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INTRAORAL FIXATION OF MANDIBULAR ANGLE FRACTURES USING SUPERIOR BORDER 2.3 PLATE VERSUS 2.0 MONOCORTICAL PLATE UTILIZING CHAMPY'S CONCEPT

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ABSTRACT

Background and objective: The purpose of this study was comparing the treatment outcomes between the rigid intraoral fixation using a superior border 2.3 plate versus 2.0 semirigid intraoral fixation via Champy technique for management of fractures of the angle of the mandible.

Materials and Methods: Twenty patients were divided into 2 equal groups. Patients in both groups open reduction and internal fixation (ORIF) via an intraoral approach. In the study group, fixation at the fracture site was achieved via 2.3 superior border plate. In the control group, fixation at the fracture site was achieved by 2.0 superior ridge plate via Champy technique. Each patient was assessed in terms of fracture segment reduction, malocclusion, wound dehiscence, and fixation failure.

Results: Both groups achieved contemporaneous skeletal stability, with little variation in the evaluation standards. However, the study group showed the advantage of better fracture segment reduction as shown by CBCT in comparison to the control group.

Conclusion: Rigid superior border fixation showed superiority in terms of fracture segment reduction in angle fractures, although the plate is not low in profile as the 2.0 used in the Champy technique group, no plate exposure or wound dehiscence was noted.

KEYWORDS: Mandibular angle fracture, Champy, rigid fixation, ORIF, superior border.

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INTRODUCTION

The strongest and stiffest bone in the skeleton of the face is the mandible. However, because of its uniqueness and prominence, it accounts for 23% to 42% of facial bone fractures and is the most often broken bone in maxillofacial trauma..[1–3] When it comes to the mandible itself, angle fractures make up 30% of all mandibular fractures and are the most common type.[4] Most of these fractures are caused by motor vehicle accidents or acts of interpersonal aggression. Mandibular fractures can also result from falls, sports- or work-related injuries, gunshot wounds, and pathologies. Men are more likely than women to sustain fractures, which are commonly linked to alcohol use.[5]

Anatomically speaking, the mandibular angle is a triangular area where the superior edge is the point where the vertical ramus and horizontal body converge, which is typically where the third molar is or was. a slanted line connecting the masseter muscle's posterior superior attachment to the third molar area forms the posterior boundary of the triangle, while the anterior border is formed by the masseter muscle.[6] A critical area in bearing masticatory forces during mastication, improper treatment would lead to malocclusion, mandibular deviation and limitation of mouth opening, all of which would greatly compromise the affected individual's quality of life. [7]

The literature explained many classifications for angle fractures as well as other mandibular fractures. Labelled as open or closed according to their relation to the external environment, simple or comminuted according to the fracture line(s) multiplicity as well as favorable or unfavorable according to the action of the related muscles which in this case are the medial pterygoid and muscle to approximate or displace the proximal and distal segments. [8]

As there are different classifications for mandibular angle fractures, there are different ways for management of such fractures as for most maxillofacial bone fractures. The standard options for treatment include either closed reduction via maxillomandibular fixation (MMF) which takes about 4 to 6 weeks to achieve healing, or open reduction and internal fixation (ORIF) with or without MMF. MMF avoids surgical intervention in addition to incisions and hardware possible complications. However, MMF application creates obstacles for the patients' concerning health and the incapacity to speak, which can result in inadequate nutrition, slowed wound healing, and weight loss and improper communication through speech compromise.[9]

ORIF provides the prime advantage of achieving primary bone healing and avoiding the need for MMF. Internal fixation should be positioned to prevent damage to the tooth roots and underlying mandibular canal.[10] Fortunately many options are available for ORIF including ; wire osteosynthesis, [11] a single superior border plate,[12] a superior ridge plate via Champy technique, [13] a single inferior border plate, [14] reconstruction plate placed along the inferior border of the mandible and fixated with bicortical screws [15], a bicortical lag screw, [16] , 3D plating, [17] or the use of 2 plates where a bicortically screwed plate is placed close to or at the mandibular inferior border and a four-hole monocortical tension band superiorly just beneath the teeth roots,[18] this option is the most recommended by the AO/ASIF (Arbeitgemeinshaft fur Osteosynthesefragen/ Association for the Study of Internal Fixation).

