EGYPTIAN DENTAL JOURNAL

VOL. 63, 2267:2274, JULY, 2017

I.S.S.N 0070-9484

ORAL SURGERY

www.eda-egypt.org • Codex : 148/1707

CONVENTIONAL TWO PLATE FIXATION VERSUS L-SHAPED PLATES IN MANAGEMENT OF MANDIBULAR ANGLE FRACTURE: A COMPARATIVE RETROSPECTIVE STUDY

Omnia I. Sultan * and Hussein Hatem **

ABSTRACT

Purpose: In mandibular angle fractures, various treatment modalities have been used to rigidly fix the fractured segments aiming to achieve healing through stability and bone formation. In this study, a comparison between two fixation techniques was implied; one L-shaped plate versus two horizontal plates superiorly and inferiorly placed respectively, in an attempt to assess their different effect on healing and complications.

Materials and methods: Sixteen patients suffering from displaced angle fractures were included in this study with a mean age of 42 years. The selected patients were divided into two equal groups; *Group A* employed the fixation of the fractured segments using one L-shaped plate and *Group B* used the conventional treatment method of utilizing two horizontal plates to fix the fragments in their normal position with subsequent immediate postoperative mandibular function. All the patients were followed-up at minimum period of evaluation of six months. Postoperative complications were recorded if present which included fragment mobility, changed occlusion, dehiscence, infection and/or parasthesia. Postoperative clinical assessment through pain evaluation via visual analogue scale (VAS; scale 0-10) and maximal non-assisted inter-incisal mouth-opening (MIO) measured in mm was performed. Plain radiographic views were performed for inter-fragment alignment assessment. Clinical readings were recorded immediately postoperative and on months 1 and 3. The collected clinical and radiographic findings were tabulated and statistically analyzed.

Results: The healing in all cases was uneventful and all patients showed clinical success with no sign of fragments mobility. All the data were analyzed by Mann Whitney U test to compare between the tested groups. Friedman test used to compare between follow up periods followed by Wilcoxon signedrank test for pair wise comparison. The clinical examination and the radiographic assessment revealed no statistically significant difference between the readings of both groups. Regarding the postoperative complications, better initial results came in favor of group A patients, however, with no difference between both groups at the end of the follow up period.

* Lecturer of Oral and Maxillofacial Surgery, Oral and Maxillofacial Surgery Department, Faculty of Dentistry, October University of Modern Sciences and Arts (MSA).

** Associate professor of Oral and Maxillofacial Surgery, Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Cairo University.

Conclusion: Despite of the displacement of the segments in mandibular angle fractures, this study stated that no significant benefit in MAF healing was seen when different plating techniques were used, under the condition of utilizing more than one plane in plate fixation. However, the one-plate L-shaped fixation technique presented fewer postoperative complications.

KEYWORDS: Mandibular Angle Fracture, Plate design, Inter-fragment stability

INTRODUCTION

Mandibular fractures (MFs) are the most-frequent injuries of all facial fractures[1-3]. The mandibular angle, in particular, is amongst the most frequent sites of these fractures [4-5].

Direct and indirect trauma to the facial bones may result in mandibular angle fracture (MAF). The main reported causes included inter-personal violence, motor vehicle accidents and falls [6-7].

The optimal treatment method of angle fractures remains controversial due to the many factors involved as; the specific site of the fracture, amount of displacement of the fractured segments, malocclusion and the patient's age [5,8].

Many treatment modalities have been proposed to rigidly and semi-rigidly align and fix the fractured segments. Although many studies have compared the competence of the standard plates and miniplates in the management of MAFs, the optimum treatment was not defined due to different plates' designs, small sample sizes, and other factors [9].

Anatomically, analyzing the tensile and compressive zones all over the mandible, and to clear the dilemma of tension band concept for the treatment of MFs, the ideal lines of osteosynthesis were studied to reach the basis of internal fixation of MFs [10-11].

In cases of mandibular angle fractures (MAFs), studies have verified that the best plating site is the vestibular bone located on the third molar region, in order to neutralize the muscular forces that act naturally to displace the fragments. It has also been suggested that the bone located down on the outer surface of the mandible, is strong enough to sustain the distracting forces on the fractured segments resulting from the masticatory forces [10-11].

The miniplate osteosynthesis was first introduced in 1973 and was further developed by ***Champy*** in 1975 to be considered as a standard surgical treatment of MAFs [12].

