



## THREE-DIMENSIONAL LOCKING PLATE AND CONVENTIONAL MINIPLATES IN THE TREATMENT OF MANDIBULAR ANTERIOR FRACTURES

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### ABSTRACT

**Objective:** This study was designed to evaluate the efficacy of 2-mm 3D locking miniplate in the management of anterior mandibular fracture and to compare it with Champy's miniplate. **Subjects and methods:** prospective, randomized, clinical trial was done on 30 patients complaining of mandibular anterior fractures They were divided into 2 equal groups. Group A: treated with 2mm 3D locking miniplates. Group B: treated with two conventional miniplates using Champy's principles of osteosynthesis. Postoperative follow up was done at 1 week, 4 weeks, 3 months. The patients were evaluated according to the outcomes of the study, that was working time, wound dehiscence, infection, segmental mobility, postoperative occlusion, need for postoperative IMF, need for plate removal, and radiological evaluation of reduction and fixation. **Results:** The average operating time required for group (A) was approximately 8.94 min less than that required for group (B). The postoperative radiographs showed excellent reduction in all cases, with alignment of the osseous borders of the mandible. There was no incidence of wound dehiscence, tooth damage, segmental mobility and nerve damage in either group. There was statistically non-significant difference between two groups regarding occlusion; occlusion was satisfactory in most cases of both groups. **Conclusion:** There was no major difference in terms of treatment outcome and both the systems are equally effective in anterior mandibular fracture treatment and provide sufficient rigidity often avoiding/decreasing the need for IMF.

**KEYWORDS:** 3D locking plate, Champy's miniplate, Anterior mandibular fracture

### INTRODUCTION

Over the years, the methods to treat mandibular fractures have undergone many refinements. Newer methods have been tried and older ones have had improvements. Two approaches to mandibular fracture fixation have evolved; one is rigid stabilization, proposed by Spiessl (1972)<sup>(1)</sup> and the other semi-rigid fixation, proposed by Champy et al.<sup>(2,3)</sup>. Both techniques have disadvantages,

as adaptation of the plate to bone is difficult and time-consuming with rigid fixation while fracture stability cannot be guaranteed with semi-rigid stabilization. A three-dimensional (3D) plate may overcome these shortcomings<sup>(4)</sup>.

Farmand and Dupoirieux<sup>(5)</sup> developed the concept of 3D miniplates whose shape is based on the principle of the quadrangle as a geometrically stable configuration for support. The basic form is

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quadrangular with  $2 \times 2$  hole square plate and  $3 \times 2$  or  $4 \times 2$  hole rectangular plate. The plates are adapted to the bone according to Champy's principles.

To overcome the disadvantages of loosening of hardware and need of perfect adaptation of traditional miniplate system, an internal Mini-Locking-System was developed in collaboration with the AO/ASIF-Institute <sup>(6)</sup>.

Three-dimensional miniplate gives 3D stability to the fractured segments during healing. Locking system does not allow screw loosening and alteration in bone alignment or occlusal discrepancies on screw tightening. Three-dimensional locking plates have been designed with the hypothesis that this will overcome the disadvantages of the both the systems and also advantages of both systems will be combined for the management of mandibular fractures.

## SUBJECTS AND METHODS

This study was conducted on 30 patients who were selected, and operated in the Oral and Maxillofacial surgery department, Sayed Galal University Hospital, Bab El Shaareya, Al-Azhar University, Cairo. 30 patients with symphyseal or parasymphyseal mandibular fracture; 27 patient were males, 3 females, their age ranged from (19 - 42) years were included in this study.

Study design was a prospective, randomized, clinical study. Inclusion criteria: 1) Patients with displaced anterior mandibular fractures. 2) Patients age ranged between (19:42) from both sexes. Exclusion criteria: 1) Comminuted fracture. 2) Patients with preoperative infection at the site of fracture. Selected patients were divided in two groups: Group (A): fixed with 3D locking miniplate (3x2 holes interconnected by vertical struts) [Modern techniques center, Nasr City, Cairo]. Group (B): fixed with 2 conventional miniplate [Modern techniques center, Nasr City, Cairo]. All patients informed about the details of the procedure and signed a written consent.

**Pre-operative evaluation:** Personal data: Name, age, sex, occupation, history of trauma, past dental history were recorded for each patient.

### Pre-operative examination:

- a. Palpation of the mandible intraorally for the presence of tenderness, tooth or bone segment mobility.
- b. Examination of occlusion: The status of occlusion was defined to be normal, slightly affected or severely affected according to the ability of the patient to close his mouth in maximum intercuspation and perform efficient mastication. Patients were radiographically assessed by: Panoramic radiograph.

### Preoperative preparation:

Debridement and suturing or dressing the soft tissue laceration were performed. Support of fractured bony segments by using arch bars or ivy loops or inter dental wiring or IMF screws.

