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Original Research Article

Management of Interforaminal Fractures of Mandible Using Conventional Mini-Plates or Lag Screws – A Prospective, Comparative Clinical Study

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Abstract:

Objectives: Mandible is the most prominent and mobile bone of the facial skeleton; therefore, mandibular fracture is more common than any other facial fractures. This study aims to compare the efficacy of lag screws & miniplates in open reduction & internal fixation of mandibular symphyseal & Para symphyseal region fractures.

Material and Methods: Thirty patients were alternately divided into two groups according to treatment modality. Clinical & radiological evaluations were made at 7th day;1 month & 3 months follow up post operatively. Parameters like duration of surgery, bone healing, a return of normal occlusion; infection rate, intersegmental mobility, and nerve paresthesia were evaluated.

Results: The clinical examination showed stable fixation with no mobility in all cases. one patient in group B showed a moderate occlusal discrepancy that was managed by giving IMF for a month. One patient in group A and two patients in group B had infection which was subside by change of antibiotic and one patient require hardware removable in group B. Duration of surgery was more in group A as compare to group B. No significance difference was noted (p>.05) between the 2 groups in the development of postoperative complication.

Conclusions: It was concluded that lag screw fixation is a cost-effective procedure, with minimal hardware, functional stability but technically sensitive. Lag screw is a reliable & safe procedure in treating interforaminal fracture of mandible.

Keywords: Lag screws, Interforaminal Fractures of Mandible, Miniplates, Rigid Fixation.

Introduction

In the present era, to cope up with the fast moving and result oriented life, individuals have begun to work harder, faster and became more uncompromising towards reaching their goals. Road traffic accidents (RTAs), interpersonal violence, sport accident, etc have had an alarming increase in the past few decades and are a cause of grave concern. Maxillofacial trauma is very common in all these foreseen events and the prominent position of the mandible on the face makes it vulnerable to fracture making it second most commonly fractured bone. [1]

The fracture of anatomical midline of the mandible is often termed as "True" symphysis fracture, [2] and the fracture of mandible between two mental foramina is termed as Para symphysis fractures.[2] Fractures of the anterior mandible are one of the common entities with a wide variance in incidence (9-57%) and the average incidence of 17% of all mandibular fractures. [3,4]

The fixation of mandibular fractures has visited different concepts. It has evolved based on the needs of the patient and understanding of principles of biomechanics from maxillo Mandibular fixation (MMF), splints, fixators to open reduction with an array of implants and fixation with scientific advances in material and instrumentations. The open reduction internal fixation (ORIF) remains a time-honoured practice. The modern era of fracture treatment has given the way to the use of rigid internal fixation to allow rapid return of function and significantly shorter convalescence.

Michelet [5] is credited for introducing miniplates for internal fixation of mandibular fracture which was later modified by Champy et al. [6] Champhy advised the use of two miniplates in the anterior region, one at the inferior border and the second 5 mm above the lower miniplate. The lag screw technique, earlier commonly used for long bone fixation was first introduced to maxillofacial surgery by Brons and Boering;[7] who postulated that lag screw not

only immobilize the fracture fragments but also produce a constant compression of the fracture area.

The anterior mandible, area between the two mental foramina, is uniquely suited to the application of lag screw fixation for three reasons. Firstly, is the curvature of the anterior mandible. This allows placements of lag screws across the symphysis, from one side to other, for sagittal fractures, and from anterior to posterior for oblique fractures and those of the anterior body region. Secondly, the anterior mandible is well suited to lag screw fixation is the thickness of the bony cortices, which provides secure fixation when the screws are properly inserted. Finally, there are no anatomic hazards below the apices of the teeth until the mental foramina are encountered. This makes lag screw placement extremely simple, safe and reliable in anterior mandibular fractures.[8]

The selection of one technique over the other seems to be based on surgeon preference, experience, availability of internal fixation of hardware, or other factors rather than documented outcome measurements. We hypothesize that there would be no difference in the frequency of postoperative complications between the 2 fixation techniques, but might differ in the types of complications. Hence, the present study was deliberated to compare the outcomes and frequency of post operative complications between the two aforementioned fixation techniques in anterior (inter-foraminal) mandibular region.