Champy et al [13] developed a technique which has been documented to have low complication rates, in which a single non-compression miniplate was placed on the oblique line in MAFs. However, the stability of single miniplate in MAF has been questioned in different biomechanical studies [10,14].

Some surgeons stated that the use of one standard miniplate at the external oblique ridge in cases of MAF, allowed for the medial-lateral displacement of the fragments at the inferior border due to torsion and bending forces, leading to the opening of the fracture line at the inferior border with subsequent postoperative complications [15].

In the angle region, where powerful elevator muscles apply their action, strong distractive forces emerge where the mandibular body and the vertical rami meet. Accordingly, this needed a stronger fixation device to counteract these forces. A two plate fixation technique was customary used; on the inferior and superior borders of the angle, to counteract these distractive forces and rigidly fix the fractured segments [16].

Further studies lead to the development of the so called "three dimensional (3-D)" titanium plates and screws. One of the advantages of this is the simultaneous stabilization of the tension and compression zones, rendering the segments

more stability than with conventional horizontal miniplates. The introduction of the quadrangular miniplates proved beneficial in the stabilization of the fractured segments in MAF's.

In the same way, L-shaped plates rendered the reduction and stronger fixation of the fractured segments at both the posterior and inferior mandibular borders using vertical and horizontal planes perpendicular to the placed screws. They also ensured the early restoration of mandibular function and reduced the incidence of infection at the fracture site postoperatively [16].

Vineeth et al [15] stated that the titanium plates dealing with these planes showed superior primary inter-fragmentary stability over single titanium miniplates. Moreover, *In vitro* studies suggested that these plates had a profitable biomechanical behavior over the other well established fixation techniques [16].

In general, the success of any treatment modality in MFs will relate directly to the inter-fragmentary stability and the incidence of the postoperative complications. The failure to achieve a stable state in the right anatomical relation to enable the undisturbed healing could result in malocclusion, infection, dehiscence or nonunion [17].

In an attempt to delineate a more efficient treatment modality with the least postoperative complications, this study was designed to address the difference between two plating techniques in MAFs; L-shaped plates versus the standard two-plate fixation, regarding their effect on segments' stability and postoperative complications.

PATIENTS AND METHODS

The present study was undertaken in the departments of oral and maxillofacial surgery, faculty of Dentistry, Cairo University and MSA University, after obtaining the ethical clearance and a written consent from each patient.

Inclusion criteria

Sixteen patients were included in this study with a mean age of 42 years with a history of facial trauma. They all had a displaced mandibular angle fracture which required management through surgical interference. All the patients needed open reduction and internal fixation of the fractured segments.

All the selected patients were medically free from any systemic disease that can affect their bone reparative power.

Patient grouping:

The selected patients were divided into two groups, eight patients each;

Group A employed the fixation of one L-shaped plate and *Group B* used the conventional horizontal plates to fix the fragments in their normal position with subsequent immediate postoperative mandibular function.

Preoperative assessment:

Clinically, the patients reported malocclusion with a restriction in mouth opening which reflected facially as swelling and asymmetry.

Preoperative panoramic radiographs were performed to reach the exact diagnosis, to exclude any hidden pathologic lesion and identify adjacent vital structures.

Surgical procedure:

Under general anesthesia with naso-tracheal intubation, all patients were subjected to open reduction to expose the fracture line through submandibular surgical approach.

The incision was performed 1.5 to 2 cm inferior to the mandible through skin and subcutaneous layers. The platysma was divided and careful dissection through the superficial layer of deep cervical fascia was done to avoid injury of the important vital structures encountered; the facial vessels and marginal mandibular branch of facial nerve.

Muscle stripping and bone exposure allowed fracture line approximation through bone clamps to align the fractured segments in their original normal positions with the aid of intra-operative maxilla-mandibular fixation (MMF) whenever needed.

In *Group A* patients, the incision was extended upwards to allow for the insertion of the L-shaped plate along the posterior and inferior borders of the mandible along the compression zone and over the fracture line. While, in *Group B* patients, two horizontal plates were placed over the fracture line along the compression and the tension zones; the inferior and superior borders respectively, of the angle of the mandible. (Figure 1).

