  
Department of Oral And Maxillofacial Surgery,  
Jaipur Dental College & Hospital,  
Jaipur, Rajasthan, India

## Abstract

The mandible is one of the most involved bones of the craniofacial system to get affected by traumatic events or craniomaxillofacial deformities.

**Aim:** The research was undertaken to relate the recovery of maxillofacial masticatory apparatus post-fracture of the mandible.

**Material and method:** 37 patients who had undergone mandibular fractures are segregated into 6 groups based on the type of fracture the patient had attained. The fractures are reduced using closed reduction or ORIF. The patient groups were then evaluated for 12 weeks. Bite force was then evaluated at the incisor, left, and the right molar region at a head upright position. **Statistical analysis** Paired student t-test was performed on the given values.

**Results:** At the incisor region, maximum bite forces were recorded at 12 weeks, in patients that have undergone angle fracture (114.85N +/-35.90N). At the left & right molar region, the utmost bite force was recorded in patients with para symphysis fracture (239.9N+/-105.23N) and (234N +/-103.62N) respectively.

**Conclusion:** functional recovery of the masticatory system was best shown by patients with mandibular para symphysis fracture at 12 weeks postoperatively.

**Keywords:** mandibular fracture, bite force, trauma, craniomaxillofacial, mastication

## INTRODUCTION

The lower jaw is one of the commonly affected long bones of the facial skeletal system to undergo trauma. The 2<sup>nd</sup> most common facial injury treated is mandibular fractures. According to several studies, they make up 36% to 70% of all fractures of the facial skeleton<sup>[1],[2],[3],[4]</sup>. In addition to altering the skeletal architecture, mandibular fractures can also result in neurovascular injuries and modifications to the other parts of the masticatory apparatus, such as a tear or injury to the masticatory muscle<sup>[5]</sup>. The main Aetiological factors for fracture of the mandible include road crash accidents, which account for a substantial number of cases in the Indian subcontinent, and intersubjective attacks and falls account for all remaining cases that are regularly seen in our clinic setups. Current literature includes multiple studies that analyse bite forces in individuals that have attained fracture of the mandible, but, detailed literature on the muscular and functional efficiency attained by the faciomasticatory system in each type of fracture at different locations has no existence.

This study aimed to compare the operational recovery of the masticatory system after the attainment of mandibular fractures which are treated utilising either ORIF or the closed reduction technique with Erich's arch bar (open reduction and internal fixation). This research was done to evaluate the efficacy of the skeletal & masticatory system, operational recovery of muscles postoperatively and time required by a patient to attain a normal bite force adequate to carry out normal masticatory functions.

## MATERIAL AND METHOD

Thirty-seven patients who visited the oral and maxillofacial surgery department between Oct 2021-22 were the subject of this investigation. Patients with unilateral isolated mandibular fractures or bilateral mandibular fractures of the same type between the ages of 18-50 were recruited for this study. All subjects were in generally good health. Both genders were taken into consideration

and all the patients had adequate dentition to undergo bite force evaluation. Patients with multiple fractures of the craniomaxillofacial region or different types of mandibular fractures were excluded from this study. Also, patients with inadequate dentition, myofascial pain dysfunction syndrome, dentofacial deformities, neurosensory deficits, and TMJ disorders were not chosen for this study.

This study was registered and ethical approval was obtained by the University Institutional Ethics committee {MVGU/ADM/2021/896(xv)}.

Consent was obtained from every patient selected to be a part of the study in the English language and the local language. Every patient underwent closed reduction using The Erich arch bar followed by open reduction & internal fixation with titanium load-sharing mini plates in accordance with Champy's rule of osteosynthesis.

Treated patients were then evaluated postoperatively using Monad<sup>TM</sup> strain gauge bite force measurement device at different intervals of time.

At one, two, four, eight, and twelve weeks, patients were evaluated postoperatively in a head upright position. The bite force was noted at the central incisor region, right & left molar region.