The AO/ASIF theorized that the premise behind treating mandibular angle fractures is to offer a superior tension band and an inferior compression band at the angle. At the superior border, which is perpendicular to the fracture line, there are forces that are present to cause displacement. Resistance to these displacement pressures can be achieved by positioning a superior border plate. Enough stability at the fracture site must be provided by the fixing

technique to promote appropriate healing and a low rate of complications.

Throughout the period between the late 70s and early 80s of the 20th century, Champy and his associates after establishing through multiple biomechanical studies the notion of the "ideal lines of osteosynthesis", documented a single monocortical plate placed along the mandibular angle's superior ridge as part of an internal fixation procedure.[19,20] The plates can be applied intraorally and MMF may be used for a little time following fixation or waived all together. Champy technique provides the advantage of using low-profile monocortical plates allowing precise adaptation of the bone segments allowing the surgeon to use the least amount of hardware required to use monocortical screws, which present relatively little risk to the inferior alveolar nerve (IAN) and mandibular canal, to stabilize the fracture against predictable stress patterns. Furthermore, their application via the easier intraoral approach helps the surgeon to reduce the risk to the facial nerve and avoid making a major incision in the skin. Yet, Champy technique for angle fractures is considered a semi – rigid fixation not allowing for primary bone healing. [21] Also, the is almost always a lack in inferior border alignment and dependence on bone remodeling mechanisms for a more favorable radiographically anatomically aligned segment.

On the other hand, the application of true rigid internal fixation of mandibular angle fractures not only abolishes the necessity of MMF and allows immediate return to function through providing optimum skeletal stability to the fractured segments while minimizing the risk of displacement postoperatively, but also simplifies steady anatomic reduction and leads to true primary bone healing along the length of the fracture line.[22]

The aim of this study was to compare treatment outcomes between rigid intraoral fixation using a superior border 2.3 plate versus the semirigid intraoral fixation via Champy technique for the management of mandibular angle fractures.

MATERIALS AND METHODS

Materials

a. Study group

Rigid 2.3, 6-hole plates at the superior border.

b. Control group

2.0 6-hole monocortical miniplates with space utilizing Champy's concept.

Study population

Twenty patients were selected suffering from unilateral mandibular angle fracture. Each patient's medical history and comprehensive examination data were gathered on a chart created especially for this study. Preoperative panoramic x-rays and 3DCTs were ordered for each patient for accurate diagnosis and measurement of the degree of segment displacement, any preoperative complaint of lip paresthesia was recorded. Medical consents were obtained, and treatment was described to each patient.

Methods

Surgical technique:

The procedures were performed while patients were nasotracheally intubated and under general anesthesia. Scrubbing of the patients was done using betadine surgical scrub and draping was carried out in the standard fashion. Local anesthesia used was Articaine 4% with 1:100000 adrenaline solution for hemostasis. An intraoral incision was made at the anterior border of the ramus but not higher than the occlusal plane, then it was carried down the external oblique ridge (EOR) on the lateral crest of the alveolus to the vestibular region of the lower second molar, Care was taken to leave 5 to 10 mm of the free gingiva attached to allow easy tensionless

