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A COMPARATIVE STUDY TO EVALUATE THE EFFICACY OF ORBITA PLATES VS CONVENTIONAL MINIPLATES IN THE MANAGEMENT OF MANDIBULAR BODY FRACTURES

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ABSTRACT

Purpose: To evaluate the efficacy of orbita plates vs conventional miniplates in the management of mandibular body fractures. **Materials & Method:** A total of 20 adult patients were selected according to the inclusion criteria and divided into two equal groups, Group A was treated by orbita miniplates while Group B was treated by conventional miniplates for the management of mandibular body fractures. Postoperative clinical evaluation was done by measuring occlusal discrepancies, neurosensory deficits, hardware failure in terms of plate fracture and loose screws, stability of fractured fragments and tooth vitality. Radiological evaluation done by measuring the adequacy of reduction, displacement of fractured fragments and invasion of screws in relation to root apices/mental foramen/IAN canal. **Results:** All patients were followed for 3 months. The results of the study showed that the incidence of mandibular body fractures was higher in males (85.0%) and in fourth decade of life. The etiology of fracture was predominantly RTA (65.0%) followed by falls (20.0%). The mean duration of surgery was 49.40 min in Group A and 54.20 min in Group B. This showed statistically significant result with P value of 0.001. Other parameters like neurosensory deficits, occlusal discrepancies, hardware failure, stability of fractured fragments, tooth vitality, radiological adequacy of reduction, displacement of fractured fragments, invasion of screws in relation to root apices/mental foramen/IAN canal and postoperative complications in terms of plate exposure & wound dehiscence did not show any statistically significant difference at intervals of 1st, 4th and 12th week follow up visits in both groups. **Conclusion:** The obtained results showed that both orbita and conventional miniplates fulfill the treatment goals of adequate reduction, fixation and stabilization of mandibular body fractures. Further studies with a larger sample size are required for more definitive conclusion.

KEYWORDS

mandible fracture, orbita plate, miniplates, ORIF

INTRODUCTION

The mandibular fractures are the second most commonly occurring fractures occurring in the craniofacial region accounting for 36-70 % after nose and tenth most frequently fractured bone in the body[1]. The most obvious cause of mandibular fractures is RTA (45.3 %) followed by fall from height (42.6 %), injuries associated with sports (2.2 %), interpersonal violence (8.9 %) and gunshot wounds (0.89 %)[2]. According to literature, the most common sites of fractures is the body (29 %) followed by subcondyle (26 %) & angle (25 %), with the symphysis, ramus, and condyle accounting for 17 %, 4 %, & 1 %, respectively[3].

The human face is the first contact point during several human interactions, so the injuries involving the facial region may leave a catastrophic effect on the individual[4]. The energy necessary for fracturing the mandible is around 44.6-74.4 kg/m, which is also same for the zygomatic bone, around half for the frontal bone and four times for the maxilla[5].

The main aim in the management of fracture is predictable restoration of preinjury anatomical form, along with aesthetics and function[6].

Traditionally, the immobilization of the jaws was accomplished using closed reduction techniques.During past years, the spectrum of managing mandibular fractures has been widened from different kinds of splinting to circummandibular wiring, application of extra oral pins, different rigid fixation methods and semirigid fixation with transosseous wiring and miniplates, three dimensional plates, locking plates to bioresorbable plates.[7]

Due to certain limitations of using miniplates and 3D plates in the region of mental foramen, the application of two Orbita plates is advocated for the management of fractures passing through mental foramen hence providing geometrically closed quadrangular three-dimensional configuration which enhances the overall stability. The formation of elliptical configuration with the use of two curved orbita miniplates makes it relatively easy to preserve the mental nerve. Fewer studies have been conducted regarding the use of this novel technique[8].

Therefore, in the present study, we attempt to compare two orbita plates vs standard plates for managing the fractures of mandibular body with respect to ease in application and clinical assessment for stability.

MATERIALS AND METHODS

A prospective randomized controlled clinical trial with analytical design was conducted to assess and compare the efficiency of orbita miniplates and conventional miniplates in management of mandibular body fractures. Informed written consent was obtained in both Hindi and English Language from all the patients selected for the study. Permission from Ethical committee of was obtained for study. A total no. of 20 patients, were selected and randomly allotted as 10 in each group, within the age group of 18 to 65 years, who reported to our institution with mandibular body fractures due to trauma. Patient with good systemic health according to ASA I or ASA II category suffering from non comminuted, non-infected fractures mandibular fracture passing through the mental foramina or just around it was included.

