Management of Mandibular Angle Fractures by Two Conventional 2.0-mm Miniplates: A Retrospective Study of 389 Patients

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Abstract

Fractures of the mandibular angle account for 23 to 42% of all facial fractures with a high complication rate (0–32%). Although the ideal treatment remains debatable, two main procedures are commonly used to manage the majority of mandibular angle fractures that are open reduction and internal fixation by a noncompression miniplate placed on the external oblique ridge with or without a second miniplate on the outer cortex. The purpose of this study was to describe our management of mandibular angle fractures by two noncompression miniplates placed on the outer cortex via a transbuccal approach. Medical records and radiographic examination of 389 patients (258 males [66.3%] and 131 females [33.7%]) operated from January 2000 to December 2012 were retrospectively reviewed. Postoperative complications including malocclusion, infection, wound dehiscence, nonunion, and reoperative surgery were recorded and analyzed. Fifty-three patients developed postoperative complications (overall complication rate: 13.6%). No significant difference was found in the complication rate by age and gender variables and regarding the interval between the trauma and the operation and the presence of the teeth in the line of fracture. A higher rate of complications was found among patients with alcohol/drug addiction and in patients with multiple-site involvement. The findings of this study suggest that the use of two transbuccal miniplates placed on the outer cortex for the internal fixation of mandibular angle fracture provided a low rate of complications. The global incidence of screw loosening, wound dehiscence, plate exposure, infection, reoperation, and plate removal were similar with the data reported in the literature with improved health outcomes, lower postoperative morbidity, and a faster return to normal life.

Keywords

- mandibular fracture
- facial fracture
- noncompression miniplates
- transbuccal approach

Fractures of the mandibular angle account for 23 to 42% of all facial fractures with a high complication rate (0–32%). Different surgical modalities have been described to manage mandibular angle fractures such as closed reduction, trans-

osseous and circum-mandibular wires, reconstruction plates, dynamic compression plates, lag screws, and noncompression plates. Although the ideal treatment remains debatable, two main procedures are commonly used to manage the majority

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of mandibular angle fractures that are open reduction and internal fixation by a noncompression miniplate placed on the external oblique ridge with or without a second miniplate on the outer cortex.¹⁻⁶

The use of noncompression miniplates was first introduced by Michelet et al⁷ and developed by Champy et al.⁸ Choi et al⁹ demonstrated in vitro that the use of a second miniplate placed on the lower edge of the mandibular angle was helpful to stabilize the fixation during the functional loading. Levy et al¹⁰ showed that the lowest rate of complications occurred with the internal fixation was achieved by two miniplates, whereas Ellis and Walker¹¹ suggested that the use of a single plate provided fewer complications when compared with the technique of two miniplates.

Several factors can influence the incidence of surgical complications including inappropriate surgical technique, patient's medical status, substance abuse, concomitant injuries, and fracture location and type. Complications include postoperative malocclusion, infection, wound dehiscence, nonunion, malunion, and osteomyelitis.^{12,13}

The purpose of this study was to describe our management of mandibular angle fractures achieved by two conventional 2.0-mm miniplates placed on the outer cortex via a transbuccal approach. We evaluated the complications of our technique and compared our results with the standard techniques of a single noncompression miniplate placed on the superior border of the mandible with or without a second miniplate on the outer cortex already published in the literature.

Patients and Methods

We designed a retrospective cohort study enrolling all patients who underwent open reduction and internal fixation of mandibular angle fractures from January 2000 to December 2012 at the Department of Maxillo-Facial Surgery of the Careggi University Hospital, Florence, Italy.

Inclusion criteria were as follows: (1) patients affected by mandibular angle fractures (single, double, isolated, or associated with other mandibular fractures) treated by two noncompression 2.0-mm miniplates placed on the outer cortex via a transbuccal approach; (2) patients aged 18 years or older. Exclusion criteria were as follows: (1) patients who underwent open reduction and internal fixation of mandibular fractures with different surgical techniques; (2) insufficient preoperative and postoperative data.

