

Comparison of Yang's Keyhole Plate and Conventional 3D Plate Fixation for the Management of Mandibular Fracture

Priyanka Baruah*, Gagan Khare, Pallavi Srivastava, Ashish Kumar Kushwaha, Richa Singh, Ibsna Shamurailatpam

Department of Oral and Maxillofacial Surgery, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India

Abstract

Background: This study was undertaken to evaluate the comparison of Yang's keyhole plate versus conventional 3-dimensional plate fixation for the management of intraforamina mandibular fracture. **Materials and Methods:** This study was conducted in the department of Oral and Maxillofacial Surgery on ten patients which were divided into two groups of 5 each into group A and group B. In group A - open reduction internal fixation with conventional 3D plate. In Group B - open reduction internal fixation was done with Yang's keyhole plate and conventional 4 holes. The amount of reduction of lingual splay was evaluated using cone-beam computed tomography (CBCT) viewing occlusal surface preoperatively and 1st week post-operative day. The patient was clinically evaluated for occlusal stability, stability of fractured fragments, pain, swelling pre-operative, 1st, 3rd, and 6th weeks post-operatively following surgery. **Results:** The data were analyzed by Statistical Package for the Social Sciences (21.0 version). Data were not normally distributed (P -value was more than 0.05). No significant difference was seen in the mean inter-operative time taken by two groups when compared using independent test as $P > 0.05$. No significant difference was seen in the lingual splaying CBCT preoperatively among two study groups as $P > 0.05$. **Conclusion:** Authors concluded very important outcomes. Within the limitation of the study, it was concluded that that Yang's Keyhole plate and 3-dimensional plates are equally effective for clinical use in the management of intraforamina mandibular fracture. Furthermore, 3-dimensional plates and Yang's keyhole plate system fulfilled the treatment goals of adequate immobilization, fixation and stabilization of intraforamina mandibular fractures. In the present study, there were no complications between both the groups.

Keywords: Cone-beam computed tomography, Intraforamina mandibular fractures, Pain, Swelling, Yang's Keyhole plate.

INTRODUCTION

Face being the most admired point, defacement due to trauma or otherwise would greatly affect a person both bodily and psychologically. For this reason, any disfiguring trauma or defect to maxillofacial region needs urgent and skilled management.^[1,2] The cause of maxillofacial injuries varies from one country to another and even within the same country depending on the existing socioeconomic, cultural, and environmental factors. Due to increasing road traffic accidents, fractures of the mandible have been reported to account for 36–70% of all maxillofacial fractures. All reports apparently show a higher frequency in males aged 21–30 years.^[3,4] Trauma to the facial skeletal commonly results in injuries to the soft tissues, teeth, and major skeletal component of the face including the mandible, maxilla, zygoma, naso-orbitoethmoid complex, and supraorbital structures.^[5] Participation in the management and rehabilitation of the patient with facial trauma involves a thorough understanding of evaluation for surgical treatment of facial injuries. To handle post-surgical

immobilization different systems for the internal fixation of facial trauma was developed resulting in patients to resume function earlier.^[6,7] Rigid internal fixation is a gold standard for the treatment of fractures. A disadvantage of traditional rigid miniplate fixation is that the plates must be perfectly adapted to underlying bone to prevent the alteration in alignment of segments and changes in occlusal relationship.^[8-10] As per my knowledge, there is no literature available for the comparison of Yang's keyhole plate and conventional 3D plate for the management of intraforamina mandibular fracture. Therefore, the purpose of this study was to compare the effectiveness

Address for correspondence: Dr. Priyanka Baruah,

Department of Oral and Maxillofacial Surgery, Shree Bankey Bihari Dental College and Research Centre, Ghaziabad, Uttar Pradesh, India.

Phone: +91-9389455020.

Email: baruahpriyanka95@gmail.com

Received: Apr. 19, 2023; **Accepted:** Jun. 06, 2023; **Published:** Jun. 15, 2023

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How to cite this article: Baruah P, Khare G, Srivastava P, Kushwaha AK, Singh R, Shamurailatpam I. Comparison of Yang's Keyhole Plate and Conventional 3D Plate Fixation for the Management of Mandibular Fracture. J Res Adv Dent 2023;14(4):1-4.

Access this article online

Website:
www.jrad.co.in

DOI:
<https://doi.org/10.53064/jrad.2022.14.4.371>

of Yang's keyhole plates and conventional 3D plate for the management of intraforamina mandibular fractures.