Group A: Orbita Plate Group -

1. 2.0 millimetres orbita plates (4 holes with bridge)
2. 2.0 millimetres mini screws (Monocortical 6 mm length and/or monocortical 8 mm length)

Group B:Conventional Miniplate Group -

1. 2.0 millimetres conventional miniplates (4 holes with bridge)
2. 2.0 milllimetres mini screws (Monocortical 6 mm length and/or monocortical 8 mm length)

Orbita Plate Group:

After obtaining occlusion with maxillomandibular fixation, first 2 millimeter, C-shaped, 4 hole with bridge Orbita miniplate was positioned overhead the mental foramen in accordance to Champy's osteosynthesis line. The first plate was fixed using two screws of 2 mm × 6 mm, keeping the concavity of the plate oriented in downward direction. The Orbita plate has two arms bent to the long axis at fifteen degrees. The second Orbita plate was positioned while placing concavity upwards and both ends touched the previous plate in order to create a geometrically similar quadrangular relationship forming an elliptical shape. The second Orbita plate was secured with the help of four, 2 mm × 8 mm screws. The mental nerve appeared to arise from the elliptical configuration. Incision was closed by using 3-0 vicryl sutures and 3-0 black silk sutures. Extra orally pressure dressings given to all patients.

Conventional Miniplate Group:

Conventional miniplate fixation was done according to the champy's principle.

The patients were evaluated clinically for postoperative neurosensory deficits, tooth vitality, occlusal derangements, hardware failure in form of plate fracture and screw loosening, stability of fractured fragments, plate exposure and wound dehiscence at the interval of first, fourth and twelfth weeks.

Radiological assessment was done for assessing accuracy in fracture reduction, interfragmentary mobility, screw invasion in proximity to root apices or mental foramen or IAN canal, malunion/nonunion and resorption around screws at the interval of first, fourth and twelfth weeks subsequently.

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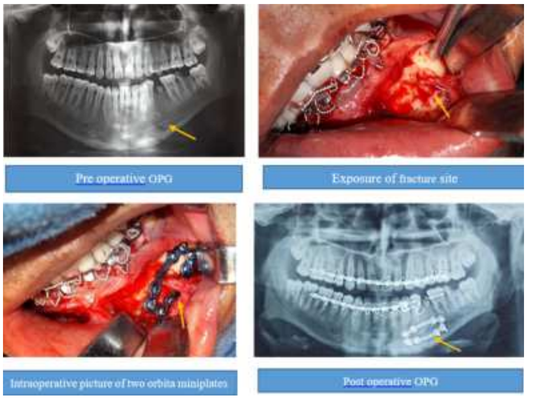

OBSERVATIONS & RESULTS

In the present study, the mean age (Table 1) for the control and the study group was 44.50 and 41.70 years, respectively.The study demonstrated a male predominance (Table 2) with males accounting for 85% of all mandibular fractures and male to female ratio of 5.6:1.The mode of injury (Table 3) was found to be RTA (65.0 %) followed by fall (20.0 %), sports related injuries (10 %) and interpersonal violence (5 %). Five out of twenty patients had loss of consciousness (Table 4) after the initial trauma accounting to around 15%.The average operating time (Table 5) for orbita plate group (49.40 minutes) was approximately 5 minutes less than that of conventional miniplates (54.20 minutes). None of the patients of Group A developed paraesthesia, whereas, 2 patients of Group B presented with paraesthesia of lower lip & chin region (Table 6). There were no cases of non-vital tooth pre-operatively and post-operatively in Group A, whereas, 4 patients belonging to group B reported with pre-operative non-vital teeth. Only one case of occlusal derangement in each group by evaluating the molar relationship. In 18 out of 20 patients, including both groups, occlusion was intact with no or limited loss in molar relationship. The two cases of deranged occlusion in each group were treated with the use of elastics for 7 days. The occlusion reached satisfactorily level in both groups during the subsequent follow up visits of fourth and twelfth weeks (Table 7). No cases of hardware failure in terms of plate fracture and loosening of screws were reported. There was absence of segmental mobility between fractured fragments postoperatively in patients who underwent osteosynthesis using orbita miniplates whereas there was presence of slight segmental mobility in the three patients treated with conventional miniplates from first week of follow-up till fourth week. At the end of third month, none of the patient presented with segmental mobility of fractured fragments (Table 8).

