

Efficacy of the Lag screw fixation for the treatment of anterior mandibular fracture

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Abstract

Aim: The present study was scrutinized to evaluate efficiency of lag screw fixation in the treatment of anterior mandibular fractures.

Patients and Methods: The study was conducted on 30 patients with mandible fracture at the anterior site, treated with lag screws and was evaluated cause, the type, and the site of fracture as well as the surgical complications.

Results: In this study the major reason for the cause of mandibular fracture is due vehicle collision. The predominant type of fracture was found to be oblique type (18 patients) and sagittal type (12 patients). After the lag screw fixation, there was a significant ($p < 0.0001$) mouth opening in 4th week and 3rd in oblique and sagittal fracture respectively. Further there was a significant improvement in the mobility of fracture fragments after lag screw fixation in both the oblique and sagittal fracture. Meanwhile, out of 18 patients in oblique fracture 11 patients resumed their normal activities in one week. Whilst, in the case of sagittal fracture ($n=12$), 11 patients resumed their normal activities in one week. The occlusion was more seen in oblique type and after lag screw fixation, significant ($p < 0.0001$) reduction was observed in both the oblique and sagittal fracture. Furthermore, no infections were detected at the fractured site, hospital stay was minimal in both the fracture types and effective bony reunion was visualized based on the radiographic findings.

Conclusion: Titanium lag screw fixation was found to have good rigidity, stability, economic and less time consuming in anterior mandibular fractures.

Introduction

In developing countries like India, the incidence of traumatic injuries to the maxillofacial skeleton are at scaling heights which might be due to rampant urbanization, upsurge invasion of high speed utility vehicles, scanty expressway and traffic collisions. Facial injuries are clinically paramount since it elicits anterior safeguard to cranium. Mandible fractures are commonly seen after assault, road traffic accidents, falls, and sporting injuries in a ratio mandible: zygoma: maxillary of 6:2:1^[1]. Despite the fact that, there is a wide fluctuation in the reported rate of anterior mandible fractures, pooled analysis places this at approximately 17% of all Mandibular fractures^[2].

The mainstay in the therapeutic management of mandibular fracture is the refurbishment of native anatomic form, function, with particular care to restoration of occlusion and facial aesthetics. However, the vicinity of teeth in the maxillofacial locale distinguishes the management of maxillofacial trauma as unique, compared to the long bones^[3].

Over the past few decades, the management of mandibular fractures has evolved significant immensity. In past, these fractures were treated through closed techniques, such as maxillomandibular fixation, splints, and external fixation. However, the modern treatment approach utilizes the rigid internal fixation technique which allows for early return of function and significantly shorter recuperation^[4].

Recently, contrary to orthopedic surgery, lag screws play a vital role in maxillofacial osteosynthesis. Brons and Boering^[5] postulation displays that lag screw technique immobilizes the fracture fragments and further

elicits a constant compression of the fracture area. However, the technique was reintroduced by Niederdellmann et al^[6] who stated that at least two screws were necessary to prevent rotational movement of the fragments in oblique fractures of the mandible. Lag screw fixation emerged as a prime technique in the management of anterior mandible fractures in the North America^[7]. Albeit, in India the lag screw fixation modality has not gained significant adoration for unexplored reasons, resulting in the non-availability of essential hardware for lag screw fixation.

In this light, the present study was scrutinized to evaluate the efficacy of lag screw osteosynthesis in the treatment of anterior mandibular fractures. Further, the ease of placement of lag screws and the complication encountered were evaluated.

Patients and Methods

This study was conducted on 30 patients with clinical and radiological evidence of fracture in the anterior region of the mandible. Cases with single/multiple mandibular fractures in anterior region between two mental foramen without any evidence of infection were included in the study.

Cases with extensively comminuted fracture, loss of tissue in the fractured site, infected mandibular fractures, history of trismus, those requiring revision previous improper treatment and comminuted fractures and below 13 years of age were excluded from the study. All the selected patients were entailed about the surgical procedure. They were informed about the surgical procedure including prognosis, potential hazards and complications. They gave their approval to participate in

a written informed consent. The study protocol was reviewed and approved by the central regional ethics committee. Besides detailed history of the patients, Clinical examination, Radiographic interpretation, blood and urine analysis was performed before the surgical technique.

Surgical Technique

Local anaesthesia (lidocaine 2% with 1:100,000 epinephrine) was preferred whenever feasible. Patients with poor verbal communication, extreme anxiety, or who were otherwise uncooperative in nature were elected to be treated under general anaesthesia.

Access to the fracture site was generally sought through a vestibular incision of 5mm below the level of attached gingival, parallel to the alveolar process. In premolar region the incision was taken superiorly to prevent the injury to mental nerve.