approximation of the tissues during suturing. The periosteum was reflected laterally to expose the fracture line down to the inferior border of the mandible. Maxillomandibular fixation (MMF) was applied via inter maxillary fixation (IMF) screws and plating was continued in both groups. In the study group, plate fixation was achieved using a 6-hole 2.3 plate at or just lateral to the superior border, with three 2.3 screws in each of the distal and proximal fracture segments. Screws were placed in a right-angle to the plate through a direct intraoral access. In the control group, the 6-hole 2.0 plate with space was bent in a 90° plane using plate pliers to allow for proper plate adaptation, with 3 holes at the upper part of the EOR of the proximal segment and 3 holes just lateral to it on the distal segment. Screws were inserted in a perpendicular direction to the plate and screwed tightly in position. After which, MMF was released in both groups to validate the patients correct pre-trauma occlusion. Irrigation of the surgical field was done with saline solution, wound edges were approximated, and the site was primarily sutured with an absorbable 4/0 vicryl suture. Antibiotics, anti-inflammatory drugs, and analgesics were prescribed. Patients in both groups were recalled 3 days after surgery for follow-up and wound irrigation.

Clinical data

Fracture segment reduction, mandibular range of motion, occlusion, and wound healing together with additional issues like infection or was assessed for every patient.

Radiographic data

Radiographic follow-up was achieved through 3DCTs which were ordered immediately postoperatively to check the location of plates and screws. Fracture segment reduction was assessed and traced using mimics software ® comparing the pre and postoperative 3DCTs and evaluating the degree of reduction between the distal and proximal fracture segments.

RESULTS

A sum of 20 patients were diagnosed with mandibular angle fracture. Four of them had isolated angle fractures on their right side while the other sixteen had isolated angle fractures on their left side. Six patients had the fracture as a result of a fall, five due to motor vehicle accidents and nine due to interpersonal assault. All patients were males with a mean age of 28 years. All surgeries went uneventful, and all patients showed perfect return to the pre-trauma occlusion except for 3 patients in the control group where they required placement of guiding elastics for 2 weeks. In the study group, no complications were noticed in any patient while in the control group, one patient showed signs of infection however no inter fragment mobilization was detected, infection was treated by extension of IM antibiotics and wound irrigation. There was no significant difference between all complications between the 2 groups.

3DCT was obtained for each patient postoperatively, gap distance was evaluated by defining points at superior border and inferior border on both the medial and lateral surfaces of the fractured segments to measure the degree of reduction achieved after fixation was done in each group

Statistical analysis of data was conducted using IBM SPSS statistics, Microsoft Office excel, and Visual Basic. Normality test was done using Wilcoxon Sum Rank test and data was found to be non-parametric data of abnormal distribution. Mann-Whitney U Test was used to analyze the test statistic and compare the medians between the 2 independent groups to evaluate the chance of occurrence of the extreme value ranked at 42, the p-value was found to be ≤ 0.05 indicating a strong statistically significant difference between the 2 groups and the less likely chance of occurrence of an extreme value as the U statistic that equaled 42.

TABLE (1) Comparing both groups regarding the inter-fragmentary gap indicating the amount of reduction mean rank measured at 40 points for each group

Group	Count points	Sum of Ranks	Mean Rank	Median	U	p-value
Champy technique (Control)	40	862	21.55	0.82	42	0.000000000000301
Superior border rigid plate (Study)	40	2378	59.45	4.525		
p-value level of significance is set at ≤0.05						