The results demonstrated that orbita plates provided adequate fracture reduction and fixation of fractured fragments.Also, there were no cases of invasion of screws near the region of root apices/mental foramen/IAN canal. Whereas, conventional miniplate group demonstrated increased interfragmentary gap during first week but later on improved with the subsequent visits during three months. In both groups, none of the patients presented with malunion or nonunion and resorption near the screws.

Table 1: Mean Age

Groups	Age				
	Mean	**Standard Deviation**	**Mean Difference**	**Value of t-test**	**Probability factor (p-value)**
Orbita miniplate	44.50	11.14	2.80	0.478	0.638
Conventional miniplates	41.70	14.78			

Table 2: Sex Predilection

Gender	Groups		Total
	Orbita miniplate	**Conventional miniplates**	
Male	9	8	17
	90.0%	80.0%	85.0%
Female	1	2	3
	10.0%	20.0%	15.0%
Total	10	10	20
	100.0%	100.0%	100.0%

Table 3: Mode of Injury

Mode of injury	Frequency	%
Fall	4	20.0%
RTA	13	65.0%
Sports related	2	10.0%
Violence	1	5.0%
Total	20	100.0%

Table 4: General Condition After Injury

General condition after injury	Frequency	%
Conscious	15	75.0%
Unconscious	5	25.0%

Table 5: Duration of Surgery

Groups	Duration of surgery				
	Mean	**Standard Deviation**	**Mean Difference**	**Value of t-test**	**Probability factor (p-value)**
Orbita miniplate	49.40	2.55	-4.80	-4.025	0.001*
Conventional miniplates	54.20	2.78			

Table 6: Post-operative Neurosensory Deficit

Post-operative neurosensory deficit		Groups		Total	Chi-square value	p-value
		Orbita miniplate	**Conventional miniplates**			
1st week	Absent	10	8	18	2.222	0.136
		100.0%	80.0%	90.0%		
	Present	0	2	2		
		0.0%	20.0%	10.0%		
4th week	Absent	10	9	19	1.053	0.305
		100.0%	90.0%	95.0%		
	Present	0	1	1		
		0.0%	10.0%	5.0%		
12th week	Absent	10	9	18	1.053	0.305
		100.0%	90.0%	90.0%		
	Present	0	1	2		
		0.0%	10.0%	10.0%		

Table 7: Post-operative Occlusion

Post-operative occlusion		Groups		Total	Chi-square value	p-value
		Orbita miniplate	**Conventional miniplates**			
1st week	Intact	9	9	18	0.000	1.000
		90.0%	90.0%	90.0%		
	Deranged	1	1	2		
		10.0%	10.0%	10.0%		
4th week	I	10	10	20	0.000	1.000
		100.0%	100.0%	100.0%		
12th week	i	10	10	20	0.000	1.000
		100.0%	100.0%	100.0%		

Table 8: Fracture Stability

Fracture stability		Groups		Total	Chi-square value	p-value
		Orbita miniplate	**Conventional miniplates**			
1st week	Acceptable	0	3	3	3.529	0.060
		0.0%	30.0%	15.0%		
	Good	10	7	17		
		100.0%	70.0%	85.0%		
4th week	Acceptable	0	2	2	2.222	0.136
		0.0%	20.0%	10.0%		
	Good	10	8	18		
		100.0%	80.0%	90.0%		
12th week	Good	10	10	20	0.000	1.000
		100.0%	100.0%	100.0%		

DISCUSSION

The mean age for the control and the study group was 44.50 and 41.70 years, respectively. Kamulegeya et al[9] evaluated around 132 cases of mandibular fractures over a period of six months. They reported that the most commonly affected age group was between 21-30 years with mean age of 28.32. Malik et al[10] conducted a study on 5962 patients suffering from lower jaw fractures for a period of five years. They observed that majority of patients were aged between 17-34 years with male: female ratio of 4.5:1. Chaurasia A et al[11] carried out a study on

1015 patients with mandibular fractures and found out that majority of them were between 18 and 35 years of age with the mean value of 47.4%.

