

ORIGINAL ARTICLE**Analysis of complication of mandibular fracture*****Akhiwu Benjamin, Kolo Emmanuel Sara¹, Amole Ibiyinka Olushola*****Abstract**

Background: In recent times, the use of wire osteosynthesis with maxillomandibular fixation (MMF) has been replaced by miniplate osteosynthesis. This has been attributed to the complications following the use of the earlier mentioned treatment modality. This however, cannot be said to be the same in developing countries mainly due to inadequate resources. The present study is aimed at identifying the complications associated with the use of wire osteosynthesis and MMF with the aim of determining if despite the said complications, these treatment modalities are still relevant in a resource poor setting.

Materials and Methods: A descriptive cross-sectional study of all patients presenting with mandibular fractures to the accident and emergency department and the maxillofacial surgery unit of Aminu Kano Teaching hospital over a 2-year period who consented to participate in the study were recruited.

Results: Closed reduction and immobilization was the commonest modality of treatment accounting for 53.10%, while open reduction and internal fixation using wire osteosynthesis accounted for only 34.51%. Majority of the subjects (53.98%) were treated under general anesthesia, while local anesthesia was used in 38.94% of cases. In addition, there was an insignificant association between modalities of treatment and etiology of fracture ($\chi^2 = 18.235$; degrees of freedom (df) = 24; P = 0.791, and critical $\chi^2 = 37.65$). In terms of complications, about 12.82% of patients who had open reduction as a form of treatment suffered nonunion as against 10% in closed reduction. Malunion, however, was higher in closed reduction (8.33%) than in open reduction which accounted for 5.13%. Not surprisingly, open reduction presented with a high rate of infection of about 28% as against 18.33% in closed reduction. Similarly, closed reduction presented with a higher rate of malocclusion of about 6.67% compared with 5.13% recorded with open reduction.

Conclusion: Despite the advent of miniplate osteosynthesis, the relevance of wire osteosynthesis and MMF in a resource poor setting cannot be underestimated.

Keywords: Complications, maxillo-mandibular fixation, miniplates, osteosynthesis, treatment, wires

INTRODUCTION

In terms of statistics, mandibular fractures complications have been evaluated on the basis of the country and the socioeconomic condition of the people.^[1] Commonly reported complications associated with mandibular fractures include infection, malocclusion, nonunion, delayed union, as well as neurological deficits. Several

factors have been shown to influence complications associated with mandibular fractures. Amongst them include, patient's age, patient's lack of compliance, duration of antibiotics use, severity and number of fractures, mandibular bone quality, and dentition.^[2] Some authors,^[3-5] however, feel that the modality of treatment play an important role in the development of these complications.

The use of wire osteosynthesis and maxillomandibular fixation (MMF) has decreased considerably in the western and other developed countries because of the disadvantages associated with them. Intraosseous wiring prevented distraction; however, it does not provide sustained interfragmentary compression.^[6] This, among other reasons, led to increased preference for open reduction and internal fixation with miniplates. This has

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helped reduce malocclusion, nonunion, improved mouth opening, speech, decreased weight loss, and increased the ability for patients to return to work earlier.^[2,6]

In our environment, however, the conventional method of treating mandibular fractures is by wire osteosynthesis and MMF.^[7-12] Okoturo *et al.*,^[8] suggested high cost of titanium plates as the reason for the non-affordability by patients.

In Nigeria, analysis of mandibular fractures complications has been reported and widely substantiated in several centers.^[5,7,13-18] However, a critical analysis of complications of mandibular fractures following treatment has not been carried out in North Western Nigeria. Hence, a study on this will not only help in bridging the gap in the existing literature, but will assist healthcare providers to plan and manage such patients with these traumatic injuries.

This study, therefore, is aimed at analyzing the complications following the treatment of mandibular fractures in a tertiary health institution in northwestern Nigeria.

MATERIALS AND METHODS

This is an ongoing prospective cross-sectional study of all consecutive trauma patients presenting with mandibular fractures (including those referred from other centers), at the accident and emergency department or the maxillofacial unit of the hospital. Ethical approval was obtained from the ethics committee, and a written informed consent was obtained from all the patients.

Study design

All consecutive patients with a definitive clinical/radiological diagnosis of mandibular fractures with or without associated injuries were included in the study. Those excluded were:

1. Patients who refused to participate in the study.
2. Those with fractures of the mandible following third molar extraction.
3. Those with evidence of pathological fractures of the mandible from any cause.
4. Patients who died before treatment could be instituted.