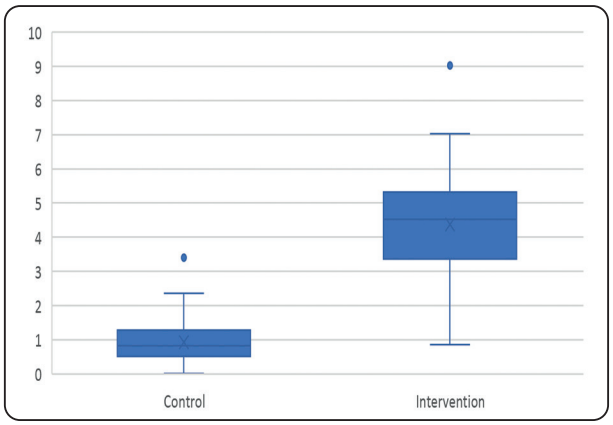

Fig (1) Box plot comparing median and ranges of both control and study groups

Gap distance was evaluated by defining points at superior border and inferior border at medial and lateral surfaces of the fractured segments. A statistically significant difference between the amount of reduction achieved between the 2 groups, showing greater reduction and less gaping in favor of the study group. The median of the control group and the study group was 0.82 and 4.525 respectively. Mouth opening returned to the normal pre-traumatic ranges according to the patients' reports with a maximum mouth opening showing a mean value of 38.5 and 38.1 for the study and control groups respectively

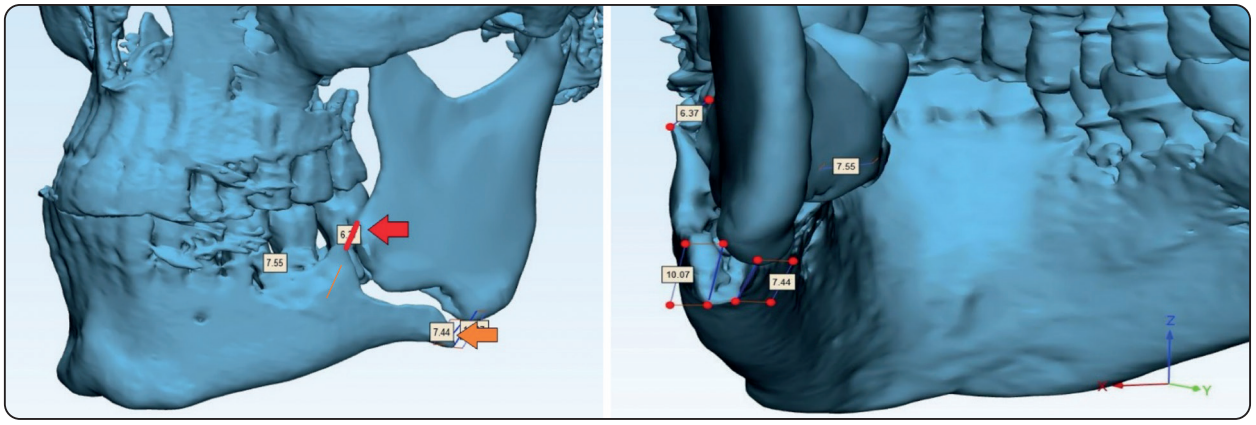

Fig. (2) Preoperative CT in the study group viewing the angle fracture with the superior displacement (red arrow) and the anteroposterior gap (orange arrow)