The screw holes were drilled perpendicular to the fracture to ensure rigid stabilization of fragments without causing displacement upon tightening. Further, the drilling point of entry was done sufficiently away from fracture so that amount of bone between the head of screw and the fracture after drilling and counter sinking was ample enough to resist all forces of mastication.

At perpendicular to buccal cortex a gliding hole of 2.7mm diameter using hand drill made, to prevent skidding of drill bit. Further, a 5mm round bur was placed to provide a platform for smooth adequate seating spherical screw head. With extra-long drill bit of 2.0mm a thread of 2.00 was drilled in second or inner fragment after perfectly centering the drill with help of drill guide and then a 2.7mm cortical screw was selected and inserted.

The Second screw was inserted in similar fashion and finally the mucosal wound was closed by interrupted 3.0 silk sutures and extra-oral dressing was given to reduce postoperative swelling. The surgical procedures were shown in Fig. 1A-F respectively.

Upon completion of the procedure, the intermaxillary fixation was abandoned and patient was placed on soft diet for 1 week, followed by advancement to normal diet.

All patients received antibiotics and analgesics postoperatively for a period of 5 days.

Operation time was recorded from the time patient was taken up on surgical table/chair, till the completion of the procedure.

Follow-up

The patients were followed up clinically after 24 h, on days 3 and 7 postoperatively, and then at weekly intervals for 6 weeks and at monthly intervals for 6 months.

Assessment of Parameters

The following clinical parameters were evaluated during the study: Mouth opening of the patient, Mobility

of fractured fragments, Time required for functional rehabilitation, Occlusion of patient, Evidence of infection at fractured site, Sensory disturbances, Weight of the patient, Radiological evidence of bony union, Anaesthesia used, Time required for surgery and Period of hospitalization.

Whilst, Mouth opening of the patient, Mobility of fractured fragments, Presence of infection, sensory disturbances and weight of patient were determined preoperatively, immediately post operatively and during weekly follow up.

The following grading system were used in the present study:

Mouth Opening of patient: Grade 0: More than 40mm; Grade 1: Between 30-40mm; Grade 2: Between 20-30mm; Grade 3: Less than 20mm.

Mobility of Fractured segments: Grade 0: No mobility at fractured site; Grade 1: Slight mobility at fractured site; Grade 2: Moderate mobility at fractured site; Grade 3: Excessive mobility at fractured site.

Time required for functional rehabilitation: Grade 0: Normal mastication within 1 week; Grade 1: Normal mastication within 2 weeks; Grade 2: Normal mastication within 4 weeks; Grade 3: Normal mastication within 6 weeks.

Occlusion of Patient: Grade 0: No evidence of occlusion; Grade 1: Minimal occlusion; Grade 2: Severe occlusion; Grade 3: Grossly deranged occlusion.

Presence of infection at fractured site: Grade 0: No evidence of Infection; Grade 1: Presence of Infection.

Sensory Disturbances: Grade 0: Normal Sensation; Grade 1: Hypoesthesia; Grade 2: Paraesthesia/Anaesthesia.

Weight of the Patient: Grade 0: Weight gained; Grade 1: No change in the weight; Grade 2: Weight lost.

Radiological Evidence of bony union: Grade 0: Bony union within 6 weeks; Grade 1: Bony union from 6-12 weeks; Grade 2: Non-union; Grade 3: No evidence of Bony Union.

Anaesthesia Used: Grade 0: Local Anaesthesia; Grade 1: General Anaesthesia

Time required for surgery: Grade 0: Less than 1 hour; Grade 1: 1-2 hours; Grade 2: More than 2 hours.

Period of Hospitalization: Grade 0: No Hospitalization; Grade 2: Hospitalization for less than one week; Grade 3: Hospitalization for more than one week.

Statistical Analysis

Mann-Whitney confidence interval W test was used to compare the categorical variables, while the T test was used to compare the continuous variable. Statistical significance was defined as probability of less than 0.05 ($p < 0.05$).

Results

The study encompasses thirty patients after the exclusion criteria and has 28 males and 2 females. The

age of patients included in the study ranges from 14 to 52 years with a mean of 28 years.

In the present study the major cause of mandibular fracture was due to vehicle collisions, which was seen in 19 patients (63.3%). Similarly, 6 (20%) cases were due to history of fall and 5 (16.7%) cases were reported due to physical attack. Regarding the type of fracture 18 (60%) cases were found to be oblique and the remaining 12 (40%) cases were reported to be sagittal fracture.