Materials and Methods

After obtaining approval from the Institutional Ethical Committee, the present prospective, comparative clinical study was executed in our department. Thirty consecutive patients with anterior mandibular fractures with/without associated other maxillofacial injuries scheduled for internal fixations from August 2013 to June 2015 were recruited in the study based on the following criteria. Patient's with comminuted fracture, soft tissue and hard tissue loss at fracture site, mixed dentition, edentulous lower arch, evidence of infections at fracture site, medically compromised patients not fit for surgery and those patients not willing for surgical treatment were not considered for the study. A written informed consent was obtained from the patients and each one of them was counselled before inclusion in the study.

These patients were alternately assigned into two groups comprising of 15 patients in each group. Group A were treated with ORIF using two titanium lag screws of 2.7 mm of diameter with 20 mm of length across the fracture line while patients in Group B were treated with standardized non-compression two titanium miniplates of 2mm of internal diameter.

A detailed clinical examination of the maxillofacial region was done for all the patients and appropriate investigations like radiographs (OPG & CT scan), complete hemogram was done pre-operatively. Patients were then taken under local anaesthesia after placement of Erich's Arch bar in all the patients. All patients were administered prophylactic antibiotic coverage (Inj Augmentin 1.2 gm IV MMG Healthcare) one hour before surgery. The duration of surgery was measured from time of placement of incision till placement of last suture in closing using digital clock by an independent observer.

In Group A, lag screw was placed according to the technique advocated earlier by Edward Ellis.[8]A gliding hole of 2.7mm diameter, was prepared with the hand drill perpendicular to buccal cortical plates at selected point of entry to prevent skidding of drill bit. Complete drilling of outer cortex fragment through buccal cortical plate and medullary bone was done. A countersink was then prepared for adequate seating of the spherical screw-head. Second drill of 2 mm, was used for a thread hole in the second or inner fragment. With the help of self-holding screw driver, the selected screw was slipped through the outer gliding hole till it came in contact with thread hole. With further tightening of screw, the long fragments were compressed together reducing the fracture line. (Figure 1)

In Group B, the fracture fragments were reduced and non-compression mini plates were fixated according to the ideal lines of osteosynthesis given by Champhy et al (1978). One 4 hole mini-plate with gap was adapted and placed on the inferior border and a second 4 hole with gap plate placed subapically at an distance of 3 to 5mm distance above the lower miniplates and screw length, 6/8mm self-tapping screws were threaded in the untapped hole. (Figure 2)

Occlusal was checked, IMF was release and closure done in layers. Pressure pack was applied and patient was prescribed antibiotic for 5 days. The patient was followed up at regular interval for 3 months.

The patients were examined for presence of infection, occlusal discrepancies and stability across fracture line by means of digital manipulation in all three planes, damage to tooth root radiographically and nerve paresthesia by means of brush test on 7th day, and at 1 and 3 months postoperatively by an independent observer not aware with the technique employed.

The findings were tabulated and statistically evaluated using SPSS version 18 software, by applying Fisher's Exact Test and Mann Whitney U Test.

Results

Out of 30 patients included in the study, majority of the patients were males (26). The mean age of the

patient in group A was 33.0±11.38 years and group B 29±12.54 years.

The operative time for patients in Group A was 150-179 minutes and that in Group B was <120 minutes. This difference was found to be statistically significant ($p<0.05$). (Figure 3)

In group A, it was observed that all the patients had occlusion stability on the day of operation and at 1 month and 3 month follow up while in Group B, 14 patients (93%) had occlusion stability and 1 patient 6.6% had moderate occlusal discrepancy which was corrected by giving IMF for month and the end of 1 month and 3 month follow up, all patients had stable occlusion and these differences were statistically insignificant. ($p>0.05$) (Figure 4)

The intersegmental mobility and damage to the tooth root either lag screw or mini plate patients were statistically insignificant ($p>0.05$).

