



Management of comminuted but continuous mandible defects after gunshot injuries

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ABSTRACT

Introduction: Firearm injuries continue as a major public health problem, contributing significant morbidity, mortality, and expense to our society. There are four main steps in the management of patients with gunshot wounds to the face: securing an airway, controlling haemorrhage, identifying other injuries and definitive repair of the traumatic facial deformities. The objective of this study was to determine late outcome of two treatment options by open reduction and internal fixation versus closed reduction and maxillomandibular fixation (MMF) in the treatment of gunshot injuries of the mandible.

Methods: Sixty patients of gunshot injury were randomly allocated in two groups. In group A, 30 patients were treated by open reduction and internal fixation and in group B, 30 patients were treated by closed reduction and maxillomandibular fixation. Patients were discharged as the treatment completed and recalled for follow up. Up to 3 months after injury, fortnightly complications like infection, malocclusion, malunion of fractured fragments, facial asymmetry, sequestration of bone and exposed plates were evaluated and the differences between two groups were assessed. The follow-up period ranged from 3 months to 10 months.

Results: Patients treated by open reduction tended to have less complications as compared to closed reduction.

Conclusion: Based on this study open reduction and internal fixation is the best available method for the treatment of gunshot mandible fractures without continuity defect.

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Introduction

Since last decade the incidence of violent crimes are on rise in Pakistan society. Gunshot injuries in particular have become increasingly more frequent in the civilian population.^{1–3} Due to the instability and increase in violence in our region, the number of deaths has also increased mainly due to firearm weapons.^{4,5} Main causes of the gunshot injuries in this part of the world are violent crimes, domestic violence, accidental discharge of bullet, suicidal attempts and air shooting.^{4,5}

Surgical management of facial gunshot wounds is generally divided into 3 stages debridement, fracture stabilisation, and primary closure; reconstruction of hard tissues, provided soft tissue coverage is adequate; and rehabilitation of the oral vestibule, alveolar ridge, and secondary correction of residual deformities.^{6,7} Comminuted fractures of the mandible as a result of gunshot injuries have been treated by a number of methods, including closed reduction, external pin fixation, internal wire fixation and more recently, open reduction and internal stable fixation using plates and/or screws.⁷ Before the development of reliable implants and instrumentation for rigid fixation, most comminuted mandibular fractures as a result of gunshot injuries were treated by closed reduction. This was done to avoid periosteal stripping and devascularisation of comminuted bony segments. Closed techniques were preferred because of poor treatment outcomes with open reduction that primarily involved internal wire fixation. These cases frequently developed infection and nonunion. In particular, conservative methods for the treatment of gunshot wound fractures have been recommended by many authors to avoid periosteal stripping of small, partially devitalised segments.^{8–10}

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Recently, open reduction and stable internal fixation using plates and/or screws has been advocated for comminuted fractures. Li and Li¹¹ also recommended open reduction and internal fixation (reconstruction plate) treatment modality with adjunct maxillomandibular fixation (MMF) for multiple site comminuted mandible fractures. On the other hand, open reduction and internal fixation of comminuted fractures goes against the most basic of maxillofacial surgery dogma that states comminuted fractures should be treated closed to prevent stripping the blood supply from the fragments.¹²

In the management of gunshot wounds in open and closed reduction the opinions are divided. This study was designed to compare the above-mentioned two techniques, which have better clinical result and fewer complications, consequently contributing towards the goals of a better treatment option and in due process providing benefit the concerned patients.

Hence this study was conducted to determine late outcome of two treatment options by open reduction and internal fixation (ORIF) versus closed reduction and maxillomandibular fixation in treatment of gunshot injuries of the mandible.

Materials and methods

The study was approved by the local ethics committee at the King Edward Medical University Lahore (F-07-2932). Trial was approved and registered at the research, training and monitoring cell, College of Physicians & Surgeons, Pakistan. RTMC allotted registered number: DSG-2006-066-380. Written informed consent was obtained from each patient.

A total number of 70 patients reported during the study period from November 2008 to November 2009 were treated for the same. Out of these, 4 patients were associated with continuity defect greater than 1 cm and 2 were associated with mid face fractures, one patient had multiple gunshot injuries to mandible and soft tissue deficient cover and three patients lost their follow up thus were excluded from the sample. Hence 60 cases with single gunshot injury to the mandible, continuity defect less than 1 cm and no intra-oral communication or/educate soft tissue cover available intra-orally and extra-orally for primary closure were included in this study. Mandible sites affected were as followed: 28 body (47%), 18 symphysis/parasymphysis (30%), and 14 angle (23%). The degree of comminution was assessed by the number of fragments with an inclusion criteria of at least 1 cm in diameter. Eight patients had a single free bone fragment, 15 had 2, 11 had 3, and 26 had at least 4 fractured fragments. In 43 cases at least 1 tooth was within the comminuted site, whereas the tooth/teeth was/were removed in 28 cases. Regarding the ORIF group, 14 patients were treated with a large mandibular reconstruction plate and 16 with at least 1 miniplate.