The aim was to evaluate the comparison of Yang's keyhole plate versus conventional 3-dimensional plate fixation for the management of intraforamina mandibular fracture. Objectives were to observe the advantages and disadvantages of Yang's keyhole plate over conventional 3D plate fixation for the management of intraforamina mandibular fracture in terms of occlusal stability, ability of preservation of mental nerve by the use of Yang's keyhole plate in comparison to 3D plate, assess 3-dimensional fixation of the mandible in terms of lingual splaying using cone-beam computed tomography (CBCT) viewing occlusal surface, change in operative time, mobility of fracture segment, pain, and swelling.

MATERIALS AND METHODS

A randomized prospective study was conducted in the Department of Oral and Maxillofacial Surgery on ten patients with intraforamina mandibular fracture. Ethical clearance number was SBBDC/2020/152118-A (dated 22 December 2020). The patients were divided into two groups of 5 each into group A and group B. In Group A - Open reduction internal fixation with conventional 3D plate was done with square 4 hole with gap, non-locking plate. In Group B - Open reduction internal fixation was done with Yang's Keyhole plate and conventional 4 hole with gap, non-locking plate. The YK plate is a modification of a sliding plate. The holes through which screw heads can pass are included in the plate. The sliding plate consists of 2 circular holes and 1 pear-shaped hole, in which a free space is given to adjust the positional relationship of the mesiodistal bone segment. The amount of reduction of lingual splay was evaluated using CBCT viewing occlusal surface pre-operatively and 1st week post-operative day. The patient was clinically evaluated occlusal stability pre-operative, 1st, 3rd, and 6th weeks post-operatively following surgery. The amount of mouth opening and patient's ability to return to normal activities was recorded. The occlusion achieved after fixation of mandibular fracture was recorded and was evaluated for change and stability during the 1st, 3rd, and 6th weeks following surgery. Stability of fractured fragments was assessed based on the clinical evaluation at pre-operative, 1st, 3rd, and 6th weeks post-operatively by digital palpation. Pain was assessed using criteria given by *Garra G, Singer AJ, Domingo A, Thode HC. Swelling was assessed clinically using thread to the fix point at preoperative, 1st, 3rd, and 6th week postoperatively. Distance between these points referred as (Line A, Line B, and Line C) where Line A represents the distance between the lateral corner of the eye and the angle of the mandible (BE), Line B represents the distance between the tragus and the outer corner of the mouth (the lip commissure) (AC), and Line C represents the distance between the tragus and the soft-tissue pogonion (AD) [Figure 1].

Methodology for 3D Plate

Placement of Erich arch bar at the beginning of the procedure under local anesthesia 2% lignocaine adrenaline was done as



Figure 1: Post-operative first week occlusion

per requirement. Erich arch bar was adapted and secured with 24-gauge stainless steel wire. Exposure of the fracture site and anatomic reduction was done. Internal fixation at fracture site was done using 2 mm 3D miniplate system 4 holes. After fixing the plate, occlusion was checked. Patients were reviewed at post-operative period 1st week, 3rd week, and 6th week post-operatively. Post-operative CBCT was taken.

Methodology for Yang'S Keyhole Plate

Internal fixation at fracture site was done using the YK plate. It has a 2.0 mm hole in its front portion, through which a mini-screw head was passed, and two 2.0 mm holes in its rear portion, through which the plate was adapted and an additional oversized 2.5 mm head screw was inserted after a screw was first inserted into the bone segment. Conventional 4 holes with gap, non-locking plate systems which was placed superiorly require a precise adaptation of the plate to the underlying bone, by the frictional force between plate and bone. After fixing the plate, occlusion was checked. Patients were reviewed at post-operative period 1st week, 3rd week, and 6th week post-operatively.

RESULTS

The data were analyzed by the Statistical Package for the Social Sciences (21.0 version). Data were not normally distributed (P -value was more than 0.05). The mean age of patients in both the groups was calculated. No significant difference was seen in the mean age of two study groups when compared using independent t-test as $P > 0.05$. No significant difference was seen in the mean inter-operative time taken by two groups when compared using independent test as $P > 0.05$. No significant difference was seen in the lingual splaying CBCT preoperatively among two study groups as $P > 0.05$. No significant difference was seen in occlusion preoperatively among two study groups as $P > 0.05$. No significant difference was seen in the mobility of fractured segment preoperatively among two study groups as $P > 0.05$. No significant difference was seen in pain preoperatively among two study groups as $P > 0.05$. Intergroup comparison of interoperative time while shows about mobility of fractured segment - Group B wherein depicts about pain group B [Tables 1-3].

