



Comparison of single versus two non-compression miniplates in the management of unfavourable angle fracture of the mandible: a prospective randomized clinical study

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Received: 27 October 2017 / Accepted: 7 February 2018 / Published online: 19 February 2018
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Abstract

Purpose The purpose of this study was to compare the efficacy of single versus two non-compression miniplates in the management of unfavourable angle fracture of mandible.

Materials and methods A total of 28 patients who required open reduction of mandibular angle fracture were included in the study. The patients were randomly divided into two groups. Group I comprised of patients treated with two miniplates and those in group II were treated with single non-compression miniplate. The parameters of assessment were malocclusion, surgical site infection, need for implant removal, duration of surgery, inter-incisal mouth opening and cost of implants used, in both the groups. Statistical analysis was carried out to compare all the parameters.

Results Out of 14 patients in group II, inadequate reduction was noticed in three patients, whereas screw loosening had occurred in two cases. Screw loosening was always associated with chronic infection. In these cases, hardware removal was deemed necessary. Plate bending was observed in two cases resulting in malocclusion and difficulty in eating. Non-union of fracture occurred in one patient treated in group II. In group I, no plate bending, screw loosening, surgical site infection, non-union or malocclusion was observed. No patient had to undergo implant removal in group I.

Conclusion In the management of unfavourable mandibular angle fracture, two miniplates must be preferred over the use of single miniplate as using two miniplates results in better results with minimal complications.

Keywords Mandibular angle fracture · Two miniplates · Single miniplate

Introduction

The angle of mandible (anatomical, clinical and surgical) fractures accounts for 16 to 42% of all facial fractures [1, 2]. After fracture, the masticatory forces on mandibular angle (MA) causes displacement of the proximal and distal segment in the unfavourable direction which makes the reduction difficult [3]. There are various treatment modalities for the management of MA fracture highlighted in the literature, i.e. closed reduction, open reduction and internal fixation with single

miniplate, two miniplates, lag screws or three-dimensional plate etc. [4–6] although the ideal treatment for MA fracture remains controversial.

The aim of this study was to compare the efficacy of single non-compression miniplate, in which a single plate is fixed onto the superior border of the mandible versus two non-compression miniplates onto the lateral aspect of the mandible in management of unfavourable MA fractures.

Material and methods

The study sample of this randomized clinical trial was derived from the population of the patients who reported in the outpatient department. Approval for the present study was obtained from our institution's Experimental Medical Research and Practicing Centre Ethical Committee. Informed consent was obtained from all patients who were enrolled in the study, after they received an explanation of the advantages and

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disadvantages of both open and closed reductions in their own language.

Inclusion criteria:

- 1) Patients with unfavourable non-comminuted mandibular angle fracture in isolation or associated with other fractures of the mandible, reported within 7 days for treatment
- 2) Patients had to be of age 18 years or older

Exclusion criteria:

- 1) Patients unfit for surgery under general anaesthesia
- 2) Patients with history of occlusal disturbances or skeletal malocclusion
- 3) Patients with insufficient dentition to reproduce occlusion
- 4) Patients with any associated midface fractures

These patients were randomly divided into two groups of 14 each. Randomization was performed by lots in closed envelopes. Group I comprised of patients to be treated with two miniplates (Orthomax, Baroda, India) secured on the lateral border of the MA from extraoral approach; group II patients were to be treated with single non-compression miniplate as suggested by Champy et al. by the intra oral extended third molar approach. The third molars were not removed during the surgical interventions unless they were loose, fractured, luxated or prevented an appropriate reduction.

Five patients who had an additional parasymphiseal fracture and three who had condylar fracture of the mandible were also treated by open reduction and internal fixation (ORIF).

A submandibular incision was used to expose the fractured angle and the fracture was then reduced and the jaws were placed into the intermaxillary fixation (IMF) with the help of arch bars, eyelet wiring or IMF screws. After fixation of plates, the IMF was released and the occlusion was checked.

The extraoral incision was closed in two layers (with 3-0 vicryl and 5-0 prolene) after which a pressure dressing was applied externally in all the patients. The patients were followed up after surgery for 1 year. A single experienced surgeon performed all the procedures. All patients, in both the groups, were given antibiotics (ampicillin 500 mg intravenously four times a day, for 5 days postoperatively, and 1000 mg intravenously, 2 h before surgery).

Assessment

The patients were assessed for malocclusion, infection, plate removal, the time taken in the surgery and cost of implants used in both the groups. All the patients were assessed by a single person who was not involved in the surgeries. Statistical analysis was performed with SPSS statistical software for windows, version 8.0 (SPSS, Inc, Chicago, IL).