Randomisation was done using a computer based software "EpiCalc2000". The software was used to generate serial numbers 1–70 into two groups randomly and those patients who fulfilled the inclusion criteria were allocated serial numbers according to date and sequence of admission to hospital. By placing the allocations in sealed envelopes at the emergency ward, any entry bias by the authors was prevented. The person responsible for conducting the measurements at the time of assessment of variables was blindfolded regarding the type of procedure that was conducted.

All infected cases of gunshot injuries to mandible and case presentation in hospital after three days of injury and displaced fractures were excluded. The authors postulated untreated mandible defects as being infectious after 3rd day of gunshot injury. The timing of surgery varied considerably, ranging from the same day as the injury up to 12 days after injury. 41 out of 60 patients were treated within 48 h post injury. Diagnosis was made

clinically and radiographically. Radiograph used for confirmation and extent of fracture was orthopantomogram (OPG) and postero-anterior (PA) view of mandible. Written Informed consents were obtained from all patients or their parents/attendants, for inclusion in either surgical procedure or for using their data in this research study. The demographic information like name, age, sex and address were recorded. There were 30 patients (group A) treated by open reduction and internal fixation by reconstruction plates and/or miniplates and in 30 patients (group B) were treated by closed reduction and maxillomandibular fixation. Before intervention, patient's record was documented on the proforma. Blood analysis was carried out at arriving to hospital site revealed positive blood alcohol levels for 6 patients. Twenty-six out of 60 patients were smokers, whereof at least 7 patients out of ORIF group did smoke postoperatively during hospitalisation. Six patients reported of mandible fractures in their history: 3 of the fractures occurred after vehicle accident, 2 after gunshot injury and 1 because of sports activity. For 2 of them the same mandible site was affected.

The time needed for treatment (open and closed reduction) was recorded. Furthermore postoperative pain analysis was conducted with the help of a 10-point visual analogue scale (VAS) on a base from 1st, 2nd and 5th day after treatment, where the patients should rate their pain on a score from 0 to 10, with 0 describing a situation without pain and 10 denoting a maximum intensity of pain. Every patient received the same postoperative analgesic drug therapy included 1000 mg Paracetamol (Perfalgan[®]) intravenously for 2 times per day for 3 days; per os: 600 mg Ibuprofen (Ibuprofen[®]) (1st day: Ibuprofen 600 mg 3 times per day, 2nd day: Ibuprofen 600 mg 2 times per day, 3rd day: Ibuprofen 600 mg 1 time per day, 4th day: Ibuprofen 600 mg 1 time per day) Antibiotic prophylaxis consisted of 600 mg Clindamycin (Clindamycin-Actavis[®]) intravenously for 3 times per day.

Patients were discharged as the treatment completed and recalled for follow up. Up to 3 months after injury, fortnightly complications like infection, malocclusion, malunion of fractured fragments, facial asymmetry, sequestration of bone and exposed plates were evaluated and the difference between two groups was assessed. Proportions of facial asymmetry were assessed frontally by indicating facial midline as a line perpendicular to midpupillary line through the neck of crista galli. The follow-up period ranged from 3 months to 10 months. The existence of facial asymmetry was checked 3 months after injury.

Since the observed variables are largely dichotomous, chi-squared tests were used to detect significant differences between group A and group B. To check for statistical significance of quantitative variables the Student *t*-test was used. A *p*-value less than 0.05 was considered to be statistically significant. The statistical analysis was conducted using SPSS for Windows version 16.0 (SPSS Inc., Chicago, IL, USA).

Results

The mean age of the patients in the study was 27.4 years (SD 10.7). The most common age group was 16–30 years followed by 31–45 years. The children under 15 years and elderly age group 45–60 years showed the least involvement with gunshot injuries of the mandible (Table 1). Male female ratio was 7.5:1 (Table 2).

The timing of treatment of the patients varied considerably, ranging from the same day as the injury up to 15 days after the injury, with a mean duration of 5.8 days (SD 3.2) (Table 3).

The mean operative time needed was 86.4 min (SD 27.6) for ORIF group, and 32.4 min (SD 12.2) for closed reduction group (*p* < 0.05) (Table 4). Regarding postoperative pain analysis, in contrast to 5th day evaluation, at 1st and 2nd postoperative day a significant reduced pain score was obtained by treatment with

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