

Tooth in the line of fracture: Its prognosis and its effects on healing

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ABSTRACT

Aims and Objective: The aim of this prospective study was to compare the postoperative results of mandibular angle fracture cases treated by open reduction and internal fixation wherein the third molar in the line of fracture was preserved in one group while it was extracted in the second group.

Materials and Methods: Group I consisted of 30 patients in which the mandibular third molar in the line of fracture was preserved and group II consisted of 24 patients in which it was extracted following specific criteria. Various parameters like postoperative healing, infection, occlusion, tooth vitality, and mobility were graded numerically. Statistical analysis using a *t*-test was done. Data were expressed as mean \pm SD and a probability (*P*) value of <0.05 was considered significant.

Results: The presence of infection with pain and tenderness was higher in group I. Osteogenesis was higher in group I till the end of the third week but the difference was not significant later. Discrepancy in occlusion was more in group II. Mobility of tooth decreased and status of periodontal tissue improved significantly with time. In the tooth involved, the return of vitality and decrease in pain/tenderness was significant after 1 week and continued till 24 weeks to normalcy. Two teeth showed mild root resorption and none showed ankylosis.

Conclusion: Postoperative occlusal discrepancy is less but infection is higher when the tooth in the line of fracture is preserved as compared to when it is removed. More than half of the teeth in the fracture line show complete recovery within a period of 6 months to 1 year. Despite the risk of an increase in the rate of complications, the tooth in the line of fracture should be preserved for its merits.

Key words: Angle of mandible, fracture line, mandibular third molar, rigid fixation

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The mandible is a commonly fractured facial bone due to its relatively prominent position. The incidence of angle fracture is 27–30%.^[1] The treatment of an angle fracture is often complicated by the mandibular third molar in the line of fracture.^[2,3] The damage to the tooth involved in the fracture line may include exposure of the root surface, subluxation, avulsion, or root fracture. The tooth involved may become non-vital as a result of injury or may have a pre-existing pulpal, periodontal, or periapical pathology.

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All these factors either singly or in combination could predispose the fracture line to infection or may complicate healing. Before the advent of antibiotic therapy, the danger of infection in a compound fracture posed several problems in treatment. Delayed union, non-union, and osteomyelitis were commonly encountered, rendering the treatment often prolonged and complicated.^[4,5]

Divergent opinions exist regarding the extraction or preservation of such teeth. The management of teeth positioned in the line of fracture has in recent years become more conservative.^[6-9] The possibility to control infection by the use of antimicrobial drugs and introduction of rigid internal fixation in the management of a fracture has made the prophylactic extraction of such teeth unnecessary. The overall complication rate associated with a tooth in the fracture line varies between 14% and 18%.^[10]

MATERIALS AND METHODS

The present study included 54 patients with a mandibular

angle fracture over a period of 2 years. The patients were taken up randomly irrespective of age, sex, or socioeconomic status.

Following exclusion criteria were applied in the study:

- Individuals below 18 years of age.
- Patients with panfacial trauma.
- Patients with a known systemic or bone disease.
- Patients having hard or soft tissue loss at the fracture site.
- Patients who were managed with closed reduction.
- Patient who failed to report in further follow-ups.

The Institute's Ethics Committee approved the study and a written informed consent was obtained from each patient. All the patients were examined, locally and systematically, and a detailed history of the patients was recorded in a standardized format. Routine hematological investigations were done. Patients were divided into two groups and evaluated on the basis of clinical and radiological interpretation:

- Group I: This included patients in whom the mandibular third molar in the fracture line was preserved [Figure 1].
- Group II: This included patients in whom the mandibular third molar in the fracture line was extracted [Figure 2].

Criteria for the extraction of the tooth in the line of fracture were:

- Grade II or III mobility due to chronic periodontitis.
- Non-restorable fracture in the tooth substance with the exposure of the pulp.
- Carious tooth with periapical pathology.
- Displaced or extruded tooth hampering anatomic reduction.