### Operative procedures:

Under general anesthesia aseptic surgical technique was achieved. An intraoral mandibular vestibular approach was utilized. The incision extended about one inch each side away from the fracture line location. A mucoperiosteal elevator was used for reflection of the flap to expose the fracture line down to the inferior border of the mandible. The fractured segments were reduced using bone clamp then both the upper and lower jaws were closed and fixed to each other using the arch bar that was previously fixed on the teeth. The fracture segment was fixed: Group (A) we used 3D locking miniplates, Group (B) we used 2 conventional miniplates (Figure 1, 2). The flap was closed in layers using interrupted or continuous technique by a resorbable suture material as vicryl, in all cases pressure bandage was applied around the chin/submental area. Upon completion of the procedure, IMF was released and occlusion was verified.

### Intraoperative assessment:

The time consumed during surgery from starting the incision till the closure of the wound was recorded and calculated in the both group. Adequacy of fracture fixation was checked immediately after fixation by clinical manipulation.

### Post-operative evaluation:

Assessment of wound healing immediately after closure and up to day of removal of suture on the seventh day. Presence or absence of infection was noted. The occlusion was checked in maximal intercuspal position to ensure proper occlusal relationship and centralization. The changes in occlusion over the different observation periods were recorded. Postoperative radiograph was taken for each patient at 1 week, 4 weeks and 3 months. The status of reduction and alignment of bone segments was observed for each patient (Figure 3,4).

### Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.

## RESULTS

### Operating time (min):

Mean operating time (min) for Group A was  $54.13 \pm 4.07$  and for Group B was  $63.07 \pm 3.75$ . There was statistically a significant difference between the two groups Reading Mean Operating time (min). Group A showed a lower Mean Operating time than Group B (Table 1) (Figure 5).

### Occlusion:

There was statistically non-significant difference between the two groups Reading Occlusion. Both groups showed the same satisfactory occlusion (Table 2), (Figure 6).

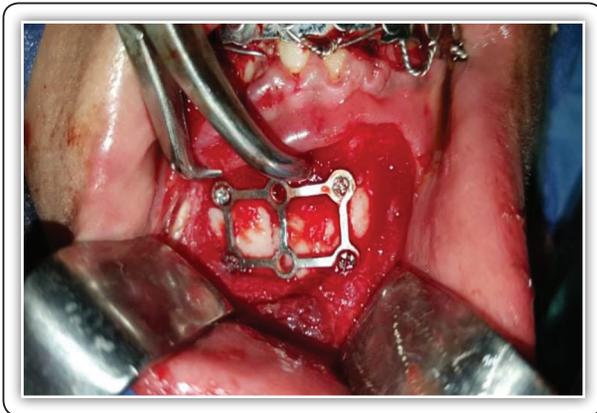


FIG (1): showing 3D locking miniplate.



FIG (2): showing 2 conventional miniplate.



FIG (3): Follow up radiograph in group (A).

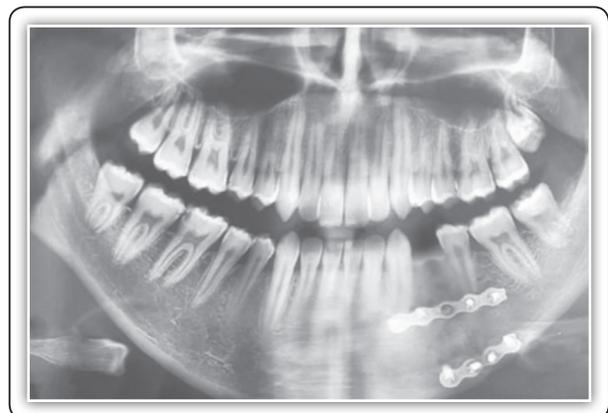


FIG (4): Follow up radiograph in group (B).

**TABLE (1):** Comparison between the two studied groups according to operating time

Operating time (min)	Group A (n = 15)	Group B (n = 15)	t	p
Min. – Max.	47.0 – 61.0	57.0 – 69.0		
Mean ± SD.	54.13 ± 4.07	63.07 ± 3.75	6.253*	<0.001*
Median	54.0	63.0		

**TABLE (2):** Comparison between the two studied groups according to occlusion

Occlusion	Group A (n = 15)	Group B (n = 15)	c <sup>2</sup>	p
<b>1<sup>st</sup> day</b>				
Mild	4 (26.7%)	4 (26.7%)	0.533	MC p=1.000
Moderate	1 (6.7%)	2 (13.3%)		
Satisfactory	10 (66.7%)	9 (60.0%)		
<b>1 week</b>				
Mild	2 (13.3%)	3 (20.0%)	0.340	FE p=1.000
Moderate	0 (0.0%)	0 (0.0%)		
Satisfactory	13 (86.7%)	12 (80.0%)		
<b>4 week</b>				
Mild	0 (0.0%)	0 (0.0%)	–	–
Moderate	0 (0.0%)	0 (0.0%)	–	–
Satisfactory	15 (100.0%)	15 (100.0%)	–	–
<b>3 months</b>				
Mild	0 (0.0%)	0 (0.0%)	–	–
Moderate	0 (0.0%)	0 (0.0%)	–	–
Satisfactory	15 (100.0%)	15 (100.0%)	–	–