It was noticed that 6.6% (1) patient in group A and 13% (2) patients in group B had infection at 1 month postoperatively. In both group infection get resovle by change of antibiotic, only one patient in group B had require incision drainage and removable of hardware. These differences were statistically insignificant ($p>0.05$). At 3rdmonth follow up all the patients had no signs of infection in both the groups. (Table 1)

One patient in group A and two patients in Group B having paraesthesia over lower lip and chin region on the day of surgery, which persist for a week and get resolve after 4week without any intervention

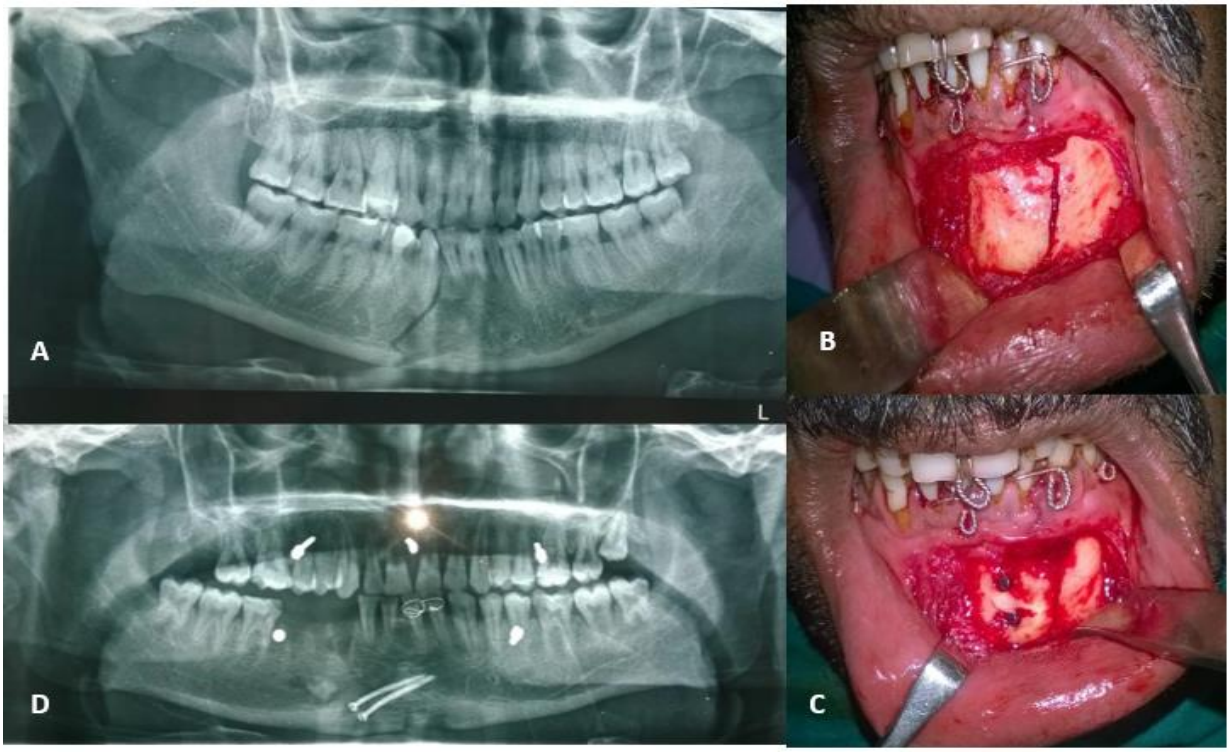

Figure 1: Internal Fixation using two lag screws. (A) Pre-operative OPG, (B) Intra-operative photograph showing fracture line (C) Intra-operative photograph showing fixation (D) Post-operative OPG