Surgical procedure

Intraoperative occlusion was achieved by means of

maxillomandibular fixation (MMF) with an arch bar and 26 gauge wire. The fracture site was exposed intraorally and a single titanium 4-hole straight plate with a gap (Stryker Leibinger 2.3 mm system) was applied at the superior border after reduction. In the postoperative phase, the patient was put on MMF for a period ranging from 7 to 10 days. Oral hygiene was maintained by a 0.2% Chlorhexidine oral rinse. Anti-inflammatory drugs were continued for 5–7 days postoperatively.

Statistical analysis

The patients were clinically and radiologically evaluated at an interval of 0, 1, 4, 6, 8, 12, and 24 weeks. Six clinical and three radiological parameters were graded numerically in the manner depicted in Table 1. All the radiographs were taken on a single intraoral periapical (IOPA) and orthopantomogram (OPG) machine and the numerical grading was done by a blinded observer. All analyses were performed using SPSS software (release 10.01, PC Windows; SPSS Inc., Chicago, IL, USA). Statistical analysis was done with a paired *t*-test to compare the significance of change from the baseline and the data were expressed as mean±SD unless otherwise specified. A probability (*P*) value of <0.05 was considered significant.

RESULTS

Group I consisted of 30 patients in whom the tooth was preserved and group II consisted of 24 patients in whom the tooth was removed from the fracture line. Both the groups were treated with open reduction and internal fixation. A total of 19 patients in group I (63.3%) and 14 in group II (58.3%) suffered injuries because of road traffic accidents which was the most common cause of facial fracture. The mean age of patients in group I was 27.3±7.26 years and that in group II was 29.03±8.42 years with no significant difference between the two groups. Group I consisted of 29

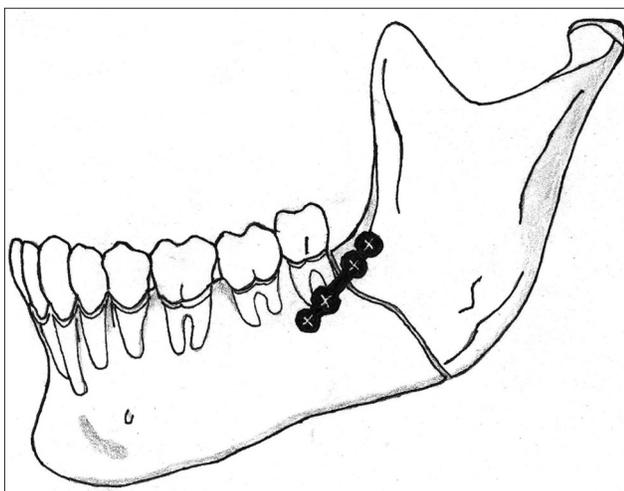


Figure 1: Diagrammatic representation of the fixation with the third molar preserved

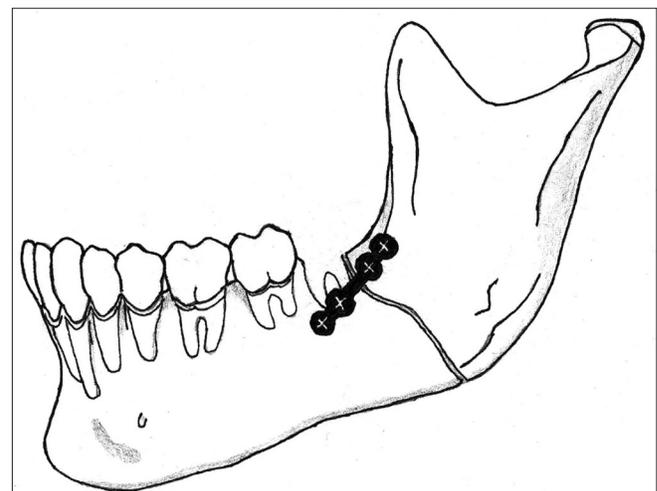


Figure 2: Diagrammatic representation of the fixation with the third molar extracted

(96.7%) and group II 24 (100%) male patients showing male predominance. The mean duration from the time of injury to definite management in group I was 10.33±4.26 days whereas in group II it was 8.96±3.94 days. The difference was not significant. Each parameter was numerically graded in both the groups and the data were tabulated to compare the results:

- Change in pain/tenderness at the fracture site in groups I and II [Table 2]: 4 out of 30 patients (13.33%) in group I and 3 out of 24 patients in group II (12.5%) had tenderness at the end of the sixth week. In group I, 4 out of 30 patients (13.33%) had tenderness at the end of the 12 weeks, wherein it was absent in group II.
- Status of infection at the fracture site in groups I and II [Table 3]: The presence of infection was higher in group I till the sixth week. A total of 4 out of 30 patients (13.33%) had infection in the sixth-week follow-up

as compared to 3 out of 24 (12.5%) in group II. The difference was not significant after the sixth week till the end of 24 weeks in both the groups.

- Postoperative occlusion in groups I and II [Table 4]: Discrepancy in occlusion was more in group II (16.66%) as compared to group I (13.33%).
- Mobility of tooth in group I [Table 5]: Mobility of the tooth decreased with improvement in the periodontal status significantly with time. It was minimum (near zero) at the end of 24 weeks. A total of 4 out of 30 teeth (13.33%) had grade I mobility at the sixth-week follow-up. One out of these four teeth presented with an increased mobility at the 24-week follow-up and was extracted.
- Vitality of the tooth in group I [Table 6]: The return of vitality was significant after 1 week and continued till 24 weeks to normalcy. A total of 8 (26.66%) out of 30 teeth

Table 1: Clinical (C) and radiological (R) parameters with their numerical grading

	0	1	2	3
C-1 Pain/tenderness at the fracture site	Absent	Mild	Moderate	Severe
C-2 Presence of infection	Absent	Present		
C-3 Occlusion	No occlusal disturbance	Minor occlusal disturbance	Deranged occlusion	
C-4 Mobility of tooth	No mobility	Grade I	Grade II	Grade III
C-5 Vitality	Normal	Hyporeactive	Hyperreactive	Nonvital
C-6 Pain and tenderness in the tooth involved	Absent	Mild	Moderate	Severe
R-1 Osteogenesis at the fracture site	Nil	Initiated	Adequate yet fracture line detectable	Complete
R-2 Ankylosis of the tooth	Absent	Present		
R-3 Resorbition of the root	Absent	Mild	Marked	

Table 2: Change in pain/tenderness at the fracture site in groups I and II

Mean±SD	Immediate postop.	1 week	3 weeks	6 weeks	3 months	6 months
Group I (n=30)	1.40±0.67	1.6333±0.5561	2.2667±0.6917	2.3333±0.6609	2.50±0.63	2.50±0.63
Group II (n=24)	1.00±0.7223	1.4167±0.6539	1.75±0.6079	1.96±0.6241	2.13±0.54	2.293±0.5500
t	2.11	1.32	2.32	2.11	2.28	1.27
P	<0.05	NS	<0.05	<0.05	<0.05	NS

Table 3: Comparison of status of infection at the fracture site in groups I and II

Mean±SD	Immediate postop.	1 week	3 week	6 weeks	3 months	6 months
Group I (n=30)	0.6667±0.4795	0.90±0.3051	0.9333±0.2537	0.9333±0.2537	0.8667±0.3457	0.9200±0.3051
Group II (n=24)	0 ± 0	0.2083±0.4149	0.2917±0.4643	0.7083±0.4643	0.8750±0.3378	0.8750±0.3378
t	6.80	7.06	6.47	2.66	0.08	0.51
P	<0.001	<0.001	<0.001	<0.05	NS	NS

Table 4: Comparison of postoperative occlusion in groups I and II

Mean±SD	Immediate postop.	1 weeks	3 week	6 weeks	3 months	6 months
Group I (n=30)	1.8333±0.3790	1.8333±0.3790	1.8667±0.3457	1.8667±0.3457	1.8667±0.3457	1.8667±0.3457
Group II (n=24)	1.7917±0.4149	1.7917±0.4149	1.7917±0.4149	1.7917±0.4149	1.7917±0.4149	1.7917±0.4149
t	0.38	0.38	0.72	0.72	0.727	0.72
P	NS	NS	NS	NS	NS	NS

Table 5: Change in the mobility of the tooth in group I (n=30)