A structured proforma was designed and used to obtain the following information: Demographic variables, etiology of injury, clinical features of mandibular fractures at the time of presentation, treatment modalities, type of anesthesia used during treatment, and complications.

Subsequently, all patients were required to obtain plain radiographs of the mandible (posterior anterior, lateral oblique, and occasionally intraoral views). These radiographs were interpreted by an experienced

consultant radiologist. Prophylactic scaling and polishing was carried out on all patients before commencement of treatment.

Treatment modalities were based on nonsurgical and surgical techniques.^[11,19] Nonsurgical involves conservative treatment and closed reduction with MMF. The protocol for conservative treatment ranged from i) relief of pain and antibiotics therapy, ii) the above with soft diets, and iii) active jaw exercise (exclusively for condylar fractures). Conservative MMF involves undisplaced fractures where there is slight mobility of the fragments. Techniques of closed reduction involved i) use of eyelets only, ii) use of arch bars, iii) use of eyelets and direct wires (figure of 8), iv) combination of arch bars and eyelets, and v) acrylic splints. Surgical technique was based on the following: i) Wire osteosynthesis, ii) lag screw, and iii) miniplates. Those patients who did not receive treatment were grouped separately. Follow-up examinations were performed for up to 8 weeks (Ghazal *et al.*,^[20]) at weekly intervals after treatment. Postoperative plain radiographs were taken at the 6th week before wire removal. Comparison of complications in the two modalities of treatment was also determined.

Data management

Data was recorded on the proforma designed for the purpose of this study (see appendix iii). The pooled data was entered into a personal computer (PC) and was subjected to a statistical analysis after coding. Analysis was done using the Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS Inc Chicago, IL). Qualitative data was presented as percentages while quantitative data was presented as mean and standard deviation (SD). Likelihood ratio or Chi-square was used to determine significant association between categorical variables, while student *t*-test was used to determine significant association between quantitative variables. A *P* value of 0.05 or less was considered significant.

RESULTS

A total number of 113 patients with mandibular fractures were studied. They comprised 99 males and 14 females with age range of 5-70 years and a mean age of 27.79 ± 11.43 years. The variance for male patients ranged from 17.90 to 37.86 years (mean of 27.88 ± 9.98), while those of female patients ranged from 7.77 to 46.5 years (mean of 27.14 ± 19.37). No statistically significant gender difference in age was found among the subjects ($t_{111} = 0.224, P > 0.05$). Also, majority (34.51%) of those who sustained mandibular fractures belonged to the 3rd decade (21-30 years) of life, followed by the 4th decade (31-40 years) representing 25.66%. Those at the 7th decade (61-70 years) were the least involved (1.77%). There was an overwhelming male preponderance in all

age groups except the 7th decade, where the ratio of male to female was 0:1.8. Overall, there were significantly more males (87.60%) that sustained fractures than females (12.40%). Likelihood ratio $\chi^2 = 0.003$ and critical $\chi^2 = 12.592$, $P < 0.05$.

Indications for treatment in patients with mandibular fractures ranged from pain, inability to chew, esthetics, occlusal derangement to reduced mouth opening. Of these, inability to chew was the commonest reason for seeking treatment accounting for 90.27%, followed by pain (75.22%) and occlusal derangement representing 53.98%. Esthetics was the least indicated reason for seeking treatment (23.89%) [Table 1].

Of the various treatment modalities employed, closed reduction and immobilization was the commonest modality of treatment in 60 patients with mandibular fractures representing 53.10%, while 34.51% had their treatment done using open reduction and internal fixation (with wire osteosynthesis). Only 5.31% of patients were treated with the conservative method. Overall, 7.1% of patients with mandibular fractures were not treated due to their inability to afford the cost of treatment [Table 2]. In addition, of the 60 patients treated via the closed reduction and immobilization technique; 28 patients (46.67%) were treated with arch bars and eyelets, while 15 patients (25.00%) had eyelets and direct wires (figure of 8). Acrylic splints were used in only two patients (3.33%) [Table 3].

On the type of anesthesia administered during the treatment of these patients, general anesthesia was the commonest modality and was used in 61 patients representing 53.98%, while 44 patients (38.94%) were treated under local anesthesia. Eight patients (7.08%) did not undergo any form of anesthesia [Table 4].