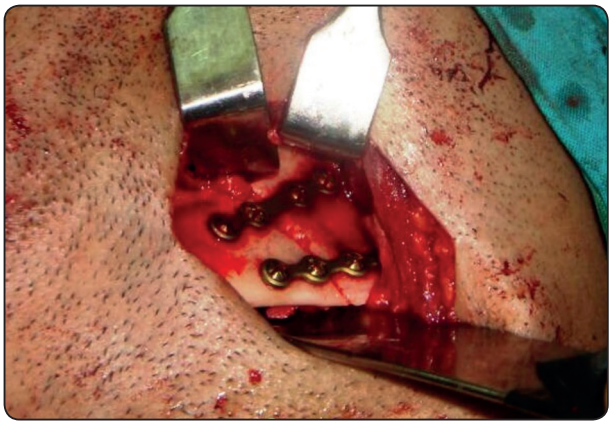

Fig. (1) A photoradiograph showing the surgical exposure and plate fixation.

Soft tissue closure in layers was performed and MMF was removed to allow the complete postoperative mandibular function. Postoperative antibiotics and analgesics were prescribed for the patients for 5 days. Sutures were removed 5 days postoperatively.

Postoperative assessment:

All the patients were followed-up at minimum period of evaluation of six months. Clinical readings were recorded immediately postoperative and on months 1 and 3.

Clinical evaluation included; pain measurement through visual analogue scale (VAS; scale 0-10) and maximal non-assisted inter-incisal mouth-opening (MIO) measured in mm. Postoperative complications were recorded if present which included fragment mobility, changed occlusion, dehiscence, infection and/or parasthesia.

Plain radiographic assessment was performed via panoramic radiographic views to ensure bone healing through the assessment of the inter-fragmentary alignment and healing. (Figure 2,3)

The collected clinical and radiographic readings were tabulated and statistically analyzed.

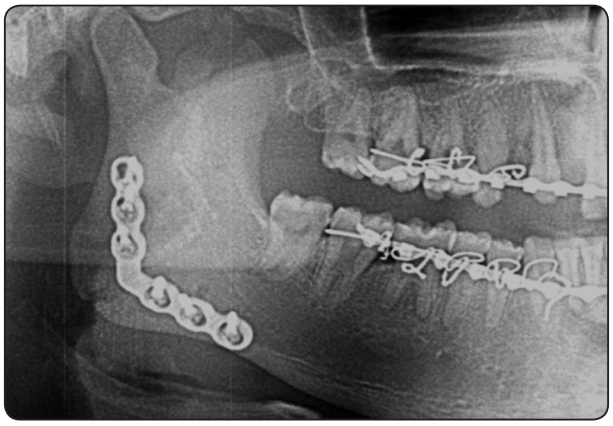

Fig. (2) A photoradiograph showing the postoperative inter-fragmentary alignment in Group A.

Fig. (3) A radiograph showing the postoperative inter-fragmentary alignment in Group B.

RESULTS

The healing in all cases proceeded uneventful. The resultant postoperative pain and swelling were tolerable and considered normal. After at least 6 months of follow up, all patients were clinically content and mandibular function was rendered satisfactory. (Table 1,2)

Initial postoperative pain and mouth opening restriction was evident which resolved eventually. Over the study period, the clinical examination and the radiographic assessment revealed no statistically significant difference between the readings of both groups. Regarding the postoperative complications, better initial results came in favor of group A patients, however, with no difference between both groups at the end of the follow up period.

At the end of the follow up period, the clinical and radiographic readings of both groups were comparable and the healing was complete. (Figure 4)

Mann Whitney U test used to compare between tested groups. Friedman test used to compare between follow up periods followed by Wilcoxon signedrank test for pair wise comparison. Significant level set at p≤0.001*.

TABLE (1) Showing pain Analogue Scale (VAS) for the tested groups.

		Groups				p-value
		Group A		Group B		
		Mean	SD	Mean	SD	
Pain analogue scale (VAS)	Immediate	7.13[a]	.99	7.25[a]	1.04	0.798 NS
	1 Month	3.25[b]	.71	3.63[b]	.74	0.442 NS
	3 Months	.88[c]	.64	1.00[c]	.53	0.721 NS
p-value		≤0.001*		≤0.001*		

TABLE (2) Showing the Maximal Inter-Incisal Opening (mm) for the tested groups.