Mandibular angle fracture patients made up Group 1, mandibular body fracture patients made up Group 2, mandibular condylar fracture patients made up Group 3, mandibular para symphysis fracture patients made up Group 4, mandibular sub condylar fracture patients made up Group 5, and symphysis fracture patients made up Group 6.

## STATISTICAL ANALYSIS

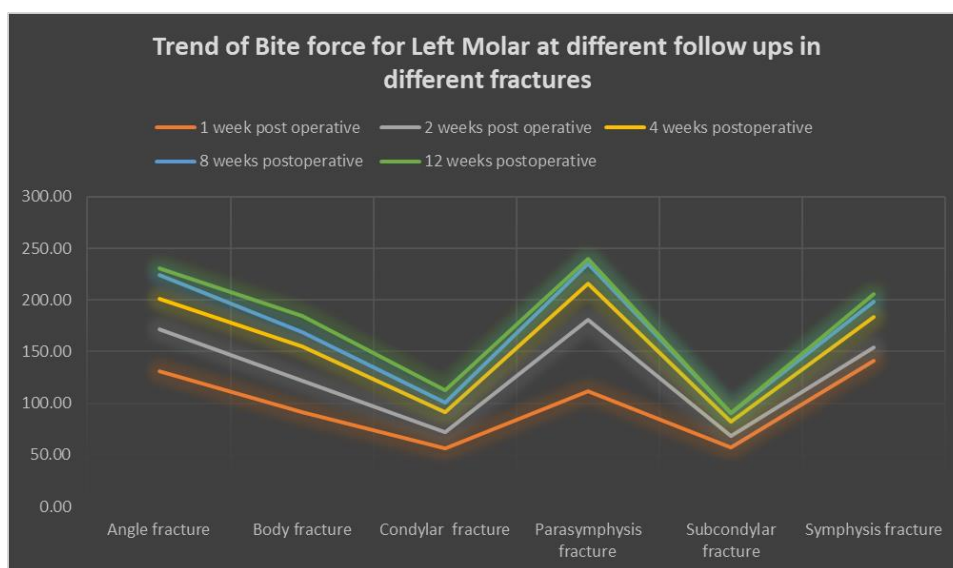
The data collected was entered in SPSS Software 18.0, (IBM, New York, United States of America). The significance level was settled at  $p = 0.05$  or  $\leq 0.05$  were statistically insignificant. The significance of the research parameters on a continuous scale between the groups (intergroup analysis) on a metric parameter was calculated using the Student's *t*-test (paired, independent).

## RESULTS

37 individuals that have undergone mandible fractures were involved in the research of which 10 patients were females and 27 were males.

At the left molar region, at 1 follow-up, the Greatest bite force was noted in patients with angle fracture (130.58N), and minimum bite force was documented in patients that have undergone condylar fracture (56.23N). At 2 weeks follow-up, maximum bite force was documented in a patient with para symphysis fracture (180.70 N), and minimum bite forces were documented in patients with sub condylar fracture (68.73N). At 4 weeks follow-up maximum bite force was noted in people

that have undergone para symphysis fracture (216.34N) and minimum bite force was noted in people that have undergone sub-condylar fracture (81.83N). At 8 weeks follow-up, maximum bite force was recorded in individuals with para symphysis fracture (235.15N), and minimum bite force was noted in people that have undergone sub-condylar fracture (90.10N). Finally, At 12 weeks of follow-up, maximum bite force was attained by individuals with para-symphysis fractures (239.9N) and minimum bite force was attained by patients with sub condylar fractures (90.60N). (Figure-1) (Table-1)



**FIGURE-1**

<b>TREND OF BITE FORCE FOR LEFT MOLAR AT DIFFERENT FOLLOW UPS IN DIFFERENT FRACTURES</b>						
	<b>Angle fracture</b>	<b>Body fracture</b>	<b>Condylar fracture</b>	<b>ParasympHysis fracture</b>	<b>Subcondylar fracture</b>	<b>Symphysis fracture</b>
<b>1 Week Post Operative</b>	130.58	91.24	56.23	111.25	57.20	141.50
<b>2 Weeks Post Operative</b>	171.25	121.56	71.66	180.70	68.73	154.00
<b>4 Weeks Postoperative</b>	200.90	155.10	91.49	216.34	81.83	183.50
<b>8 Weeks Postoperative</b>	224.55	168.90	100.34	235.15	90.10	198.20
<b>12 Weeks Postoperative</b>	230.39	184.70	112.19	239.99	90.60	206.00