Data were obtained from the patients' medical charts. Age, gender, substance abuse, and medical history were collected. Cause of injury, interval between the trauma and the surgical procedure, the presence of any concomitant fractures, and type of fixation system used were also recorded. Postoperative complications including malocclusion, infection, wound dehiscence, nonunion, and reoperative surgery were analyzed through the patient's medical records and the radiographic examination; they were considered as primary outcome variables during the follow-up examination. Comparative statistics of categorical variables was performed using Fisher exact test. Parametric data were analyzed using

Student *t*-test. The differences were considered statistically significant at $p \leq 0.05$.

Preoperatively, each patient underwent radiographic examination that was also useful for the evaluation of the dental roots' position prior to the placement of maxillomandibular fixation bone screws used for intermaxillary fixation. In cases of concomitant maxillofacial fractures, a computed tomographic (CT) scan was performed for better evaluation and preoperative planning.

During the follow-up period, all the patients underwent postoperative radiographic examination such as orthopantomography (OPG) and/or CT scan depending on the severity of the injury to analyze the correct position of the miniplates and the proper alignment of the fracture.

Under general anesthesia in all cases, four bicortical screws were placed and rigid intermaxillary fixation was provided. The third molars that were included in the line of fracture were removed when they were evaluated unstable or interfering with reduction. An open reduction of the fracture was performed through a standard intraoral approach and percutaneous access with the help of a transbuccal trocar.

Internal fixation was performed with two 2.0-mm noncompression miniplates (OsteoMed, Dallas, TX) placed on the outer cortex of the mandible. The first plate was always placed as close as possible to the inferior mandibular border, followed by the second plate located below the external oblique line. Occlusion was checked by releasing intermaxillary fixation and actively bringing the jaw closer. After an accurate washing, the operative site was closed with absorbable suture. All cases were performed by three consultant surgeons.

Patients underwent antibiotic therapy for 5 to 7 days after surgery. Before discharging, each patient underwent a plain radiographic examination (OPG) to check the fracture reduction and the position of the two miniplates. The mean duration of postoperative intermaxillary fixation was 16 days ranging between 15 and 41 days. Clinical follow-up started 1 week after the discharge and continued at 1-, 3-, and 6-month intervals. During follow-up, panoramic radiography was obtained at 3 and 6 months after surgery. In cases of complex mandibular fractures, patients underwent CT scan (→ Fig. 1a, b). This research was approved by the local ethics committee.

Results

Applying the inclusion criteria, of the 425 patients with mandibular angle fractures who underwent surgical treatment in the department between January 2000 and December 2011, only 389 were included. Twenty patients were excluded due to insufficient preoperative and postoperative data. Sixteen patients were not included due to different surgical techniques for osteosynthesis. The final study sample consisted of 389 patients (258 males [66.3%] and 131 females [33.7%]) who were treated by two conventional 2.0-mm miniplates placed on the outer cortex. The mean age of patients was 28.7 years with a range of 17 to 54 years. Two hundred forty-eight patients (64%) presented with an isolated fracture of the

Fig. 1 (a and b) Preoperative and postoperative radiographic examination which showed mandibular angle fracture treated by two non-compression miniplates placed on the outer cortex.

mandibular angle and 141 patients had a combination of fractures (36%). Teeth in the line of the fracture were presented in 330 (84.8%) patients and were removed in 297 cases (76.3%) (→ **Tables 1** and **2**).

The main cause of injury was fights (141 cases [36.2%]) followed by traffic accidents (81 [20.8%]), domestic accidents (75 [19.3%]), sports injuries (49 [12.6%]), and work-related accidents (43 [11%]) cases. Daily abuse of alcohol was detected in 98 cases (25.2%); 82 patients reported drug abuse (21%). The average time between the accident and the surgery was 2.5 days. The average hospital stay was 3.1 days. The mean operation time was 65 minutes.