Results

The 28 patients were randomly divided into two groups of 14 each. Out of 28, 22 (78.57%) were male and 6 (21.42%) were female patients. The cause of fracture in 16 (57.14%) patients was road traffic accidents (RTA), 10 (35.71%) had fallen, 2 (7.14%) were victims of assault and 1 (3.57%) patient had history of fracture after extraction of impacted third molar. The age of the patients ranges from 18 to 55 years, with the mean age of 39.81 years.

No patients complained of malocclusion in group I, one patient had occlusal disturbance in group II which was treated by occlusal grinding, which was not statistically significant ($p=0.99$).

Wound dehiscence and infection occurred in two patients in group II but none in group I. Two patients had screw loosening (Fig. 1) and one had non-union (Fig. 2) in group II in which plate removal followed by IMF was done for 4 weeks. Plate bending was observed in one case in group II (Fig. 3). No bending of plates and screws loosening was observed when two plates were used for fixation. The average time taken in group II was 78.33 min and that in group I was 73.50 min. The mean preoperative mouth opening in groups I and II was 20.30 and 21 mm respectively which increased to 41.22 and 40.33 mm after treatment.

Discussion

The purpose of this study was to identify a better method of fixation in the management of unfavourable angle fracture of mandible. Specifically, the intent was to see the efficacy between single versus two non-compression miniplates. The results of this study confirmed that two miniplates are better in unfavourable angle fracture fixation (Fig. 4a–c).

Malocclusion occurred in one patient treated with single miniplate; no malocclusion was noticed in two-miniplate



Fig. 1 Orthopantomogram showing screw loosening with single miniplate



Fig. 2 Panoramic radiograph representing non-union of angle fracture treated with single miniplate

group. Studies on two-miniplate fixation system reported malocclusion ranged from 4 to 5.9% [7–9]. Various authors reported satisfactory occlusion when treated the angle fracture extraorally [10, 11].

No non-union or malunion was observed when patients were treated with two miniplates. Similar results were obtained in many studies [9, 12, 13]. Non-union was observed in one patient treated with single miniplate. Malunion/non-union was reported 1.5 to 8% when treated with two miniplates. The reason given behind inadequate bone healing may be due to poor nutritional status, metabolic disturbances and medically compromised patients. Foreign bodies between the fracture fragment, inadequate reduction, comminution of fracture and infection at the fracture site were the local reasons resulting in malunion/non-union [14–16].

The infection rate ranges from 2.9 to 25.3% when two miniplates were used for fixation in angle fracture management [10–12]. In the present study, we did not notice any infection in patients treated with two miniplates. We did less periosteal and muscle stripping; at the same time, we did excellent water tight closure in three layers. Levy et al. [17] also reported lowest complication rate when fixation was done

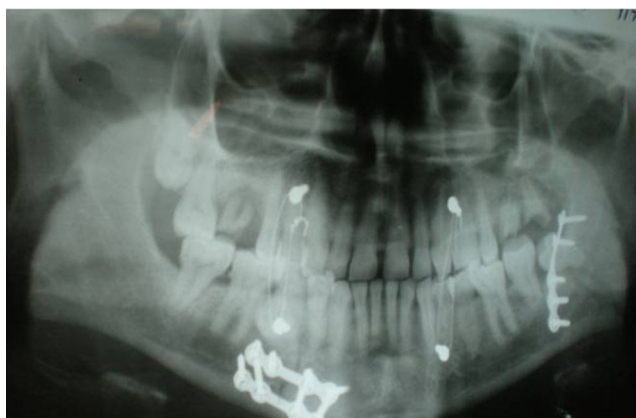


Fig. 3 Orthopantomogram showing plate bending treated with single miniplate

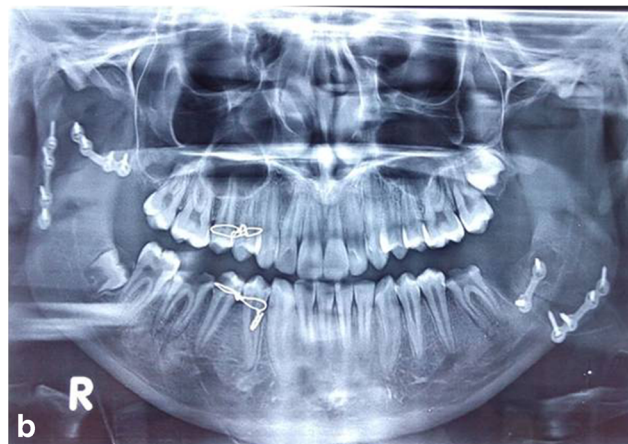


Fig. 4 a–c Panoramic radiographs representing accurate reduction with two miniplates

with two miniplates. They also concluded that two plates were better than one for fixation. On the other hand, two patients had postoperative infection when treated with single miniplate. The cause of infection could be due to the presence of third molar in the fracture line, inadequate adaptation of miniplate at the superior border or time delay between trauma and operation. Danda AK [18] also noticed wound dehiscence more in patients treated with single plate than with two plates in their study.