There is male predominance pattern with males accounting for 85% of all lower jaw fractures and male to female ratio of 5.6:1. The main reason of injury was found to be RTA (65.0 %) followed by fall (20.0 %), sports related injuries (10 %) and interpersonal violence (5 %). Kamulegeya et al[9] also found out that the males were commonly affected accounting for 88.7% (male: female ratio of 7.7:1). The main cause of injuries was found to be road traffic accidents (56.06%), followed by assault (34.84%), sports injuries (3.79 %), occupational related accidents (3.03 %) and ballistic wounds (2.27 %). Malik et al[10] documented that RTA were most common cause of maxillofacial injuries accounting for 82% followed by assaults (8.2%), falls (4.2%), sports related injuries (0.65%), occupation related injuries (3.3%) and miscellaneous (1.7%). Chaurasia et al[11] also observed male predilection (78.6%) over females (21.4%) in their study. They stated that RTA are the primary cause of maxillofacial fractures in their study. The results of our study demonstrated that five out of twenty patients had loss of consciousness after the initial trauma accounting to around 15%. Almost similar findings were reported by Hung et al[12] in their study in which fifteen out of 85 subjects had loss of consciousness after trauma; hence the incidence of loss of consciousness after lower jaw fractures in their study was around 17.6 %. However, Khan et al[13] documented that 66 out of 254 patients had loss of consciousness, and the incidence of loss of consciousness associated with mandibular fractures was 25.9%.

The duration between trauma and definite treatment was observed in all the cases and it was found between 1-5 days from the initial injury till open reduction and internal fixation. Similar results observed by Malhotra et al[14] who reported that the duration between the time of injury and treatment ranged from 1-5 days (mean value of 3.1$\pm$ 1.21 days). However, Gupta et al[15] reported that the duration between the initial trauma and definite fixation was around 1 to 3 days. According to study conducted by Malanchuk et al[16], the elased time amid initial trauma and definitive fixation was < 24 hours (18.5 %), 2-3 days (39 %), 4-7 days (19.5 %), > 7 days (23 %) of the patients with mean value of around 6.4 days. The main reasons for delay in definitive treatment was due to lack of awareness regarding the potential side effects involving facial injury among people, poor patient cooperation, trauma under influence of alcohol, improper diagnosis and financial conditions. This delay in definitive fixation may lead to increased incidence of infection rates resulting in formation of abscess, nonunion or malunion, or the formation of a fistula in individuals with advanced age, poor oral hygiene, smoking, immunocompromised status and systemic conditions. The threat of postoperative complications due to the delayed treatment of compound mandibular fractures > 72 hours is extremely high since the medullary bone is acutely infected and the blood supply may be impaired. The manipulation of fractured fragments becomes a surgical challenge due to callus formation in non-reduced mandibular fractures during the operative procedure. Other postoperative complications are nonunion and malunion, malocclusion, soft tissue dehiscence, and temporomandibular dysfunction resulting from delay in repair[17].

The technique of using two Orbita plates resulting in three dimensional configuration was adopted in our study. The present study established that the average operating time required for the placement of orbita plates was approximately 5 minutes less than placement of conventional miniplates. These findings were relatable to the results of the research carried out by Zix et al[18], Jain et al[19], and Budhraja et al[20], which also reported decreased operating time in mandibular fractures with the use of three-dimensional plates. Jain et al[19] reported that the average operating time with three dimensional plating system was 8 minutes lesser than the conventional plating system.

Neurosensory deficit is a problem commonly associated with lower jaw fractures. The most apparent reason for neurosensory disturbances is basically due to iatrogenic injury of the nerve during manipulation of fractured fragments, drilling and placement of screws in the vicinity of the nerve. The fixation of mandibular fractures passing through the mental foramina with the help of conventional miniplates, making them proximal to mental foramina and tooth roots, thereby increasing the chances of root damage rendering tooth non-vital. There may be probability of nerve damage as well as screw penetration into the anterior loop (mental nerve) leading to paraesthesia. But both of these complications were avoided with use of curved orbita plates. In the current study, we found that none of the patients of Group A developed paraesthesia whereas 2 patients of Group B presented with paraesthesia involving the region of lower lip & chin region at subsequent follow up visits. We found that all patients in Group A had normal tooth vitality after trauma as well as postoperative phase whereas four patients of Group B reported with non vital teeth preoperatively which doesn't resolved even after the definitive fixation during subsequent follow up visits. Anchlia et al[8] also reported in their study that none of the patients developed paraesthesia and root damage by applying two orbita plates for the fixation of lower jaw fractures. Similar findings were observed by Ellis et al[21] who reported cases of paraesthesia and damage to tooth roots by using two conventional miniplates for managing the lower jaw fractures passing through mental foramina.