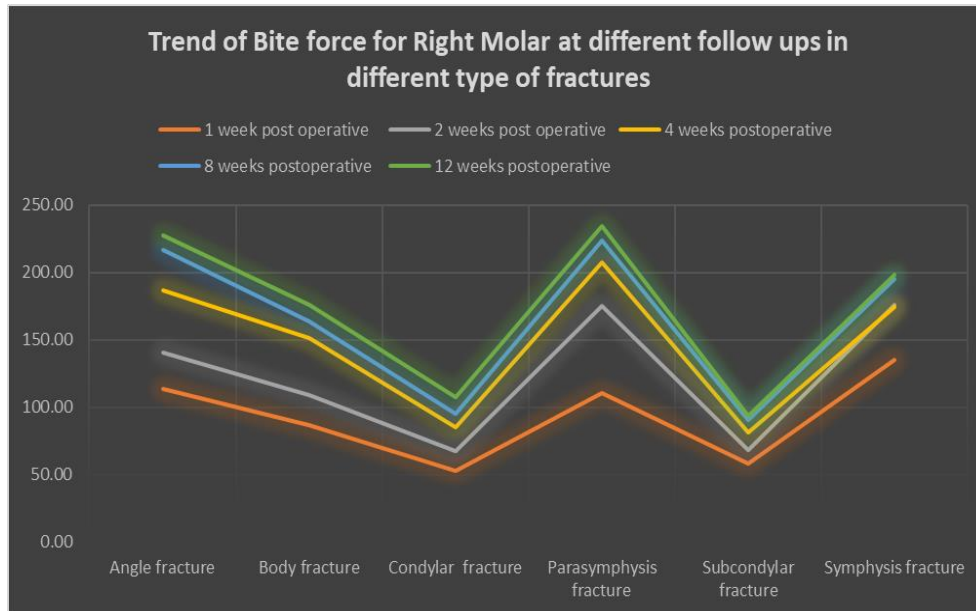
**TABLE-1**

The maximum bite force at the right molar area was obtained in patients with symphysis fractures at 1 week postoperatively (135.00N), whereas the

minimum bite force was recorded in patients with condylar fractures. At 2 weeks postoperatively, maximum bite force was recorded in patients with

symphysis fractures (176.10 N), and minimum bite force was recorded in patients with condylar fractures (67.15 N) at the right molar region. At 4 weeks postoperatively maximum bite force was recorded in patients with para symphysis fracture (207.73) and minimum bite force was recorded in patients with sub condylar fractures (81.23N). At 8 weeks postoperatively, maximum bite force was

recorded in patients with para symphysis fracture (223.51N), and minimum bite force was recorded in patients with sub condylar fracture (90.40N). And, At 12 weeks postoperatively, maximum bite force was attained by patients with para symphysis fracture (234.41N) and minimum bite force was attained by patients with sub condylar fracture (93.80N). (Figure-2) (Table-2)



**FIGURE-2**

<b>TREND OF BITE FORCE FOR RIGHT MOLAR AT DIFFERENT FOLLOW UPS IN DIFFERENT FRACTURES</b>						
	<b>Angle fracture</b>	<b>Body fracture</b>	<b>Condylar fracture</b>	<b>Parasymphysis fracture</b>	<b>Subcondylar fracture</b>	<b>Symphysis fracture</b>
<b>1 Week Post Operative</b>	113.18	86.64	52.88	110.57	58.43	135.00
<b>2 Weeks Post Operative</b>	140.63	108.66	67.15	175.44	68.10	176.10
<b>4 Weeks Postoperative</b>	186.44	151.58	84.74	207.73	81.23	174.25
<b>8 Weeks Postoperative</b>	216.38	163.36	95.48	223.51	90.40	195.00
<b>12 Weeks Postoperative</b>	227.54	175.68	107.28	234.41	93.80	198.00