		Groups				p-value
		Group A		Group B		
		Mean	SD	Mean	SD	
Maximal Inter-Incisal Opening (mm)	Immediate	28.25[a]	1.98	27.88[a]	1.36	0.665 NS
	1 Month	36.13[b]	1.96	35.25[b]	1.58	0.342 NS
	3 Months	39.38[c]	1.77	37.88[c]	1.55	0.093 NS
p-value		≤0.001*		≤0.001*		

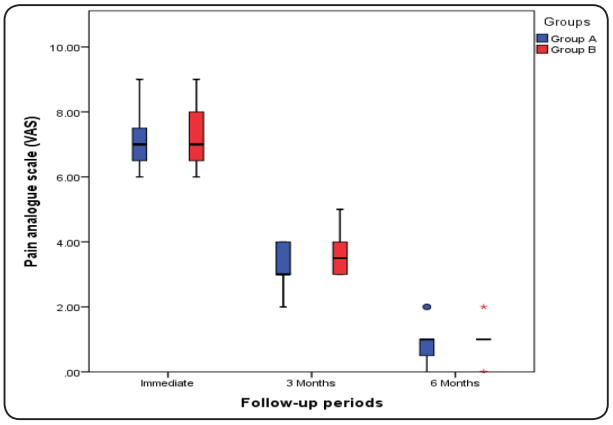

Fig. (4) Box Plot of the VAS Score for different tested groups

DISCUSSION

Many factors influence the choice of the treatment method for angle fractures, including age of the patient, displacement degree, other concomitant facial fractures, and malocclusion.

Some authors advocate the more 'conservative' management by intra-oral fixation of one plate on the "***Champy's***" line to avoid the risk of facial nerve injury, avoid the facial scar, and reduce postoperative morbidity and pain [13,18-19].

However, the literature remains to support the rigid fixation as a line of treatment of displaced MAFs through the placement of two plates, over the compression and tension zones respectively, for strong stabilization and secured union [10-11].

Recently, 3-Dimensional geometry of the recent plates assured the stability of the fractured segments as it offers good resistance against torque, tensile and compressive forces [20]. Similarly, this study used the L-shaped plates, which utilizes more than one plane of fixation, to counteract the muscular forces and the resultant load from mastication. This was in agreement with ***Yong Liu et al*** [18] who found that 3D quadrangular miniplates significantly reduced the incidence of malocclusion and hardware failure.

Our clinical examination revealed the high immediate postoperative pain sensation which resolved over time in the follow-up period. This was interpreted as a normal reaction to the surgical interference and the resultant wound from the open reduction at the fracture site.

The readings of this study detected the initial restriction of mouth opening which improved along the follow-up visits. This was in accordance with ***El-Anwar et al*** [21] and ***Sorel B*** [22] and it may be attributed to the inability of the patients to open their mouths fully due to the muscular re-attachment and pain from the healing soft tissue wound.

In this study, no statistically significant difference between both groups was detected which proved the equivalent two lines of treatment. This came in accordance with ***Alkan et al*** [16] who confirmed the advantageous plate fixation techniques which employs two planes of fixation in terms of inter-fragmentary stability and biomechanical behavior.

Regarding the postoperative complications, even though studies didn't prove a statistically significant difference between the mentioned techniques, the superior inter-fragmentary stability found with the use of 3D miniplate fixation in the management of MAFs may have had an influence on the lower rates of some postoperative complications [11].

Accordingly, in this study, the reported incidence of wound dehiscence in both groups was insignificant. It was not seen with the L-shaped plate as it was covered by the masseter muscle buccaly, well away from the surgical incision. On the other hand, it was rarely seen in the superior plate in the two-plate fixation technique due to its proximity to the thin oral soft tissues, when placed on the external oblique ridge.

No statistically significant difference in the incidence of parasthesia was observed between the two techniques. This came in agreement with most of the studies which did not declare whether the parasthesia was present before surgery or due to the surgery itself, because of the established fact

which states that the main causative factor of nerve affection in MAFs is the degree of displacement of the segments [11]. This was confirmed by other studies which did not detect any pronounced difference between various treatment methods with regard to the outcomes of infection, nonunion, and paresthesia [23].

CONCLUSION AND SIGNIFICANCE

Different rigid fixation plates have long been used for different hypothesis regarding fixation of MAFs. This study stated that no significant benefit in MAF healing was seen when different plating techniques were used, under the condition of utilizing more than one plane in plate fixation. However, the one-plate L-shaped fixation technique presented fewer postoperative complications.

The need to include more architectural plate designs in an experimental study is evident in order to statistically verify small differences on a biomechanical level.