DISCUSSION

The mandible is the second most commonly fractured bone of the maxillofacial skeleton and the 10th most commonly

Table 1: Intergroup comparison of interoperative time

Parameters	Group	N	Mean	Standard deviation	Standard error mean
Intraoperative time	A	5	103.00	13.038	5.831
	B	5	115.00	28.062	12.550
P-value					0.411

Table 2: Mobility of fractured segment-Group B

Pre-operative	3 weeks	Total
	0	
1		
N	1	1
%	100.0	100.0
2		
N	4	4
%	100.0	100.0
Total		
N	5	5
%	100.0	100.0

Table 3: Pain Group B

Parameters	Mean	N	Standard Deviation	Standard error mean	P value
Pre-operative	8.00	5	1.414	0.632	0.001
1 week	4.40	5	1.673	0.748	
Pre-operative	8.00	5	1.414	0.632	<0.0001
3 weeks	1.20	5	1.095	0.490	
Pre-operative	8.00	5	1.414	0.632	<0.0001
6 weeks	0.40	5	0.894	0.400	

fractured bone in the whole body. It is a horseshoe-shaped bone occupying a very prominent and vulnerable position on the face.^[11,12] Because of its position and prominence, it is the vital structure for the survival of an individual to protect the airway, for the proper function of the stomatognathic system, and its ability to dissipate externally applied force in a fashion to prevent fatal brain injury.^[13-15] Techniques for the treatment of mandibular fractures have evolved significantly in the past decade. These techniques have ranged from closed reduction with maxillomandibular fixation (MMF), to open reduction with wire osteosynthesis, to open reduction with either rigid internal fixation or semi-rigid miniplate fixation.^[16,17] Rigid Internal Fixation was an unacceptable mode of therapy until 1958 because of the high rate of associated complications.^[18,19] Myriads of ideas and modalities have been tried and contemplated that the goal of treatment is to bring the ends of the fracture into their anatomically correct position with as much precision as possible and to ensure, by the means of appropriate fixation, that bony consolidation should take place in this position.^[20-22] Few authors observed hardware failure based on the clinical and radiographical for plate fracture and loose screws.^[23-25] It was evaluated as present/absent. In our

study, none of the patients developed infection and hardware failure in 3-D miniplates and Yang's keyhole plate. Other pioneer workers observed a study of children 7–12 years presenting with acute pain. Patients rated pain severity on the visual analog scale (VAS) with marked end points of “no pain” and “worse pain ever.” The most commonly selected face was the “hurts even more” face, which correlated with a mean VAS of 55 mm.^[26,27] There were few patients who selected the smiling, “no hurt” face. In our study, we questionnaire the patient and asked them to rate 0, 2, 4, 6, 8, and 10, at pre-operatively, 1st, 3rd, and 6th weeks post-operatively where rating was similar to recent workers.^[28] Most of the cases reported with a VAS score between 6 and 10 preoperatively. In 1st week, postoperative period VAS score was between 4 and 6 in both the groups. VAS score reduced significantly after 2nd week (2–0) in most of the cases. At 6th week post-operative, 2 patients complained of pain in both the groups, while opening and closing the mouth or while chewing. Highly significant ($P < 0.0001$) % of pain reduction was noted between two groups in our study however Yang's keyhole plate over 3-dimensional plate pain was observed less in Yang's keyhole plate. We summaries that both the 3-dimensional plate and Yang's Keyhole plate performed well clinically with good clinical parameters at the end of 6th week. Unlike the existing plate system, in the Yang's Keyhole plate, a screw is first inserted into a part of the displaced bone segment. Moreover, especially in patients with severe bone segment displacement, the bone segment should be reduced using an anchor screw or by drilling a hole using bone-holding forceps. However, when the Yang's Keyhole plate system is used, the trauma imposed on the bone can be reduced by first implanting a screw and using it as an anchor screw. In addition, for proper fixation after the bone segment reduction, a contra-angle handpiece and a driver should be used after the plate adaption and screw insertion to apply the maximum intraoral approach without an extensive incision. The pain and swelling were overall lesser, with Yang's Keyhole plate.

CONCLUSION

The study was primarily aimed at investigating the comparison between 3-dimensional plates and Yang's keyhole plate in its use in intraforamina mandibular fractures. Based on the finding of our study, the following conclusions were derived. Our study results indicated that Yang's keyhole plate and 3-dimensional plates are equally effective for clinical use in the management of intraforamina mandibular fracture. The 3-dimensional plates were better in terms of handling characteristics because of its small quadrangular size, additionally only four screws were required to fix the 3-dimensional plate rather than using eight screws in case of Yang's keyhole plate, considerably reducing the plate adaptation time. Our study also indicates significant difference in the distribution of pain and swelling of Yang's keyhole plate over 3-dimensional plate. The results we obtained suggest that 3-dimensional plates and Yang's keyhole plate system fulfilled the treatment goals of adequate

immobilization, fixation, and stabilization of intraforamina mandibular fractures. In the present study, there were no complications between both the groups. However, more detailed study using larger samples with long-term follow-up will help evaluate this system in the future.

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