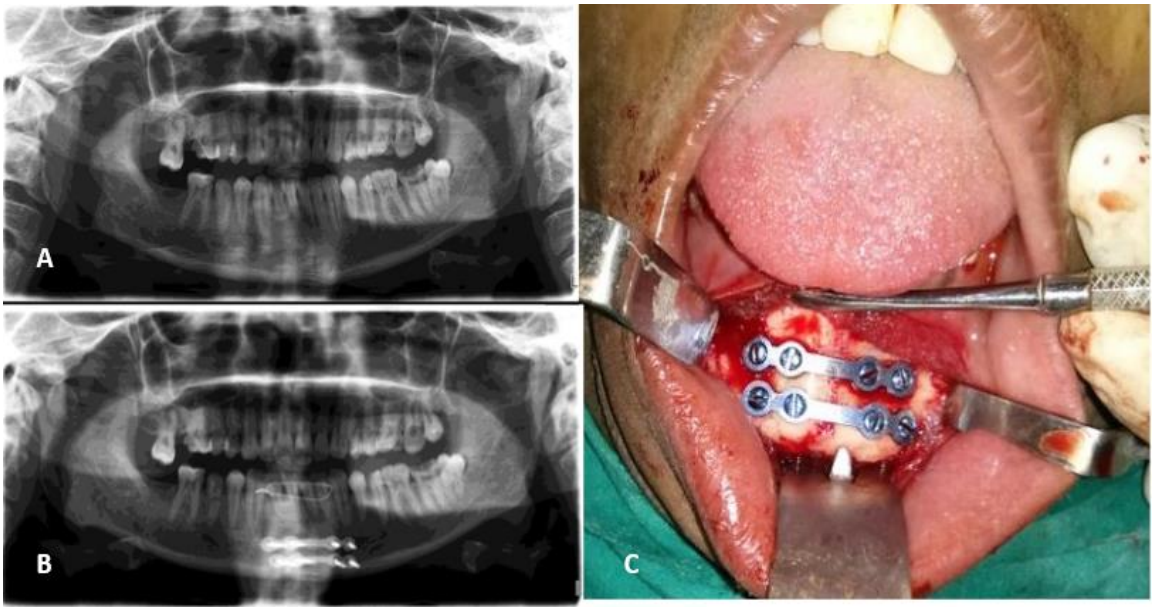

Figure 2: Internal Fixation using two mini-plates (A) Pre-operative OPG, (B) Intra-operative photograph showing fixation (C) Post-operative OPG

