e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(3); 1138-1143

Original Research Article

Assessment of Mandibular Fractures Treated with Locking Plates versus Three-Dimensional Plates

G. Ambedhkar[1], Manish Kumar[2], Anand Bhatnagar[3], Anurag Jain[4]

[1]MDS, Department of Oral and Maxillofacial Surgery, Senior Resident, Andhra Medical College. King George Hospital, Visakhapatnam

[2]Associate Professor, Department of Dentistry, Government Medical College & Hospital, Ratlam, M.P

[3]Reader, Department of Periodontics, Jaipur Dental College Jaipur Rajasthan

[4]Associate Professor, Department of General Surgery, Government Medical College, Ratlam, M.P.

Received: 16-01-2023 / Revised: 20-02-2023 / Accepted: 16-03-2023

Corresponding author: Dr. Anurag Jain

Conflict of interest: Nil

Abstract

Objectives: The goal was to evaluate postoperative complications and compare the effectiveness of 2.00 mm unicortical locking plates and 3D plates in the surgical correction of uncomplicated mandibular fractures.

Materials and Procedures: A prospective cohort study of forty patients with uncomplicated mandibular fractures that were treated either with a noncompression unicortical 2 mm locking mini plate or with a noncompression unicortical 2 mm 3D mini plate was enrolled, and the patients were then monitored for the study's outcomes, including the length of the operation, any postoperative infections, and any postoperative occlusion.

Results: Male patients made up 90% of those who had road traffic accidents. Parasymphysis was the location of the mandibular fracture in 92.5% of cases. All cases operated with 3D plates did not require intermaxillary fixation, compared to 60% of cases performed with locking mini plates, P = 0.020. In comparison to 25% in another group, 95% of patients operated with 3D plates did not require postoperative occlusion correction (P = 0.016). There were no statistically significant variations between the two groups for other parameters like postoperative sensory disturbance, postoperative infection, incidence tooth damage, vertical displacement of the mandible, sensation of a plate after plating, and chewing efficiency after a week.

Conclusions: The 2.0mm 3D mini-plate has superior results in terms of operating time, the need for intermaxillary fixation after surgery, and occlusal correction. While the results in terms of metrics like infection rate and incidence of tooth damage etc. are comparable to using non-compression unicortical 2.00mm locking miniplate.

Keywords: Locking Plate, Mandibular Fracture, Three-Dimensional Plate, Infection Rate.

Introduction

The mandible is one of the most frequently fractured facial bones because of its prominent location and shape. Mandibular fractures need to be carefully considered

because they affect speech, mastication, deglutition, and the shape of the bottom part of the face [1,2]. Mandibular fractures that are successfully treated lead to a bony fusion that is anatomically correct and the return of normal occlusion and function. Road traffic accidents, falls, gunshot wounds, interpersonal aggression, and sporting mishaps are the most frequent causes of mandibular fractures [3].

The recognized universal principle for treating a bony fracture is reduction and immobilization, and a variety of treatment modalities can be used to accomplish this. Simply put, there are two types of treatment: closed reduction with intermaxillary fixation and open reduction with internal fixation. (ORIF). Open reduction with internal stabilization can be achieved intraorally or extraorally, using bone plates and screws or transosseous wires [4]. The development of locking plates/screws plating devices for the management of mandibular fractures is one of the most recent developments that has had a significant impact on the field of maxillofacial trauma. In comparison to the conventional nonlocking plate screw system, the screws, plate, and bone create a strong structure with greater stability.

Furthermore, it is hypothesized that the locking mechanism requires less precise plate adaptation to the underlying bone, reduces the risk of screw stripping, and results in less stress shielding. Its application via noncompression mechanism also reduces the risk of necrosis of the fracture segments.[5] Three-dimensional (3D) plates, which comprise of two 4 hole plates connected by vertical cross struts, are another advancement in the area of oral and maxillofacial surgery. Their stability is independent of plate width, unlike compression and reconstruction plates. The rectangular plate creates a 3D cuboid when combined with the screws monocortically attached to the outer cortex. The aim of this research was to compare the effectiveness of 2.00 mm locking plates and 3D plates in treating mandibular fractures, as well as any complications that may have arisen during or following the procedures.

Method

Patients with uncomplicated mandibular fractures will be enrolled in a prospective cohort research between December 2021 and December 2022 in the oral and maxillofacial surgery department. The research included patients over the age of 18 with mandibular symphysis, parasymphysis, and body fractures. The research excluded any additional patients who had any one of the following complications at the time of presentation: patients with comminuted fractures of the jaw or pan facial fractures

Patients with severe displacement of the fractured segments, those with traumatic brain injury, those with compromised health, those with poor oral hygiene, and those with severe infection at the fracture site, among others, Patients who reported their injury more than seven days after it occurred, Patients with less mandibular vertical height between the lower border of the mandible and the root apex of the molars. The clinical history of the enrolled patients was evaluated prior to surgery, including the accident's time and date, the reporting period, the cause of the injury, and any prior instances of ear, nose, or oral cavity bleeding. The patient was also questioned regarding past experiences with forgetfulness, vomiting, convulsions, and unconsciousness. A comprehensive clinical evaluation came next. Blood clots, fractured teeth edges, and other foreign objects were removed from the oral canal. When deemed essential, ligature wire and barrel bandages offered a temporary stabilization. There were checks for soft tissue injuries on the cheeks and the mouth. All injuries were cleaned up, and 3-0 silk and 3-0 vicryl were used to stitch up lacerated wounds. The patients received a 0.5 ml

intramuscular injection of tetanus toxoid before beginning their treatment with medicines and painkillers. Before the surgery, an informed written agreement was obtained.