In terms of the association between etiology of fracture and treatment modalities used, there was an insignificant relationship ($\chi^2 = 18.235$; degrees of freedom (df) =24; $P = 0.791$, and critical $\chi^2 = 37.65$). This implies that choice of modalities is based on the relevance of modality in each particular case without room for bias [Table 5].

The duration of immobilization ranged from 2 to 8 weeks in all patients who had MMF both in the closed and open reduction techniques. Majority of the subjects (56.57%) out of the 113 patients had immobilization for 6 weeks, while 34 patients (34.34%) had immobilization for more than 6 weeks. Only seven patients (7.07%) had immobilization for 2 weeks [Table 6].

Generally patients with closed reduction had greater number of complications (79) than those patients with open reduction (68). The rates of complication per patient, however, for closed reduction and open reduction were 1.32 and 1.74, respectively. The findings

Table 1: Indications for treatment in patients with mandibular fractures

Indication for treatment	F (%)	
	Yes	No
Pain	85 (75.22)	28 (24.78)
Inability to chew	102 (90.27)	11 (9.73)
Esthetics	27 (23.89)	86 (76.11)
Occlusal derangement	61 (53.98)	52 (46.02)
Reduced mouth opening	28 (24.78)	85 (75.22)

F=Frequency, %=Percentage

Table 2: Treatment modalities in patients with mandibular fractures

Treatment modality	F (%)
No treatment	8 (7.08)
Conservative	6 (5.31)
Closed reduction with immobilization	60 (53.10)
Open reduction and internal fixation (using wire osteosynthesis)	39 (34.51)
Total	113 (100.00)

F=Frequency, %=Percentage

Table 3: Modalities of closed reduction techniques in patients with mandibular fractures

Treatment modality	F (%)
Eyelets	3 (5.00)
Eyelets and direct wires (figure of 8)	15 (25.00)
Arch bars	12 (20.00)
Arch bars and eyelets	28 (46.67)
Acrylic splints	2 (3.33)
Total	60 (100.00)

F=Frequency, %=Percentage

Table 4: Types of anesthesia used in patients treated for mandibular fractures

Type of anesthesia	F (%)
General anesthesia	61 (53.98)
Local anesthesia	44 (38.94)
No treatment	8 (7.08)
Total	113 (100.00)

F=Frequency, %=Percentage

also indicate that about 12.82% of patients who had open reduction as a form of treatment suffered nonunion as against 10% in closed reduction. Malunion, however, was higher in closed reduction (8.33%) than in open

Table 5: Association between etiology of fracture and treatment modalities used

Variables	No treatment F (%)	Conservat treatment F (%)	Closed R F (%)	Open R F (%)	Total F (%)	χ^2	df	Prob	Critical χ^2
Motorcycle	7 (10.15)	4 (5.80)	32 (46.38)	6 (37.68)	69	18.235	24	0.791	37.65
Motor vehicle	1 (7.69)	1 (7.69)	6 (46.15)	5 (38.46)	13				
Bicycle	0 (0.00)	0 (0.00)	2 (66.67)	1 (33.33)	3				
Fight/assault	0 (0.00)	0 (0.00)	7 (87.50)	1 (12.50)	8				
Sports	0 (0.00)	0 (0.00)	1 (100)	0 (0.00)	1				
Falls	0 (0.00)	1 (7.14)	11 (78.57)	2 (14.29)	14				
Missiles	0 (0.00)	0 (0.00)	1 (20.00)	4 (80.00)	5				
Total	8	6	60	39	113				

Conservat=Conservative; R=Reduction; Prob=Probability; df=Degrees of freedom

Table 6: Duration of immobilization in patients with maxillomandibular fixation both in closed and open (wire osteosynthesis) reductions

Duration (weeks)	F (%)
2	7 (7.07)
3	2 (2.02)
6	56 (56.57)
7	20 (20.20)
8	14 (14.14)
Total	99 (100.00)

F=Frequency

reduction. Similarly, closed reduction presented with a higher rate of malocclusion (6.67%) compared with 5.13% recorded with open reduction. The incidence of neurological deficits in the form of paresthesia did not seem to differ much in the two techniques used for treatment. Dysphagia, which was the greatest complication in open reduction (56.41%), only acted as a factor in the overall rate of complications. Similarly, poor oral hygiene as a factor in the rate of complication was slightly higher in closed reduction (55.0%) than in open reduction (51.28%) [Table 7].