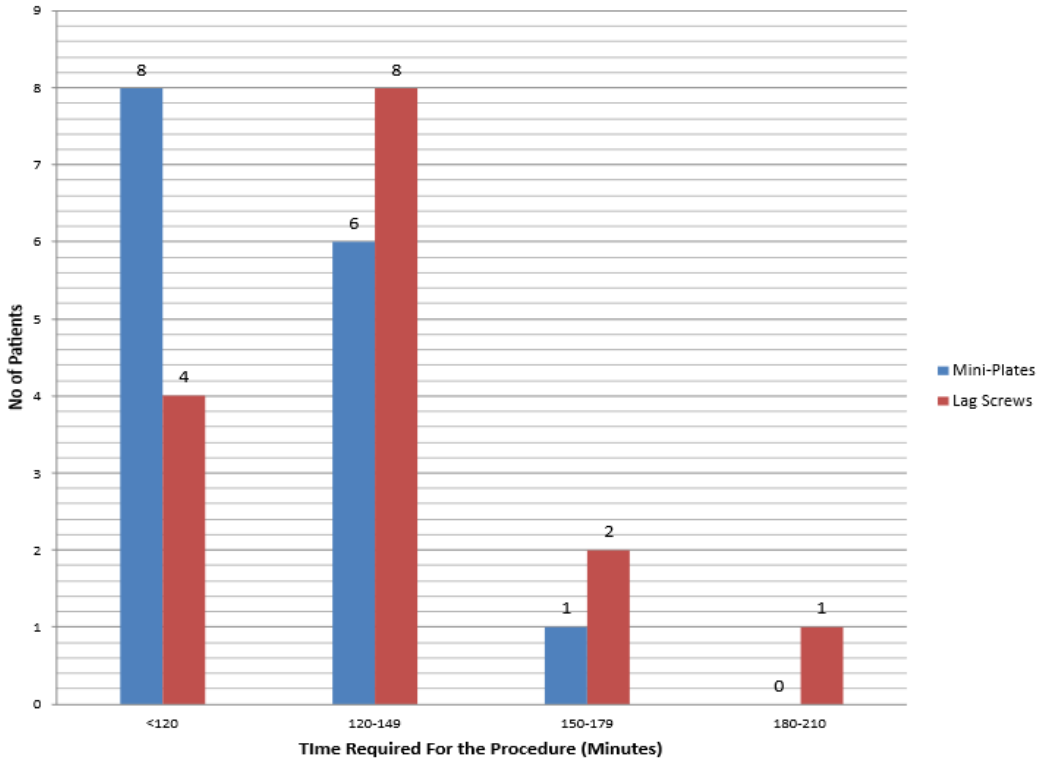

Figure 3: Comparison of duration of surgery in two groups

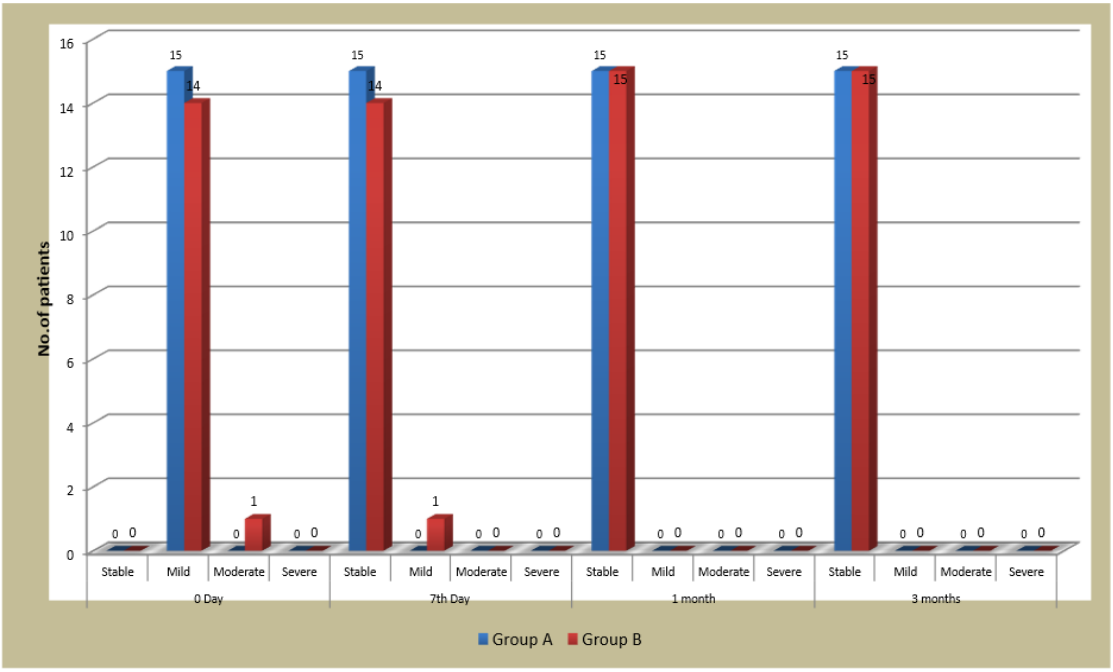

Figure 4: Comparison of Occlusion in two groups

Table 1: Distribution of patients according to infection

	Infection	Group A	Group B	p value
3rd Day	No Infection	14	13	1.00 NS
	Redness	0	0	
	Swelling	1	2	
	Purulence Discharge	0	0	
7th Day	No Infection	14	13	1.00 NS
	Redness	0	0	
	Swelling	1	2	
	Purulence Discharge	0	0	
1 month	No Infection	14	13	1.00 NS
	Redness	0	0	
	Swelling	0	0	
	Purulence Discharge	1	2	
3 months	No Infection	15	15	NA
	Redness	0	0	
	Swelling	0	0	
	Purulence Discharge	0	0	