Based on the sort of plate used, this cohort of patients who underwent bone plate osteosynthesis was split into two groups: Noncompression unicortical 2 mm locking miniplate was used in Group I (n=20), and noncompression unicortical 2 mm 3D miniplate was used in Group II (n=20). When patients were admitted to the hospital, both sets of patients were monitored daily for postoperative complications. They were then monitored on a weekly basis for factors like chewing effectiveness at one month, postoperative sensory disturbance, postoperative infection, and mandibular vertical displacement. Software from IBM SPSS version 20.0 (Armonk, NY, IBM Corp.) was used to evaluate the data. To examine whether there was a significant variation between the two groups, Fisher's exact test was used. Additionally, the operating duration was subjected to an unpaired t test. When the P value was 0.05, it was considered statistically important.

Results

In both categories, the majority of patients (92.5%) were men. The patients' ages in both groups varied from 18 to 50 years old. 72.5% of the patients in both categories were in the 18–30 age range. (Table 1)

Table 1: Characteristics of both categories' study participants

Patient's characteristics	Group I* (*n*=20), *n* (%)	Group II# (*n*=20), *n* (%)	Total (*n*=40), *n* (%)
Gender			
Male	18 (90)	19 (95)	37 (92.5)
Female	2 (10)	1 (5)	3 (7.5)
Age group			
18-30	14 (70)	15 (75)	29 (72.5)
31-40	4 (20)	3 (15)	7 (17.5)
41-50	2 (10)	2 (10)	4 (10)
Etiology			
Road traffic accidents	17 (85)	19 (95)	36 (90)
Assault	1 (5)	1 (5)	2 (5)
Fall	2 (10)	0	2 (5)
Mandibular fracture site			
Symphysis	1 (5)	1 (5)	2 (5)
Parasymphysis	18 (90)	19 (95)	37 (92.5)
Body	1 (5)	0	1 (2.5)

Chewing efficiency after 1 week of plating was not statistically significant. However chewing efficiency varied in two groups, 4 patients (20.0%) in Group I and 2 patient (10%) in Group II showed difficulty in chewing after 1 week. (Table 2).

Table 2: Comparison of the two groups' following and surgical results

Variables	GroupI (n=20), n (%)	Group II (n=20), n (%)	Total (n=40), n (%)	P value
Need for intermaxillary fixation				
Needed	15 (75)	1(5)	16 (40)	0.020*
Not needed	5 (25)	19 (95)	24 (60)	
Postoperative occlusion				
No need for occlusal correction	3 (15)	18 (90)	21 (52.5)	0.016*
Minor occlusal correction	15 (75)	0	15 (37.5)	
Major occlusal correction	2 (10)	2 (10)	4 (10)	
Postoperative infection				
No infection	20 (100)	18 (90)	38 (95)	0.315
Infection present	0	2 (10)	2 (5)	
Incidence tooth damage				
No damage	19 (100)	16 (80)	35 (87.5)	0.055
Minor contact	1	4 (20)	5 (12.5)	
Postoperative sensory disturbance				
No disturbance	19 (95)	15 (75)	34 (85)	0.124
Disturbance present	1 (5)	5 (25)	6 (15)	
Vertical displacement of mandible				
No displacement	20 (100)	20 (100)	40 (100)	1.04
Displacement	0	0	0	
Feeling of plate after platting				
No feeling	19 (95)	18 (90)	37 (92.5)	0.450
Bad feeling	1 (5)	2 (10)	3 (7.5)	
Chewing efficiency after 1 week				
No difficulty	16 (80)	18 (90)	34 (85)	0.274
Difficulty present	4 (20)	2 (10)	6 (15)	

Discussion

According to Yadav S. *et al*. [6] who reported that (90%) of cases involving 3D locking plates involved men and (10%) involved women, the incidence of mandibular fractures in this research was (4:1) for men and (1:1) for women.

This study's low incidence of females may be explained by the fact that women in our nation don't engage in the same physical pursuits as men, are less likely to experience violence, and experience trauma less frequently overall. Road traffic was the primary etiologic factor in 90% of the cases of mandibular fractures in this research, which is in agreement with Yadav *et al*. [6] who reported that road traffic accidents were the etiological factor in 70% of cases. Additionally, Sadhwani and Anchlia [7] confirmed that the majority of cases in their research were caused by traffic accidents.