Open reduction technique through intra oral approach was carried out in the present study. In this, 27 cases were with 2 screws, 1 patient was fixed with 3 screws and 2 cases were fixed with one screw. Post operatively the patients were followed at three time points as follows, daily for 1st week, weekly for 6 weeks and once in a month for 3 months for the following parameters,

The median mouth opening was 20mm and 22mm pre operatively in both the oblique and sagittal fractures respectively. However, the immediate post-operative median value was 18mm in oblique and 20mm in sagittal fractures respectively and it found to be insignificant. Whilst, there was a statistical significant ($P < 0.0001$) mouth opening was observed after 4th week in oblique fracture and 3rd week in sagittal fracture (Table 1).

Regarding the mobility of the fractured fragments, in oblique fracture, 4 patient displayed grade 1 mobility, 7 patients elicited grade 2 and 3 respectively during post-operative conditions. However, after lag screw fixation, the mobility was statistically significant ($p < 0.0001$) with median grade of 1 in 14 patients and 4 patients have no mobility with 0 grade.

Meanwhile, in sagittal fractures 2 cases were grade 1, 6 patients of grade 2 and 4 patients displayed grade 3 pre operatively. However, post operatively there was a significant ($p < 0.0001$) reduction in fracture mobility with a median of 0 grade and 4 cases elicited mild mobility.

In both the fractures none of the patients showed the mobility of the fragments 6 weeks after lag screw fixation.

In oblique fracture, after lag screw fixation 11 patients returned to the normal activities within 1week (Grade 0), 2 patients within 2 weeks (grade 1) and 5 cases required 4 weeks (grade 2). However in sagittal fracture, out of 12 cases 11 of them returned to their normal activity by one week (grade 0). From the results the functional rehabilitation was more prevalent in sagittal fractures patients.

The occlusion was more prevalent in oblique fracture with 16 cases have grade 3 and 2 patients have grade 2 pre operatively. After lag screw fixation there was a significant reduction in the occlusion with 14 cases displayed grade 0. In the case of sagittal fractures, 6 cases elicited grade 2 and the remaining 6 cases showed grade 3 occlusion before lag screw fixation (Fig. 2A-2B) Post operatively, there was significant ($p < 0.0001$)

improvement and all the patients displayed normal occlusion.

None of the patients were detected to have infection at the fracture site since they have treated with antibiotics pre and post operatively.

In the present study, 4 patients displayed sensory disturbance, hypaesthesia in lower lip (grade 1) with oblique fracture and 1 patient with sagittal fracture after lag screw fixation.

Further, there was an evidence of bony union within a 6 weeks post operatively in all the cases of oblique and sagittal fracture (Fig. 1)

Regarding the time required for surgery, in oblique fracture 9 patients were fixed with lag screws in 1 hour (grade 0) and 5 patients in 1-2 hours (grade 1) and 4 patients required > 2 hours (grade 2). Whilst in sagittal fracture 10 patients were operated in 1 hour (grade 0) and the remaining two cases had grade 1 and 2 respectively.

In oblique fracture, 11 patients were treated out patients and requires no hospitalization grade 0), 5 patients required < 1 week hospital stay (grade 1) and 2 patients grade 2 hospitalization. Meanwhile, in sagittal fracture 11 patients requires no hospitalization and the remaining 1 patient stayed in hospital for less than one week.

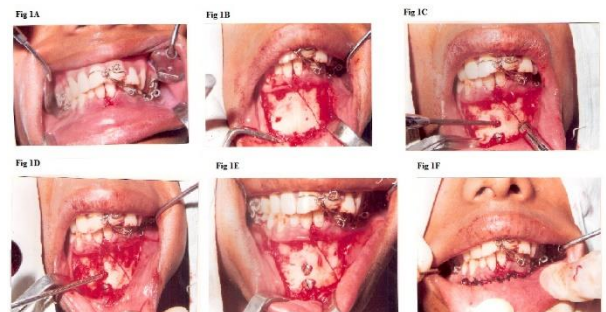


Fig. 1

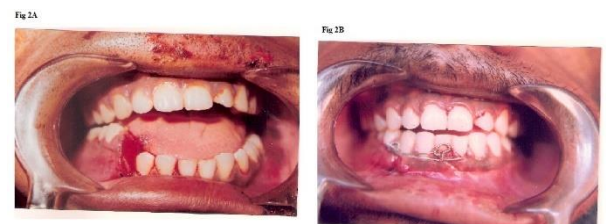


Fig. 2

Table 1: Evaluation of mouth opening after Lag screw fixation

Mouth Opening (in mm)	Oblique fractures (n=18)	Sagittal fractures (n=12)
Immediate	18 ^{NS}	22
1 st Week	18 ^{NS}	26.50
2 nd Week	20.50 ^{NS}	30
3 rd Week	25.50 ^{NS}	32 ^{b*}
4 th Week	28.50 ^{a*}	32.5 ^{b*}

5 th Week	30 ^{a*}	34 ^{b*}
6 th Week	32 ^{a*}	34 ^{b*}

The results were expressed as mean \pm S.D. n=18 for Oblique fracture; n=12 for Saggital fractures respectively. The comparison were made between ^apre-operative (20 mm) vs post-operative mouth opening in Oblique fracture; ^bpre-operative vs post-operative mouth opening in Saggital fracture. *denotes statistically significant $p < 0.05$; NS- Statistically non-significant.