DISCUSSION

In the present study, inability to chew (90.3%) was the commonest reason for seeking treatment. This is consistent with the high frequency of step deformity (85.0%) recorded in the clinical features of the subjects. Closed reduction with MMF was the commonest modality of treatment (53.1%), while open reduction and internal fixation using wire osteosynthesis accounted for 34.5%. Treatment modalities of closed reduction include use of eyelets or combination of eyelets, interdental wiring, and use of archbars. In Nigeria, wire osteosynthesis is still very useful as an effective method of immobilizing fractures despite their obvious disadvantages.^[9-12] Wires are affordable; simple to place and in most cases will maintain the bone fragments and prevent displacement by muscle pull until healing occurs.

Majority of the subjects in this study were treated under general anesthesia accounting for 53.98% of all mandibular fractures. This could possibly be due to the severity of their injuries apart from subject's preference for general anesthesia. Eight subjects (7.08%) with mandibular fractures were not treated because they could not afford the cost of treatment.

The average recommended period of immobilization of fractured mandible is 6 weeks.^[1,10,11,21] Although this

Table 7: Complications seen in patients with mandibular fractures treated with open and closed reduction techniques

Complications	Reduction F (%)	
	Closed 60 (100)	Open 39 (100)
Neurological deficit (transient paresthesia of lower lip)	7 (11.67)	4 (10.26)
Dysphagia Infection (postoperative)	10 (16.67) 11 (18.33)	22 (56.41) 11 (28.21)
Poor oral hygiene	33 (55.00)	20 (51.28)
Nonunion	6 (10.00)	5 (12.82)
Malunion	5 (8.33)	2 (5.13)
Facial disfigurement	3 (5.00)	2 (5.13)
Malocclusion	4 (6.67)	2 (5.13)
Infection	11 (18.33)	11 (28.21)
Total	79	68
Infection	11 (18.33)	11 (28.21)

F=Frequency, %=Percentage

reduction which accounted for 5.13%. Not surprisingly, open reduction also presented with a high rate of infection of about 28% as against 18.33% in closed

is only empirical, it is usually influenced by several factors such as age of patient, type, number and severity of fracture, presence or otherwise of retained teeth in fracture line, and presence or absence of infection amongst others.^[3,21,22] In this study, majority of subjects (56.6%) treated had MMF for 6 weeks. Only 7.1% of subjects had immobilization for 2 weeks representing those children treated for condylar fractures.

Complications

Postoperative complications differ for open and closed reduction techniques. Generally, it was higher (in terms of overall number of complications) in patients with closed reduction (79) than those treated using open reduction technique (68). The rates of complication per patient, however, did not seem to differ much in the two techniques used.

Infection accounted for 18.33 and 28.21% for closed and open reduction, respectively. The relatively higher value for the latter may be explained in terms of the surgical technique used that required exposing more tissues in order to gain access to the fractured bone segments. The rate of infection obtained in the present study was higher than the 8.1% reported by Ugboko *et al.*,^[10] possibly due to the higher number of patients treated with open reduction technique.

The incidence of malocclusion was slightly less in open reduction (5.13%) compared to closed reduction (6.67%). As expected, malunion was less in open reduction (5.13%) than in closed reduction technique (8.33%). The reason for these observed differences may probably be due to direct visualization of the fracture site in open reduction as opposed to the blind procedure associated with closed reduction technique with resultant inadequate reduction and fixation of fracture resulting in indirect healing at the fracture site.

It is interesting to note that neurological deficits (in the form of transient paresthesia of the lower lip) did not differ much in the two groups studied in terms of complications with values of 11.67 and 10.26% for closed reduction and open reduction techniques, respectively. This finding was, however, higher than the figures recorded by Okoturo *et al.*,^[8] (7.1%) and Cawood^[23] (8%). This may probably be due to fractures involving the premolar regions of the mandible where the risk of damage of the mental nerve exists as well as during surgical manipulations of the fractured bone segments.

Dysphagia which was thrice as common in open reduction (56.41%) as in closed reduction technique (16.67%), possibly due to endotracheal intubation, was not considered significant as it acted as a cofactor in the rate of complication. The same can also

be said of poor oral hygiene with complication rates of 55 and 51.28% for closed and open reduction techniques respectively, possibly due to the presence of archbars and dental wires thereby resulting in difficulty in maintaining a good oral hygiene.

CONCLUSION

High levels of success can still be achieved using available materials in the form of arch bars, eyelets and wire osteosynthesis in the treatment of mandibular fractures using either the closed or open reduction technique in resource poor settings despite the advent of miniplate osteosynthesis.

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