	Preop.	Immediate postop.	1 week	3 week	6 weeks	3 months	6 months
Mean±SD	1.60±0.4983	0.5333±0.5074	0.5667±0.5040	0.400±0.4983	0.1667±0.3457	0.1333±0.3457	0.0667±0.2537
Change in mean±SD	-	1.0667±0.6915	1.5333±0.5713	1.0333±0.5713	1.20±0.7144	1.4333±0.5683	1.4667±0.5713
t	-	8.45	8.46	9.20	13.81	14.06	14.70
P	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

were diagnosed nonvital preoperatively, 14 (46.66%) were hypo-responsive, 6 (20%) were hyper-responsive and tender, and 2 (6.66%) were normal to pulp testing. Six out of these eight nonvital teeth showed a slow return of vitality whereas two showed no sign of vitality at the end of 24 weeks.

- Pain/tenderness in the tooth involved in group I [Table 7]: Pain/tenderness decreased significantly with time. It was negligible by the end of 12 weeks (near zero). Five (16.66%) teeth in the fracture line were tender at the sixth-week follow-up. One tooth out of these five was tender at 12- and 24-week follow-ups and was extracted.
- Status of osteogenesis (radiological) in groups I and II [Table 8]: Osteogenesis was significantly higher in group I till the end of the third week but the difference was not significant in both the groups after the third week till the end of 24 weeks.
- Resorption of the root: 2 out of 30 (6.66%) teeth showed mild resorption of the root at the end of 12 weeks but no further.
- Ankylosis of the tooth: None of the teeth showed ankylosis (complete obliteration of the periodontal space).

DISCUSSION

The rationale behind the extraction of the tooth present in the line of fracture in the preantibiotic era was to minimize complications. Various complications like delayed union, nonunion, infection, and odontalgia were attached with such teeth. After the advent of antimicrobial drugs and rigid internal fixation, the conservative management of such teeth has been advocated.

The most common complication in the angle fracture is delayed healing. In a study of 226 cases of mandible fracture, Amartunga observed 6.86% cases of delayed healing in the extraction group compared to 8.06% in the nonextraction group.^[10] In our study, 4 out of 30 patients in group I (13.33%) showed signs of delayed osteogenesis at the fracture site radiologically whereas in group II, 3 out of 24 patients (12.5%) showed delayed healing. The time lapse between injury and definitive management seems to be an important factor in the postoperative healing. In our study, majority of the patients reported between 8 and 14 days after injury. Due to the compound nature of all the fractures in the dentate segments, preoperatively, infection was considered to be present and prophylactic antimicrobial coverage was routinely done.

Ellis reported a 19.5% infection rate when the tooth was present in the angle fracture as compared to 19.0% ($P=NS$) when the tooth was extracted.^[11] Our results corroborated with this study. In group I, 4 out of 30 patients (13.33%) and in group II, 3 out of 24 patients (12.5%) had postoperative infection. In six out of seven of these patients, it subsided with an antimicrobial therapy following a pus culture sensitivity test. The fourth patient in group I showed signs of implant rejection, extrusion and bone loss around the tooth, and tenderness at the fracture site and in the tooth itself. The plate and tooth were removed and the signs of infection subsided thereafter. One should consider the short-term retention of the tooth with a guarded prognosis when it can be useful for fracture reduction and stabilization (pulpectomy may be helpful). Teeth can be extracted 4–6 weeks after fracture reduction without disrupting the healing fracture.^[12]

Table 6: Vitality of the tooth in group I (n=30)

	Preop.	Immediate postop.	1 week	3 weeks	6 weeks	3 months	6 months
Mean±SD	1.60±0.9322	1.5333±0.8996	1.40±0.9685	1.30±0.9523	0.9667±0.9279	0.700±0.9523	0.6333±0.9643
Change in mean±SD	–	0.0667±0.3651	0.20±0.6103	0.30±0.6512	0.6333±0.9643	0.90±0.9948	0.9667±1.16
t	–	1.00	1.80	2.52	3.60	4.96	4.57
P	–	NS	NS	<0.05	<0.01	<0.001	<0.001