In our study, occlusal discrepancies were monitored in first day, 1st week, 4th and 12th weeks after the surgical procedure. We reported only one case of occlusal derangement in each group by evaluating the molar relationship. In 18 out of 20 patients, including both groups, occlusion was intact with no or limited loss in molar relationship. The two cases of deranged occlusion in each group were treated with the use of elastics for 7 days. The occlusion reached satisfactorily level in both groups during the subsequent follow up visits of fourth and twelfth weeks. Similar findings were discovered by Anchlia et al[8] who applied orbita miniplates for fracture fixation and reported only three cases of occlusal derangements with loss of molar relationship in same side which was later rectified by using use of guiding elastics for the duration of one week postoperatively. The current study was also identical to Wakeel et al[22] and Doshi et al[23] who observed only one case of deranged occlusion during first two weeks after surgery in the patients who underwent fixation using conventional miniplates.

None of the patients presented with any incidence of hardware failure in terms of plate fracture and loosening of screws. The results of our study were equivalent to other studies conducted by Goyal et al[24], Aggarwal et al[6], and Budhraja et al[20] who also published that none of the patients reported with hardware failure with the use of conventional miniplates for managing lower jaw fractures. The possible cause for hardware failure comprises the plate's material and shape, surgical factors that contribute to plate weakening, decreased bone density at the site of fracture, and technological aspects.

Digital manipulation with the help of the thumb and index finger of both hands was performed to determine the fracture stability. The results of our study depicted that there was absence of segmental mobility between fractured fragments postoperatively in patients who underwent osteosynthesis using orbita miniplates whereas there was presence of slight segmental mobility in the three patients treated with conventional miniplates from first week of follow-up till fourth week. At the end of third month, none of the patient presented with segmental mobility of fractured fragments. The observations of our study were indistinguishable with Wakeel et al[22] and Doshi et al[23] who also discussed the incidence of segmental mobility present between the fractured fragments with the use of conventional miniplates. However, Goyal et al[24], Aggarwal et al[6] and Malhotra et al[14] didn't reported any incidence segmental mobility in their respective studies.

Nobody in Group A complained about any incidence of postoperative complications in form of infection, dehiscence of wound & plate exposure except one case in Group B presented with plate exposure and two with wound dehiscence respectively. Similar findings were observed by Malhotra et al[14], Doshi et al[23] and Ellis et al[21] who reported the incidence of infection in the patients treated with miniplates. Ellis et al[21] reported plate exposure (6 out of 265) from the dehisced incision in the patients treated with conventional miniplates. Wound dehiscence usually occurrs 6 to 10 days postoperatively due to inappropriate wound closure during surgery, smoking, trauma, infection, etc. it can be managed by draining the pus, careful debridement of wound, administration of antibiotics for five days, intermaxillary fixation for atleast three weeks and plate removal subsequently.

The results of our study in patients treated with orbita plates demonstrated adequate fracture reduction and fixation of fractured fragments during subsequent follow up visits evaluated by panoramic radiographs (OPG). None of the patients reported with paraesthesia of lower lip and dentin hypersensitivity due to non invasion of screws near the region of root apices/mental foramen/IAN canal. Whereas, the fracture reduction and fixation observed radiographically was not adequate in patients with miniplates during first week but later on improved with the subsequent visits during three months. In both groups, none of the patients presented with malunion or nonunion and resorption near the screws. Anchlia et al[8] also demonstrated adequate fracture reduction radiographically with the use of orbita plates with no incidence of malunion/nonunion or displacement of fractured fragments or penetration of screws into root apices/mental foramen/IAN canal.

CONCLUSION

The present study demonstrated that reduction of fractures in region of mental foramina using conventional miniplates had increased chances of adjacent root damage, compression of nerve as well as screw penetration into the anterior loop. This can be avoided by using curved orbita miniplates. The key advantages of using curved orbita plates over two conventional miniplates as observes in this study:

1. Establishment of a three-dimensional configuration.
2. Mental nerve preservation.
3. Tooth vitality maintained.

The results of present study showed that both orbita and conventional miniplates fulfill the treatment goals of adequate reduction, fixation and stabilization of mandibular body fractures. Further studies with a larger sample size are required for more definitive conclusion.

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