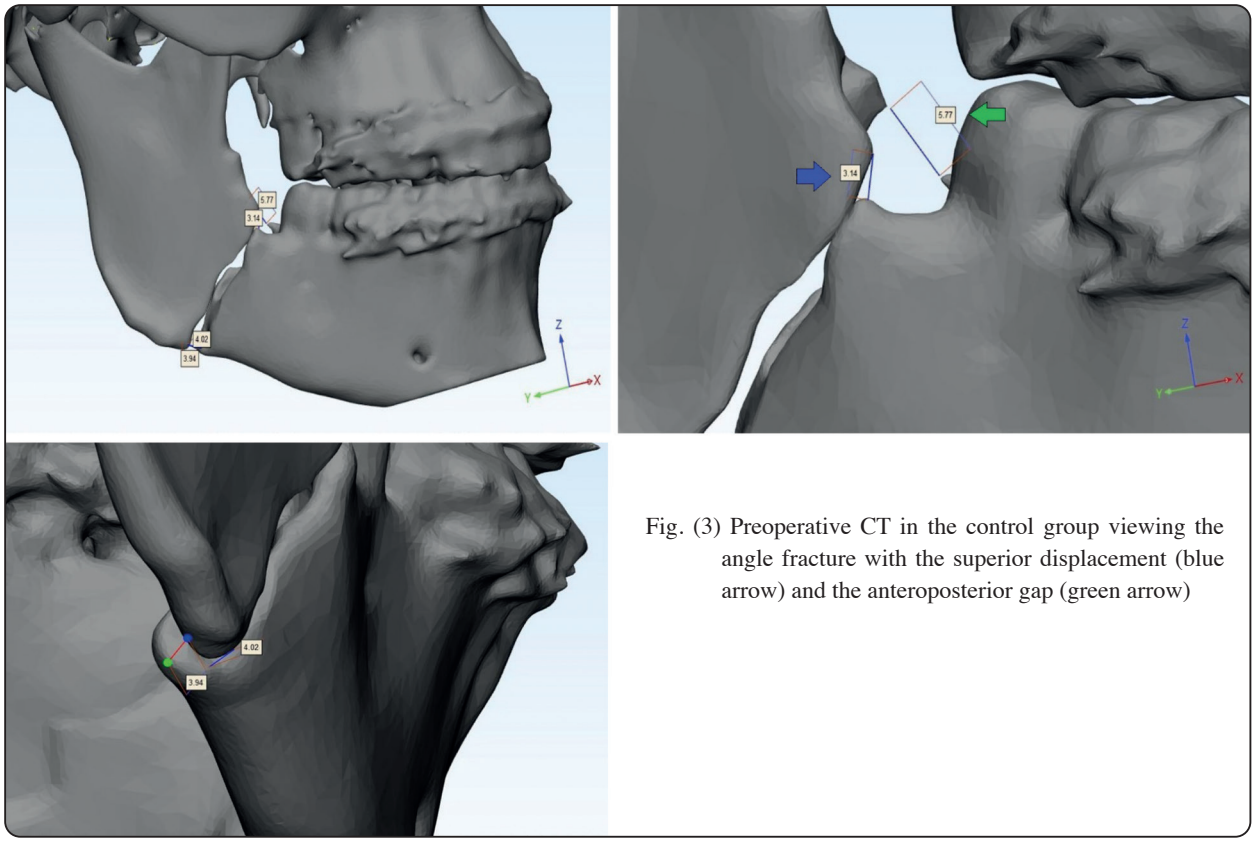

Fig. (3) Preoperative CT in the control group viewing the angle fracture with the superior displacement (blue arrow) and the anteroposterior gap (green arrow)

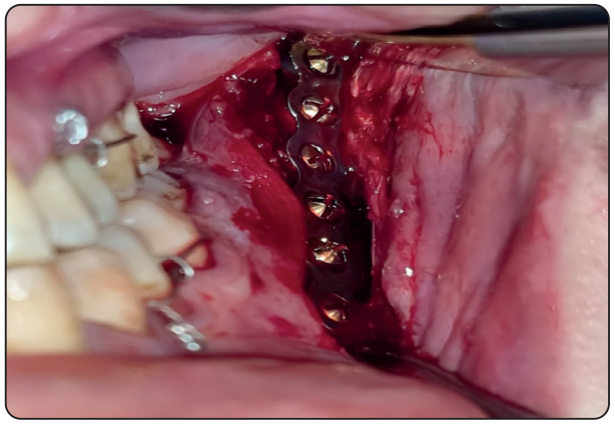

Fig. (4) Intraoperative view of the rigid plate placed at the superior border.

Fig. (5) Intraoperative view of the 2.0 plate placed according to Champy's technique.