Table 7: Pain/tenderness in the involved tooth in group I

	Preop.	Immediate postop.	1 week	3 weeks	6 weeks	3 months	6 months
Mean±SD	1.50±0.5724	1.20±0.4068	0.9333±0.2537	0.6667±0.4795	0.40±0.4983	0.1667±0.3790	0.1667±0.3790
Change in mean±SD	–	0.30±0.5960	0.5667±0.6789	0.8333±0.7466	1.10±0.7120	1.3333±0.6609	1.3333±0.7581
t	–	2.76	4.57	6.11	8.46	11.05	9.6333
P	–	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001

Table 8: Comparison of the status of osteogenesis in Groups I and II

Mean±SD	10 days	3 weeks	6 weeks	3 weeks	6 months
Group I (n=60)	0±0	0.90±0.3051	0.9333±0.2537	1.8333±0.3790	2.57±0.6261
Group II (n=48)	0±0	0.50±0.5108	0.875±0.3378	1.7083±0.4643	2.46±0.7211
t	0	3.57	0.72	1.09	0.60
P	NS	<0.01	NS	NS	NS

A fully erupted third molar, even though in the line of fracture, aids in reduction (MMF) and stabilization of the fracture segments. In this study, 4 out of 30 patients in group I (13.33%) showed minor occlusal discrepancy in the postoperative phase which was correctable by selective enameloplasty. Comparatively, 4 out of 24 (16.66%) showed minor postoperative occlusal discrepancy in group II. The difference though not statistically significant shows that the tooth if preserved in the fracture line provides an occlusal reference and a posterior stop in addition to providing more surface area for an increased bracing effect. In contrast, after extraction there will be a loss of contact and continuity in the fracture, and thus, more chances of displacement or collapse during fixation.

Almost all the teeth preserved in the fracture line show mild to moderate mobility preoperatively with gingival inflammation. Majority of them show gradual improvement postoperatively as the healing progresses. A periodontal breach due to trauma and later by the surgeon's incision (in the case of intraoral fixation of the mandibular angle) makes the attached gingiva susceptible to pocket formation and further periodontitis. Involvement or loss of the alveolar bone around the tooth also enhances the chances of periodontal infection.^[13] Proper redraping of the soft tissue around the tooth (sling suturing) with meticulous postoperative care (daily irrigation) gives adequate environment for the periodontium to heal. In case one suspects some degree of displacement or extrusion, conservative enameloplasty in the involved or opposite (maxillary) tooth may provide relief by breaking contact.

Open reduction procedures have been shown to cause an increased loss of vitality of the tooth in the fracture line compared to closed reduction.^[7] This can be attributed to the manual manipulation of fracture segments for anatomical reduction and raising of a mucoperiosteal flap for internal fixation. A total of 8 out of 30 teeth (26.66%) in group I presented as nonvital preoperatively. Six out of these eight teeth showed a slow return of vitality whereas two showed no sign of vitality at the end of 6 months. A non-vital tooth can be managed easily with an endodontic intervention.

Root resorption in the tooth in the fracture line has been noted in a range from 3% to 11%.^[14-16] The factors which precipitate resorption are luxation of tooth, fracture of alveolus, and fracture of the root itself. In this study, 2 out of 30 (6.66%) teeth showed mild root resorption around 12–14 weeks but no further. None of the tooth showed ankylosis or complete obliteration of the periodontal space.

CONCLUSION

The current evidence presented by researchers all over the world seems to be overwhelmingly in support of the

conservative management of the tooth in the fracture line. The tooth involved may often be of great value in repositioning of the fracture segments and can be later on used as abutment for prosthesis placement. The extraction of such tooth may cause further trauma and compounding of the fracture thus exaggerating the attending complication and may preclude the possibility of some form of rigid fixation. We recommend a 1-year follow-up with clinical and radiological evaluation of the tooth in the line of fracture. It would be sufficient to exclude any temporary loss of vitality and avoid unnecessary endodontic intervention. Lastly, the absolute indication for the extraction of such tooth prior to fixation are non-restorable damage in the tooth substance, grade II or III mobility due to chronic periodontitis, presence of caries with periapical pathology, and displaced or extruded tooth hampering anatomic reduction.

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