Discussion

In the clinical setting, treatment of mandibular fractures with intermaxillary fixation has substantial disadvantages like airway obstruction and unsuitable for epileptics, mentally ill patients, addictive's, COPD patients and pregnant women. Further, post operatively the patients may experience periodontal problems and residual trismus.

However, rigid internal fixation approach for mandibular fractures elicits more benefits like early restoration of masticatory function, mouth opening and no speech difficulties. Further, it provides a good and stable fixation with early functional repair and minimum morbidity.

Apart from the above underscored advantages, recently the use of lag screws as method of rigid internal fixation has gained a lot of importance over bone plate fixations. The major advantage is that lag screw can be applied more rapidly without decreasing the rigidity, allows a more anatomically accurate reduction without displacement of fragments. It is important to understand that the stability of this kind of osteosynthesis relies solely on compression between the fragments. If there is fragmentation this single stabilizing factor is lost and the fracture must be treated with bone plates and screws in neutral position. If there is fragmentation this single stabilizing factor is lost and the fracture must be treated with bone plates and screws in neutral position.

Eliminating maxillomandibular fixation generally results in greater patient satisfaction because of decreased postoperative discomfort, earlier return to normal jaw function, easier maintenance of oral hygiene and better nutrition. Intermaxillary fixation (IMF) was used in two cases only, as both the patients had additional mandibular fractures with severe occlusal derangement but IMF was removed on the 2nd postoperative day to facilitate early functioning. Neiderdellman 1981 has described the use of a single unprotected lag screw for the fixation of transverse fractures of the angle of the mandible. Spiessl has recommended the use of lag screws in oblique fracture of the body of the mandible. In our study as some of the symphysis fractures were not stable after single lag screw placement, an additional screw was placed. According to Ardary the ultimate stability of screw fixation is dependent on the number of screws used, method of screw placement, bicortical placement of screws and the holding power of screws, which is

affected by cortical bone thickness. Ideally the length of fracture surface should be greater or equal to the mandibular height in oblique surface fractures. Spiessl states that the length of fracture should be atleast twice the height of the mandible, in atrophic mandibles.

Lag screw can be used alone or as a supplement to plate osteosynthesis dependant on the anatomy of fracture site. In our study, in two patients, the treatment plan was modified and a single lag screw was supplemented with a conventional miniplate due to bone loss at the inferior border of the mandible. Whenever a plate is used to repair an oblique fracture with overlapping fragments, any screws passing through the overlapping fragments must be placed using lag screw techniques, otherwise they will tend to distract the fracture segments. The plate here serves merely to increase the structural strength of bone in this area and there by relieve stress on the fracture weakened area.

Studies suggested that rigid internal fixation results in lower rate of infection, lesser chances of malunion and non-union when compared with standard treatment. A lower incidence of infection due to absence of inter fragmentary mobility has been reported is also an advantage of this technique. Rigid internal fixation patients who are non-complaint may have a lower risk of developing malunion, non-union or infection than non-complaint patients treated by standard therapy. In the postoperative follow up period all the patients in our study showed satisfactory bone healing without any signs of infection, malunion and non-union. One patient had lingualcortical perforation, but there was no soft tissue perforation and the patient didn't have any postoperative complaints, hence it was left in place and retrieval was not planned. The other patient had developed transient Bell's palsy due to facial nerve injury because of associated condylar fracture, on the opposite side.

In our study when we observed the time factor, which was far less when compared to the adaptation and fixation of bone plate and cost economic too, along with patients satisfaction due to immediate release of intermaxillary fixation. In one of the cases patient had postoperative tingling sensation at the site of associated mandibular angle fracture, in rest of the treated patients, in our study none developed significant postoperative complications like, infection, occlusal disturbance, sensory disturbances, malunion, non-union, mobility of the screw or bone fragments during the follow up period.

However, there are circumstances where the lag screws are contraindicated. The most important is when there is comminution and or bone loss in the fracture gap, in such situations, applying a bone plate without compression across this gap can achieve rigid fixation without disturbing the occlusion. Communitated fractures and with severe bone loss were excluded from our study and two patients with bone loss at the lower border were supplemented with bone graft and plate fixation at the inferior border.

In the current era of increasing medical costs, our study shows a promising useful application of titanium lag screws in oblique or sagittally displaced mandibular fractures, which gives optimum stability, rigidity, requires less time and cost effective also, in the hands of an experienced surgeon.

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