Table 1 Data of the population

Age (y)	28.7 (range: 17–54 y)
Gender	258 males (66.3%)
Isolated fractures	248 (64%)
Wisdom teeth	330 (84.8%)
Alcohol/Drug addiction	180 (46%)
Average time between accident and surgery	2.5 d

The follow-ups ranged from 6 to 25 months. Postoperative OPG and CT scans were performed on average 5.1 months (standard deviation: 1.4 months) after the procedure. Fifty-three patients developed postoperative complications (overall complication rate: 13.6%) which were divided into major complications requiring return to the operating room (7.4%)

Table 2 Fracture characteristics

Angle fracture	389
Left	250
Right	139
Associated fracture(s)	141
Mandible	73
Maxilla	29
Frontal	7
Zygoma	32
Neural deficits	184
Anesthetic	52
Hypoesthetic	132

and minor complications managed in the outpatient clinic (6.2%). Twenty-one patients (5.4%) reported malocclusion and 5 patients developed nonunion (1.3%). The reoperation rate to manage malocclusion and nonunion was 1.9%. The rest of the group was managed conservatively in the outpatient clinic by prolonged guiding elastic therapy and orthodontic treatment. Thirty-two patients reported postoperative infection (8.2%). Seventeen patients (4.3%) presented a dehiscence of the surgical wound which required a prolonged antibiotic therapy and the subsequent removal of the miniplates at least 45 days postoperatively with the resolution of the complication. The rest of the group experienced minor complications; they were managed in the outpatient clinic by incision and drainage, irrigation of the wound, and prolonged antimicrobial therapy which solved the condition. No statistically significant difference in the complication rate was found by age and gender variables ($p > 0.05$). A higher complication rate was found among patients with alcohol/drug addiction ($p < 0.05$). No statistical difference was found regarding the interval to surgery and the presence of the teeth in the line of fracture ($p > 0.05$). A higher rate of complications was found in patients with multiple site involvement ($p < 0.05$).

Discussion

The complications reported in this study included postoperative malocclusion, infection, wound dehiscence, nonunion, and reoperative surgery. Paza et al¹⁴ reported a total complication rate of 20% with a lower reoperation rate (3%). Siddiqui et al¹⁵ reported a higher rate of postoperative complications (58.1%); Bormann et al¹⁶ described a 15% complication rate (75% infection/wound dehiscence).

Regarding postoperative infection, our rate was lower (8.2%) compared with other investigations. Ellis and Walker¹¹ reported a higher infection rate (25%) and an overall complication rate of 28%. Iizuka and Lindqvist¹² described an infection rate of 6.6%. We had a 4.3% rate of wound dehiscence that was similar to previously published studies. Fox and Kellman¹⁷ reported a lower rate of local wound infection and dehiscence (2.9%), whereas Seemann et al¹⁸ described an incidence of 5.9%. The reoperation rate for malocclusion and nonunion was 1.9% which is lower when compared with the findings of Maloney et al (6.31%).¹⁹

The timing of surgery is still controversial in the literature. Some studies have suggested immediate surgery; other reports have supported to wait the decreasing of the edema of the soft tissues before operating.^{20,21} We showed that the delay of treatment in patients with mandibular fractures was not associated with a higher complication rate. According to other studies, we demonstrated an increased rate of complications in patients with substance abuse or medical diseases.^{22,23}

It is known that the placement of two miniplates on the outer mandibular cortex requires a wide subperiosteal dissection and leads to a longer postoperative edema but ensures great stability to the fracture as demonstrated by the studies of Choi et al.^{9,24} A shorter recovery is important especially for patients with a reduced compliance. A majority of the patients do not follow standard cleaning procedures of

the oral cavity and nutritional advice (such as liquid/soft diet). The 17 infection cases of our series did not require any admission to the hospital. The miniplates were removed under local anesthesia as outpatient procedure with less cost for the hospital and less discomfort for the patient.

Conclusion

The findings of this study suggest that the use of two trans-buccal miniplates placed on the outer cortex for the internal fixation of mandibular angle fracture provided a low rate of complications. The global incidence of screw loosening, wound dehiscence, plate exposure, infection, reoperation, and plate removal was similar with the data reported in the literature. This procedure seems to be an effective and repeatable technique with improved health outcomes, lower postoperative morbidity, and a faster return to normal life.

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