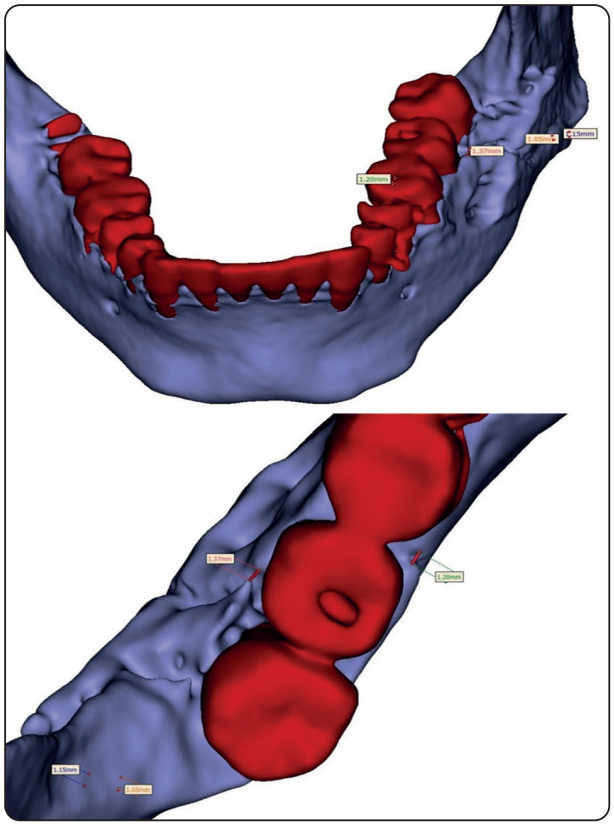

Fig. (6) CT scans of the study group demonstrating the postoperative alignment of the fractured segments following fixation across the whole segments at the fracture site.

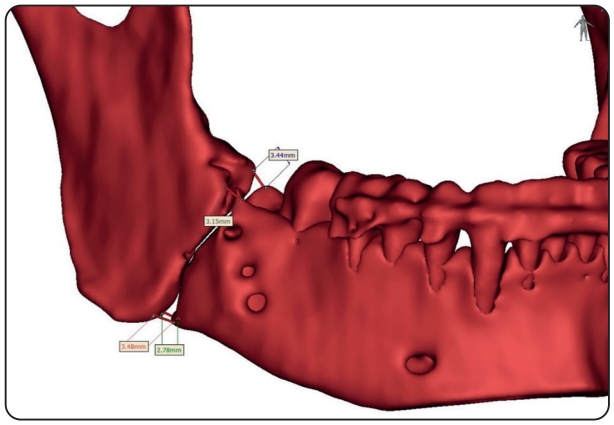

Fig. (7) CT view displaying the postoperative alignment of the fractured segments in the control group following fixation across the segments at the fracture line.

DISCUSSION

Among the widest controversy in treatment in oral and maxillofacial surgery lies that of mandibular angle fractures, complication rates are labelled as rather high oscillating up to 32%.[23–25] Although a versatility in treatment techniques for mandibular angle fractures through various studies have been conducted ORIF remains the gold standard. While it provides ultimate skeletal stability, fragment compression and primary bone healing and strongly recommended by the AO, inferior border compression plating present many drawbacks as extraoral facial scarring, risk of facial nerve injury and difficult plate application.[26]

As favored as it is in being applied easily intraorally and easily adapted to the bone, Champy technique for mandibular angle fractures relinquishes fragment compression and primary bone healing. Various clinical studies showed a high success rate for said treatment with complication rates as low as 3.8%.[20] However , several invitro studies spoke differently as they concluded that biomechanically the normal masticatory forces supersede the plates ability to provide sufficient stability needed to prevent displacement and provide healing of the fractured segments. [27,28] This contradiction between the low complications and the invitro studies could cleared by the fact that during the early postoperative phase, the biting forces are compromised and reduced to substandard level for weeks, so this method of fixation though biomechanically inadequate, yet circumstantially sufficient throughout the recovery period to provide the stability necessary for healing. [29] This lack of fragment compression also forsakes proper segment alignment at the inferior border. Although the key for proper reduction is restoration of patient's centric occlusion yet step deformity present due to lack of alignment could be troublesome and noticed by the patient till remodeling occurs.