At 1-month follow-up period, all the patients in group I resumed adequate mouth opening (41.22 mm). The mean

preoperative maximum inter-incisal mouth opening was 20.30 mm, which increases to 28.80 mm after 1 week of operation. Similar results were obtained by Al-Tairi N.H et al. [19]. The mean maximum mouth opening in their study preoperatively was 18.87 mm; after 1 week, mouth opening was increased to 25.37 mm, and at 1-month follow-up, the mouth opening was 39.25 mm. Six patients in group II who had postoperative complications did not achieve adequate mouth opening after 1-month follow-up but after re-treatment, they gained the adequate mouth opening on 3-month follow-up (40.33 mm); similar results were obtained by Vineeth et al. [13] and AbuRagab et al. [20]. There was no statistically significant difference between the groups through the 1-month follow-up. At the 12-week follow-up, mouth opening was greater in group I (two miniplates) as compared to group II (single miniplate); in our opinion, this could be attributed to less muscle manipulation in extraoral cases, probably due to easy and direct access.

The time taken for the surgery in the present study in group I is 73.50 min which is less than in group II, i.e. 78.33 min. Choi BH et al. [8] in their study also reported average operating time 105 min, which reduced to 75 min when two-plate fixation in angle fracture management became a routine. Singh V et al. [21] in their study also documented less operating time (31.80 ± 4.42 min) while doing reduction and fixation extraorally, in comparison to the time taken through intra oral approach (i.e. 45.25 ± 4.44 min). This could be due to the direct access for reduction and fixation provided by the extraoral approach. Although they used single miniplate for fixation on superior as well as on the inferior border. Mehra P and Murad H [11] also believed that extraoral approach provides excellent visualization and good control over the fracture fragment, which makes reduction and fixation early. Sugar et al. [22] also suggested that an increased thickness of soft tissue covering the hardware greatly decreases the incidence of soft tissue dehiscence through an extraoral approach.

Single versus two plates

Various authors advocated the use of two miniplates in management of MA fracture. The *in vitro* studies suggested that the second plate makes the fixation more stable under functional loading and holds the bony fragments in such a way that resists muscle pull and occlusal forces [8, 23–25]. Two-plate fixation allows early mobility of the jaw, accurate reduction and stable fixation [8].

SchierleHP et al. [26] advised two-plate fixation in unfavourable, old, comminuted, infected or severely dislocated fractures, as well as fractures in the edentulous mandible or with atypical tension/pressure forces due to poor dentition or pathological occlusion.

Choi BH et al. [8] also support two-plate fixation because according to them, the powerful elevator muscles attached to the ramus transfer their force to the body of the mandible which creates great demands on fixation if rigidity under functional load is to be maintained. Therefore, techniques for internally stabilizing fractures of the mandibular angle must provide adequate neutralization of forces developed during functional loading.

The gaping at the lower mandibular margin (after single-miniplate fixation) was due to the loading force close to the fracture which makes the line of tension shifts from the upper border of the mandible to the lower. Fixation with one miniplate at external oblique ridge cannot resist the reverse effects of tension and compression as proposed by Champy et al. [27]. Due to this, Spiessl B [28] advocated two miniplates are necessary to resist the adverse effects during chewing and loading in the fracture region. The treatment cost of two-plate fixation is more but less in comparison to patients who required re-treatment.

The small sample size and limited follow-up could be considered the limitation of the study. The two groups, apart from using single and two miniplates, also differ in the surgical approaches used. The results obtained in the study may have although less but some discrepancy due to the different approaches used, which can also be considered as limitation of the study. Authors recommend another study to be carried out with larger sample size and single surgical approach for proper standardization and accurate results.

In conclusion, we recommended fixation of unfavourable angle fracture with two miniplates.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Research involving human participants and/or animals Ethical clearance was taken from institutional ethics committee.

Informed consent No patient identifying photographs are included.

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