Discussion:

Fractures of the anterior mandible are common facial injuries. The strategic position of the mandible on the facial skeleton and its unique role in mastication, deglutition, phonation and esthetics compels the clinician to give immediate attention whenever it is fractured. [8]

There are numerous techniques has been advocated for ORIF however the quest of optimum technique is still debatable. The goal of each of the operative treatment of mandibular fracture is to achieve functionally stable osteosynthesis which permits firm binding of fracture fragments, quick healing without complication, early return of function and aesthetics.

There are basically two different modalities of internal fixation, rigid fixation and semi-rigid fixation.[9]

Therefore, a study was deliberated to evaluate the influence of two fixation techniques in anterior inter-foraminal region of mandible on post operative sequelae such as occlusion, intersegmental mobility in all three planes, infection, nerve paraesthesia, damage to the tooth root.

Recently, the use of internal fixation utilizing mini plates has shown the highest success rates with lowest incidence of non-unions and post operative infection. When a fracture is compressed, absolute inter fragmentary immobilization is achieved with no

resorption of fracture ends, and intra cortical moulding across the fracture site whereby the fractured bone cortex is gradually replaced by new haversian systems. However, in other studies, it has been shown that absolute rigidity and intimate fracture interdigitation is far from mandatory for adequate healing. Compression is not necessary at the fracture site for healing, and it is questionable whether compression stimulates osteogenesis. [10]

In the present study, the incidence of mandibular fractures was more in males (87%) There were only 13% (4) females, one in Group A and three patients in Group B which can be attributed to more active social life-styles, more prone to situations like RTAs, sports activities, interpersonal violence, fall etc in males leading to more probability of fractures. Our results are in understanding with a few other studies had nearly similar results. [11-16] Maximum patient belonged to 20-30 years of age in both groups. The mean age of the patient for both the groups in our study were akin to those given in the previous studies [17-20]

The duration of surgery was measured from the time of placement of incision till the closure of surgical wound. The time duration for completion of the procedure was less for miniplates fixation as compared to the lag screw fixation. This is in contrast with the observations of Ellis and Ghali [8], who reported that lag screws could be applied more rapidly as compared to miniplates as the latter require contouring and adaptation, which may be time-consuming considering the complexities of the anterior mandible contour. We place lag screw rather infrequently in practice at our centre, and therefore the time required for placement of lag screws during the study was longer.

Restoration of pre-morbid occlusion is one of the important goals of management of fracture of dentofacial region. The effect of not restoring the occlusion to its original condition is disabling and can cause severe effects especially on the temporo-mandibular joint. Results of the present study were found to be statistically insignificant with regarding to occlusion.

At 1 month and 3 month follow up all the patients had stable occlusion in both the groups. Similar result found by Agnihotri et al,[3].in which none of the patient had any malocclusion at the end of 6 months follow up.

In the present study occlusal discrepancy was 6.6% (n=1) in miniplates group. Previous studies, [21-24] reported malocclusion in 3% to 6 % of patients treated with miniplates in symphysis region fracture, where a few studies [25], found 1.4 % of malocclusion [26].

In our study all lag screw treated patients, the occlusion was found to be stable, which was comparable with the result obtained in earliar studies [8] with lag screw osteosynthesis in anterior mandibular fracture. [2,27]

In the present study, there was no intersegmental mobility in both the groups at 0, 7th day,1 month and 3 months post operatively. This finding was comparable with finding of study conducted by Agnihotri, et al. [3]

In our study it was observed that there was no damage to the roots of teeth in either lag screw or mini plate patients as observed by OPG. Similar results were found by Edward Ellis in 2011.[26] However, E Eillis observed that, application of a second miniplate more superiorly on buccal cortex has potential to damage the tooth root. Such findings were not observed in our study.