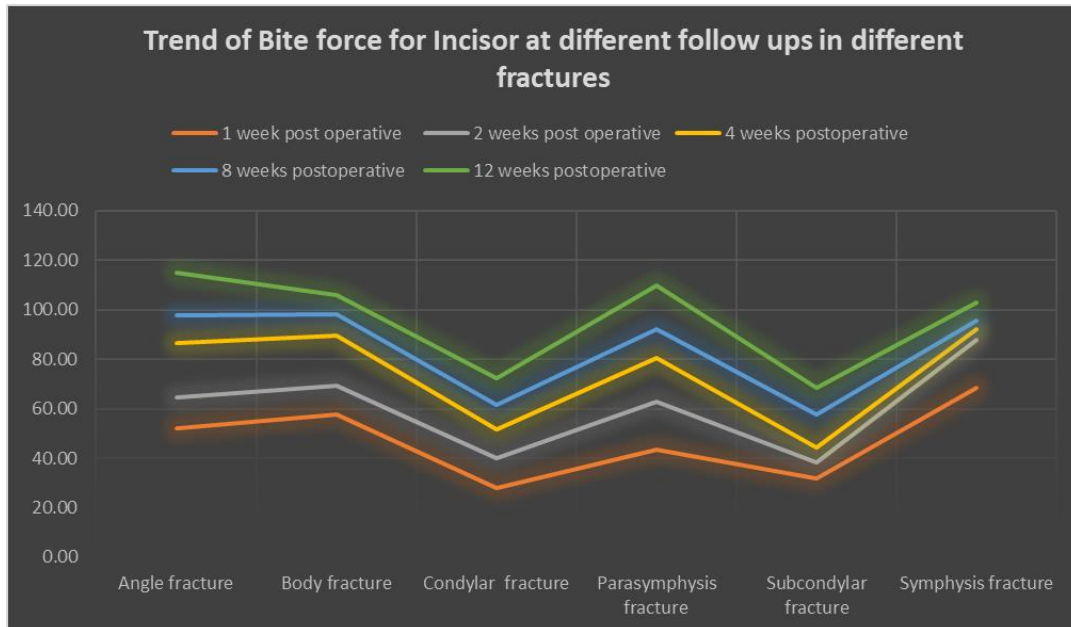
**TABLE-2**

At the incisor region, at 1 week postoperatively, Maximum bite force was recorded in patients with symphysis fracture (68.50 N), and the minimum bite force was recorded in patients with condylar fractures (27.80 N). At 2 weeks postoperatively, maximum bite force was recorded in patients with

symphysis fractures (87.65 N), and minimum bite force was recorded in patients with condylar fractures (39.78 N). At 4 weeks postoperatively maximum bite force was recorded in patients with symphysis fracture (92 N) and minimum bite force was recorded in patients with sub condylar fractures

(44.4N). At 8 weeks postoperatively, maximum bite force was recorded in patients with body fracture (98.20N), and minimum bite force was recorded in patients with sub condylar fracture (57.43N). And At 12 weeks postoperatively, maximum bite force was

attained by patients with angle fracture (114.85N) and minimum bite force was attained by patients with sub condylar fracture (68.40N). (Figure-3) (Table 3).