The surgical site was significantly reduced by using just one plate for stabilization at the superior and inferior borders of the symphysis/parasymphysis region, making 3D miniplate fixation an easy to use alternative to conventional miniplates. They came to the conclusion that the surgical stress was also significantly less. Another research by Balakrishnan *et al*. that examined the effectiveness of using 3D titanium miniplates for the management of mandibular fractures came to a similar conclusion. They came to the conclusion that 3D titanium miniplates were an effective treatment option for mandibular fractures, with the benefits of intraoral placement, reducing surgical time and trauma, and the additional benefit of straightforward techniques for bone adaptation [8].

In comparison to the mean operating time for 3D plates, which was 44.10 (SD = 4.25), the mean operating time for securing plates was more than 55.02 minutes (SD = 14.24), P= 0.0001. The reported incidence of infection with open reduction and internal fixation varied from 2% to 38%.[9]. Locking plate patients did not experience postoperative infection, but one patient (10%) in the 3D plate group did (P > 0.05), and this patient was treated with wound cleaning and antibiotics for five days.

In the locking system, the screw and plate thus fuse together to form a singular, rigid functional unit that no longer depends on the bone to plate interface for stabilization. The locking system combines two principles: first, it stops stripping of screws as well as movement and loosening of screws; second, it makes it easier to bend plates and reduces torsion or opening at the fracture site thanks to the fixator principle.

Because there is no pressure beneath the plate, the periosteum can expand and aid in the healing of fractures by preventing interference with the blood flow to the bone [10]. On the other side, 3D locking design principles rely on 3D miniplate system and locking system principles. First, shearing, vertical displacement, and bending are the main factors to be aware of when the mandible is functioning. The vertical bars that join the two horizontal bars in a 3D plate resist bending forces. Since the pressures are distributed over a surface area rather than along a single line by the plate's box configuration, it is more stable in three dimensions against torsion forces, vertical displacement, bending, and shearing forces. The 3D plate gets its moniker from this three-dimensional stability [11–15].

Conclusion

We came to the conclusion that the use of a non-compression unicortical 2 mm 3D mini plate is a better approach for an uncomplicated mandibular fracture in terms of operating time, the absence of the need for inter maxillary fixation, and the need for postoperative occlusal correction, while sharing a similar outcome profile in other parameters, such as infection rate, incidence of tooth damage, vertical displacement, and chewing difficulty.

References

1. Manson PN. Facial Injuries. In: McCarthy JG (ed). Plastic Surgery Vol. 2. Philadelphia: WB Saunders, 1990: 916-78.
2. Anwar M, Iqbal T, Malik SA. A Study on the Surgical Management of Mandibular Fractures by Different Treatment Modalities. Pak J Plast Surg. 2013; 2: 1-36.
3. Khan M. Management of Maxillofacial Trauma. AFID Dent Jr. 1998; 10: 18-21.
4. Mezitis M, Zachariades N, Rallis G. Anaudit of mandibular fractures treated by intermaxillary fixation, intraosseous wiring and compression plating. Br J Oral Maxillofac Surg. 1996; 34: 293-7.

5. Giri KY, Sahu P, Rastogi S, Dandriyal R, Mall S, Singh AP, *et al*. Bite force evaluation of conventional plating system versus locking plating system for mandibular fracture. J Maxillofac Oral Surg. 2015; 14:972-8.
6. Yadav S, Agarwal A, Singh S, Kumar S, Anand KR, Chhabra V. 3-D locking titanium miniplates in management of mandibular fracture; A prospective 64-67 clinical study. J Dent Specialities. 2015; 3: 64-7.
7. Sadhwani BS, Anchlia S. Conventional 2.0 mm miniplates versus 3-D plates in mandibular fractures. Ann Maxillofac Surg. 2013; 3: 154-9
8. Balakrishnan R, Ebenezer V, Dakir A. Three-dimensional titanium mini plates in management of mandibular fractures. Biomed Pharmacol J. 2014; 7:241-6.
9. Engroff SL, Blanchaert RH Jr., von Fraunhofer JA. Mandibulotomy fixation: A laboratory analysis. J Oral Maxillofac Surg. 2003; 61:1297-301.
10. Bouloux GF, Chen S, Threadgill JM. Small and large titanium plates are equally effective for treating mandible fractures. JOMS. 2012; 70:1613-21.
11. Kumar N, Malhan S, Mahajan S, Asi KS. Titanium miniplate osteosynthesis of mandibular fractures. IJDS. 2012; 1:21-4.
12. Melek LN, El Mahallawy AS, Sharara AA, Ezz El Din A, Nour El-Din AHM. Evaluation of the 3-Dimensional Thread lock plate in the management of mandibular angle fractures. Ph.D. Thesis. Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Alexandria University. 2014.
13. Parmar S, Meanat S, Raghani M, Kapadia T. Three dimensional miniplates rigid fixation in fracture mandible. J Maxillofac Oral Surg. 2007; 6: 14.
14. Khalifa ME, El Hawary HE, Hussein MM. Titanium Three Dimensional Miniplate versus Conventional Titanium Miniplate in Anterior Mandibular Fracture. LifeScience J. 2012;9: 1006-10.
15. Wittenberg JM, Smith BR, Trigg DD. Treatment of mandibular angle fractures with 3-D titanium miniplates. J Oral Maxillofac Surg. 1994; 52: 106.