REFERENCES

1. Brasileiro BF, Passeri LA. Epidemiological analysis of maxillofacial fractures in Brazil: a five-year prospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:28–34
2. Fasola AO1, Nyako EA, Obiechina AE, Arotiba JT. Trends in the characteristics of maxillofacial fractures in Nigeria. J Oral Maxillofac Surg 2003; 61: 1140–3.
3. Fasola AO, Obiechina AE, Arotiba JT. Incidence and pattern of maxillofacial fractures in the elderly. Int J Oral Maxillofac Surg2003;32:206–8
4. Gassner R, Tuli T, Hach O, Rudisch A, Hide HU. Cranio-maxillofacial trauma: a 10 year review of 9543 cases with 21067 injuries. J Craniomaxillofac Surg 2003; 31: 51–61.
5. Assael LA. Open versus closed reduction of adult mandibular condyle fractures: an alternative interpretation of the evidence. J Oral Maxillofac Surg 2003; 61: 1333–9.
6. Matos FP, Arnez MFM, Sverzut CE, Trivellato AE. A retrospective study of mandibular fracture in a 40 month period. Int J Oral Maxillofac Surg 2010;39:10–5
7. Sawazaki R, Lima-Junior SM, Asprino L, Moreira RWF, Moraes M. Incidence and patterns of mandibular condyle fractures. J Oral Maxillofac Surg 2010; 68: 1252–9.
8. Villarreal PM, Monje F, Junquera LM, Mateo J, Morillo AJ, González C. Mandibular condyle fractures: determinants of treatment and outcome. J Oral Maxillofac Surg 2004; 62: 155–63.
9. Zix J, Lieger O, Iizuka T. Use of straight and curved 3-dimensional titanium miniplates for fracture fixation at the mandibular angle. J Oral Maxillofac Surg. 2007; 65(9):1758–63.
10. Chrcanovic BR. Fixation of mandibular angle fractures: in vitro biomechanical assessments and computer-based studies. Oral Maxillofac Surg 2013; 17: 251–68.
11. Al-Moraissi E.A, El-Sharkawy T.M., El-Ghareeb T.I., Chrcanovic B.R.: Three-dimensional versus standard miniplate fixation in the management of mandibular angle fractures: a systematic review and meta-analysis. Int. J. Oral Maxillofac. Surg. 2014; 43: 708–716.
12. Champy M, Wilk A, Schnebelen J. Die Behandlung der. Mandibular-frakturen mittels Osteosynthese ohne intermaxillare Ruhigstellung nach der Technik von FX Michelet. Zahn Mund Kieferheilkd Zentralbl. 1975; 63(4):339–41.
13. Champy M, Lodde JP, Schmitt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. J Maxillofac Surg 1978; 6: 14–21.
14. Chrcanovic BR. Fixation of mandibular angle fractures: clinical studies. Oral Maxillofac Surg 2012. [Epub ahead of print].
15. Vineeth K, Lalitha RM, Prasad K, Ranganath K, Shwetha V, Singh J. A comparative evaluation between single non-compression titanium miniplate and three dimensional titanium miniplate in treatment of mandibular angle fracture—a randomized prospective study. J Cranio maxillofac Surg 2013; 41: 103–9.
16. Alkan A, Celebi N, Ozden B, Bas B, Inal S. Biomechanical comparison of different plating techniques in repair of mandibular angle fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007; 104: 752-6.
17. Moore E, Bayrak S, Moody M, Key JM, Vural E. Hardware removal rates for mandibular angle fractures: comparing the 8-hole strut and Champy plates. J Craniofac Surg 2013; 24: 163–5. 21.

18. Singh V, Puri P, Arya S, Malik S, Bhagol A. Conventional versus 3-dimensional mini-plate in management of mandibular fracture: a prospective randomized study. Otolaryngol Head Neck Surg 2012; 147: 450–5.

19. Barry CP, Kearns GJ. Superior border plating technique in the management of isolated mandibular angle fractures: a retrospective study of 50 consecutive patients. J Oral Maxillofac Surg 2007; 65: 1544–9.

20. Sadhwani Bipin S. Conventional 2.0 mm miniplates versus 3-D plates in mandibular fractures. Annals of Maxillofacial Surgery 2013; 3: 2.

21. El-Anwar MW, El-Ahl S and Amer HS. Open reduction and internal fixation of mandibular fracture without rigid maxillamandibular fixation. Int Arch Otorhinolaryngol 2015; 19: 314.

22. Sorel B. Open versus closed reduction of mandible fractures. Oral Maxillofac Surg Clin North Am. 1998; 10: 553.

23. Yong Liu and Bo Wei et al. The 3-dimensional miniplate is more effective than the standard miniplate for the management of mandibular fractures: a meta-analysis. European Journal of Medical Research 2017; 22:5.