**FIGURE-3**

<b>TREND OF BITE FORCE FOR INCISOR AT DIFFERENT FOLLOW UPS IN DIFFERENT FRACTURES</b>						
	<b>Angle fracture</b>	<b>Body fracture</b>	<b>Condylar fracture</b>	<b>Parasymphysis fracture</b>	<b>Subcondylar fracture</b>	<b>Symphysis fracture</b>
<b>1 Week Post Operative</b>	51.96	57.50	27.80	43.24	31.73	68.50
<b>2 Weeks Post Operative</b>	64.45	69.44	39.78	62.90	38.40	87.65
<b>4 Weeks Postoperative</b>	86.61	89.70	51.74	80.68	44.40	92.00
<b>8 Weeks Postoperative</b>	97.70	98.20	61.44	91.99	57.43	95.65
<b>12 Weeks Postoperative</b>	114.85	105.74	72.45	109.80	68.40	102.80

**TABLE-3**

A significant difference was seen statistically in all the bite force values at 1, 2, 4, 8, and 12 weeks in groups 1, 2, 3, and 4 ( $P < 0.05$ ) However, there were lesser statistically significant changes seen in groups 5 and 6.

## **DISCUSSION**

Mandibular bone fractures are a significant patient source of worry, while not being a serious injury. This is because of the significant impact such fractures have on mastication, a function that can only be performed by the craniofacial muscular and skeletal systems. To determine the extent of harm to

the masticatory system induced by mandibular fractures and the impact of different mandibular fractures on the maximal bite forces, this study was done. Soft tissues injury, the dentoalveolar system, and significant skeletal elements of the face, such as the maxilla, mandible, naso-orbital-ethmoid complex, zygoma, or supraorbital structures, are

usually caused by trauma to the facial region. A significant fraction (>70 per cent) of all facial injuries are mandibular fractures alone [6]. The considerable reduction in bite forces that occurred after treatment for a fractured mandible may have been caused by surgical or trauma-related damage to the masticatory muscle or by the masticatory system's protective neuromuscular mechanisms.

In an analysis done by Yadav et al [7], it was found that 10% of women and 90% of men experience mandibular fractures, respectively. In the present study, there were three times as many males who experienced mandibular fractures as girls. The fact that women in our society do not engage in as many of the same physical activities as men do, once again, plays a role in the low frequency of females in our study.

In their study, Gandhi and Kattimani et al [8] found that RTA is a major contributing factor to the development of mandibular fractures. A similar study done by Friedrich et al [9] deduced the cause for mandibular fractures to be RTA as well. But a study done by Guimond et al [10] concluded that assault is the primary causative factor for the incidence of mandibular fracture. Road traffic accidents (RTA), which accounted for almost 80% of cases in the current study on the aetiology of mandibular fractures, were the other causes of mandibular fractures, followed by assault (15%) and falls (5 per cent). The fact that the study was carried out in industrialised nations may account for the variation in the etiologic factor when compared to previous studies.

In the current research, the maximum bite force at one week was attained by group 6 i.e., symphysis fracture. But, in the progressive follow-ups, the maximum bite force was attained by patients with para symphysis fracture, i.e., group 4.

A sudden spike was also observed during the study from the 4<sup>th</sup> week postoperatively to the 8<sup>th</sup> week postoperatively. This could be due to its correlation with the stage of bony callus formation that starts on the 11<sup>th</sup> day postoperatively till the 28<sup>th</sup> day and the bone remodelling phase which starts from the 18<sup>th</sup> day postoperatively and can last for several years. A similar observation was made in the present where, At the end of the 8<sup>th</sup> week, no significant changes were seen in the bite force values and similar values were also seen at 12 weeks postoperatively. The normal bone structure can eventually regenerate after a lengthy bone remodeling process that can extend for many months. [11],[12],[13].

It is essential to emphasize that the present study was a comparative evaluation of the bite force postoperatively for 12 weeks alone. Hence, Further studies are required to evaluate the bone formation post mandibular fractures as well as the functional recovery of the mandibular joint unit post a traumatic event for a longer duration of time.

## CONCLUSION

The findings of this investigation were in line with the initial intent of the study. Patients with para-symphysis fractures regained maximum functional efficiency post a traumatic event. In patients with mandibular fractures, there is an initial decrease in the bite force but a sudden rise was observed at 4 weeks and eventually, the values were stable by the end of 12 weeks postoperatively.

Further studies need to be performed to deduce the maximum bite force that was obtained postoperatively.

## Ethical Statement

University institutional ethics committee  
MVGU/ADM/2021/896(xv)

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