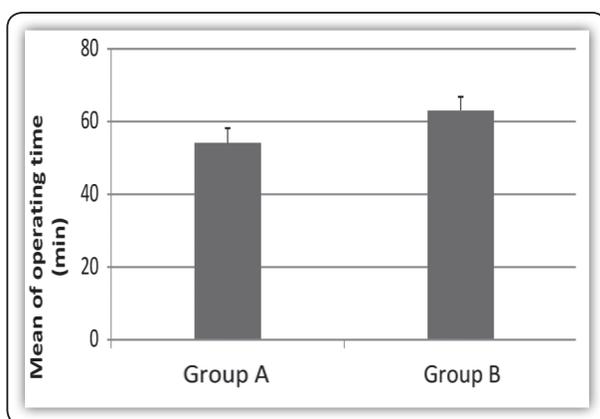


FIG (5): Comparison between the two studied groups according to operating time

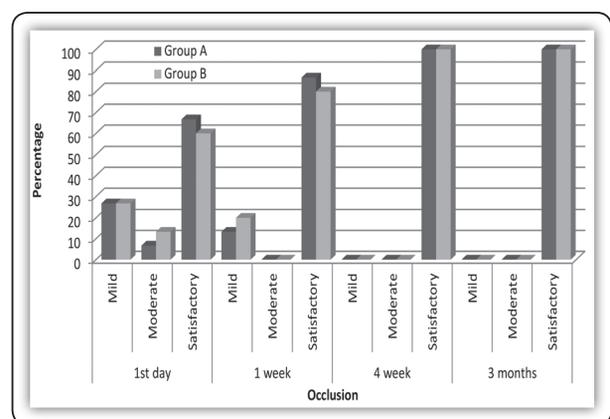


FIG (6): Comparison between the two studied groups according to occlusion

## DISCUSSION

The present study was designed with an aim of evaluating the efficacy of 2-mm 3D locking miniplates in the management of anterior mandibular fracture and to compare it with 2 conventional miniplates and to report the complications encountered during its use. In current study, 27 (90%) patient were males, 3 (10%) females and this is in accordance with Yadav et al<sup>(7)</sup> who reported in their study to evaluate 3D locking plate that (90%) of cases were males and (10%) were females.

The age of the patients in this study was in the range of 19-42 years with a mean of 29.8, this is in agreement with a study made by Sojat et al<sup>(8)</sup>. In this study, RTA were the main etiologic factor representing (73.33%) of cases followed by assaults (20%) and falls (6.67%) this is found to be in agreement with Yadav et al<sup>(7)</sup> who reported that Road traffic accident was the etiological factor in 70% of cases.

The average operating time required for group (A) was approximately 8.94 min less than that required for group (B). These findings were similar to the results of a study by Zix et al<sup>(9)</sup>. In our study there was statistically non-significant difference between two groups regarding occlusion, occlusion was 10 (66.7%) satisfactory in group (A) and 9 (60.0%) in group (B) at the first postoperative day. The occlusion became 100% satisfactory at the fourth postoperative week. Few patients with slightly occlusal derangement disappeared by instruction and selective occlusal grinding, there was no need for postoperative IMF in this study. This is in agreement with Agrawal et al<sup>(10)</sup>.

In this study, there was not any statistically significant difference between the two groups with respect to infection rates at the end of first week. The incidence of infection for group (A) was 2 (13.3%), for group (B) was 3 (20%). All cases treated by

antibiotics and all recovered at the end of first week. There was no incidence of wound dehiscence.

The postoperative radiographs showed excellent reduction in all cases, with alignment of the osseous borders of the mandible. In this study, none of the patients in either of the groups had nonunion, plate fracture, or loosening of plate and screws and there was no need for plate removal within the follow up period and this is in agreement with Agrawal et al<sup>(10)</sup> who reported that no such significant complications were noted in both conventional and 3D miniplates.

The results suggest that fixation of mandibular anterior fracture with 3D locking plates provides 3D stability, carries low infection rates and shorter operative time because of simplified adaptation to the bone and simultaneous stabilization at both superior and inferior borders. The 3D locking miniplate system may be considered inconvenient to use in cases of oblique fractures and in fractures involving the mental nerve area. The other probable limitations of these plates could be the excessive implant material due to extra vertical bars incorporated for counteracting the torque forces.

## CONCLUSIONS

Within the limitations of this study, the following conclusions can be drawn:

- 3) 3D locking plates provide the advantage of less operative time.
- 4) 3D locking plates are easier and quicker to place and less expensive than miniplates.
- 5) Precise adaptation of 3D locking plates is not required and does not affect their mechanical behavior.
- 6) 3D locking plates provide 3D stability because of its design in fixation of symphyseal and parasymphyseal fractures.

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