Rigidity of fracture segment produces a stable foundation for soft tissue growth and improved vascularity to the area that improves and allows better healing of the wound. It also prevents bacteria from being continually pumped through the fracture site thereby decreasing the chance of osteitis. It is seen that, greater the mobility presents at the fracture site, greater the chances of infection.

Mandibular fractures are often contaminated by oral bacteria. The propensity of infection increases with natural reluctance of patient to swallow or move his tongue freely so that stasis develops with consequent accumulation of debris in the region of fracture. This encourages multiplication of the bacteria and the greater delay in obtaining reduction and immobilization; the more likely it is that infection will result.

Infection rate in the both groups was statistically insignificant. In Group B treated patients, two had infection at conclusion of 1st month post operatively for which no reason could be given. In one patient infection subsided once the antibiotic cover was changed. In another patient infection was not controlled inspite of specific antibiotic cover, this case showed signs of implant rejection, mandating removal of implant. In Group A one patient (6.6%) reported with post operative infection; the incidence of post operative infection was similar with Goyal et al;[28] who reported one case of infection out of fifteen in titanium miniplate group respectively responding to removal of plate, recurrettage and administration of oral antibiotics.

Our results were in contrast to the study by Tuovinen et al,[23] who determined the incidence of infection related plate removable to be 3.6%. Touvinen et al. [23]in addition to infection, they observed plate removal for other reasons, such as patient discomfort and plate fracture; however. Agnihotri et al.[3] observed that, the cortical screw fixation group had a lower incidence of postoperative complications compared to the miniplate fixation group, even though the percentage (12.5%) was much higher

compared to previous study by Ellis and Ghali.[8] Parallel observations was observed in study of Haranal S et al [27]in which 20 patient were treated with lag screw fixation in which the author found no post operative infection. Assael et al [29] had found lower incidence of infection due to absence of interfragmentary mobility as an advantage of lag screw technique.

Agnihotri et al [3] required removal of hardware (plate) in four patients (10%). According to him postoperative complications in the cortical screw group were minor and resolved without any aggressive management. Possible reasons for infection in the symphyseal region could be pre-existing subclinical infection, loose implant, foreign body reaction, inappropriate sterilization, poor host defence, and poor oral hygiene but at last both groups were having insignificant results.

Disturbance of sensation classically occurs after mandibular fractures. The nerve may not only be injured or severed when fracture takes place but may be further damaged during manipulation of fractured fragments while reduction of fracture. The minor damage is usually present if fragments are slightly displaced or not displaced, but damage is more if greater displacement of fragment is present Tuiovinen et al. [23]

The degree of paraesthesia in both the group was statistically insignifican. The neurosensory deficit improved in a week's time in our study. These results were in correlation with the previous studies [21-23,30] where paraesthesia was reported in few patients who regained their normal sensations after 12 weeks. This could be due to the injury to the nerve which may have resulted from oedema or stretching of soft tissue during retraction.

In lag screw fixation of anterior mandibular fractures, Kallela et al. reported paresthesia in the region of the mental nerve distribution in 68% of cases, which recovered within an average of 5.4 weeks. Cawood [21] reported an incidence of 8% for mental nerve paresthesia and attributed this to direct damage to the mental nerve caused while inserting the Plate. Goyal M et al. [28] showed that post–operative or sensory deficit in form of slight hypoesthesia in lower lip and chin region occurred in five (33.3%) cases of miniplates whereas it was present in two (13.3%) cases of lag screw group which probably in vicinity of mental foramen. But no paraesthesia was seen in the end results after 6 weeks.

Conclusion

Through the observations and results of this clinical study we would like to conclude that lag screw is a reliable and safe procedure in treating interforaminal mandibular fractures. It may be presumed that the greater quantity of implanted hardware and greater amount of bone drilling required for placement of a large number of screws and plates as compare to the lag screws. However clinical study with larger sample size is required to firmly validate whether lag screw or two miniplates is better for treatment of interforaminal mandibular fractures.

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