Another noteworthy point regarding the need for adequate segmental alignment is correction of the post-trauma disruption of the IAN continuity, which is a common complication after mandibular fractures as well as after its operative treatment. In our study, Seventeen patients showed postinjury IAN hypoesthesia correlating with other studies that analyzed the IAN function after mandibular fractures [30–32] Thankfully, research indicates that there is a good chance of recovery following interrupted IAN continuity, with reported recovery rates ranging from 33 to 100%.[33,34]. Seven patients in the study group made a full recovery, according to an analysis of the publication's results, while one patient made a partial recovery before fully recovering after 2 months. Regarding the control group, four patients showed signs of complete recovery, five showed signs of partial recovery that improved in three months, and one patient showed no improvement in six months following the disruption of the IAN continuity before reaching complete recovery eight months postoperatively, suggesting a slow rate of neural regeneration that may be related to compromised fragmentary alignment. There were no preinjury or postoperative neurosensory disturbances reported by one patient in the control group and two patients in the study group. Sharp/blunt and two-point discrimination were used in neurosensory testing, along with patient feedback. [35] Such results suggest superior interfragmentary alignment and stability in the study group in comparison to the control group.

Champy technique could be used with or without MMF, yet MMF was disregarded in our study to allow immediate mobilization and exploit the chance of abrupt return to function. ***Samuel et.al*** conducted a study aiming at evaluating the need for MMF following ORIF. In their study, they came to the conclusion that neither postoperative edema nor pain varied. Additionally, the postsurgical re-established occlusion is unchanged. Conversely, it was discovered that MMF patients had worse oral hygiene than non-MMF patients. This indicated that, in comparison to rapid mobilization following ORIF for mandibular fractures, keeping patients on MMF does not provide any further benefits.[36]

While Champy's principles suggest the adaptation and placement of a four-hole miniplate along the buccal shelf of the EOR,[13] we used a six-hole plate at the identical most advantageous biomechanical location, minimizing the plate thickness to a with resulting benefit of greater malleability. The choice was based on the idea of increasing the possibility of maintaining at least two monocortical screws on either side of the fracture line in case a screw loosening was faced after drilling through of the plate holes, the other two would suffice.

Although in this study inferior border plating is also disregarded, the use of a rigid plate at the superior border succeeded in providing sufficient compression to allow for better skeletal stability providing primary bone healing as well as a notably much better inferior border alignment and fracture segment reduction. In addition to that, this higher level of skeletal stability showed less predisposition to infection as interfragmentary movement that could be encountered - and probably was - the reason for the one case which had infection in the control group is nearly eliminated. Similarly, it provided a better alternative where fixation via Champy technique was questionable as in severely displaced unfavorable fractures. Following the same concept with the control group, a six-hole plate was also used to ensure that at least two screws were placed at either side of the fracture line. Although the plate has a noticeably higher profile, no plate exposure, root or inferior nerve injury was encountered. Preoperative paresthesia was improved significantly during the postoperative follow-up period. This was more evident in the study group which showed a shorter recovery time than the control group.

Compared to the Champy technique plating, superior border plating has the advantage of

reducing infection and plate dehiscence as the plate becomes farther away from the incision. According to the literature, compared to surface plating, there were more patients who needed plate removal following transmucosal fixation on the superior border. Additional factors contributing to the superior border plating's superiority include the ability to see the fracture line more clearly both before and after reduction, the minimal amount of plate manipulation required for adaptation, the possibility of screw insertion perpendicular to the fracture line, and the ability to secure a second plate in case it becomes necessary.[37]

CONCLUSION

Rigid superior border fixation showed superiority in terms of segmental alignment in angle fractures, although the plate is not low in profile as the 2.0 used in the Champy technique group, no plate exposure or wound dehiscence was noted. Additional prospective, randomized research including a larger sample size, and a longer time frame would be beneficial in validating our findings.

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