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Treatment of Mandibular Symphseal Fracture Using A Single Ao Locking Plate

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ABSTRACT: To prospectively evaluate the use of a single Arbeitsge meinschaftfür Osteosynthese frage(AO) 2.0-mm locking reconstruction plate for linear noncomminuted mandibular fractures without theuse of a second plate.
Patients and Methods: We analyzed the clinical and radiologic data of 20 patient with 20 fractures (11single fractures, 9 double fractures). Fracture locations were the symphysis body and angle . We recorded the mechanism of injury, timebetween admission to the hospital and surgery, gender and age, temporary maxillomandibular fixation and its duration, and the surgical approach. Postsurgical complications that were recorded as minor did not requiresurgical intervention, whereas major complications required further surgical intervention.
Results: All patients had satisfactory fracture reduction and a successful treatment outcome withoutmajor complications
Conclusion: The present study has demonstrated that treating linear noncomminutedmandibular fractures with a single AO 2.0-mm locking reconstruction plates is associated with no major complications and sound bone healing in all patients.

I. INTRODUCTION

The mandible is the most frequent site among facial fractures. Fractures with displacements are often treated by open reduction and internal fixation using mini plates.When planning a surgical strategy for mandibular fractures, it is most important to obtain arigid initial fixation to bear the masticatory load.While stabilization is as important for symphysis fractures as other mandibular fractures, has been relatively little study on an optimal method of internal fixation. This may be because, the shape of the symphysis region is simpler than that of the angles or condyles, surgeons could assume that differences in fixation methods were less important. Little data exist on the selection of the number and positions of a plate in the symphysis region, and these decisions are typically made empirically. To address this uncertaintyAkiko kimuraet alused 3-dimensional Finite Element Analysis to investigate whether or not the stability of the fracture surface differs with different plating strategies.Treatment of mandibular fractures has changed over the last 20 years. There has been a decrease in the use of wire osteosynthesis and intermaxillary fixation and an increase in preference for open reduction and internal fixation with miniplates. This has helped reduce malocclusion, non-union, improved mouth opening, speech and oral hygiene, decreased weight loss and increased the ability for patients to return to work early

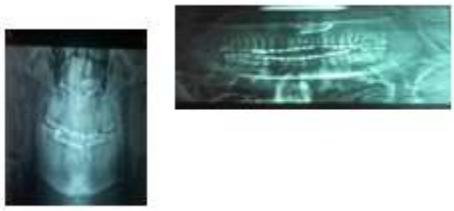
Research continues to focus on the size,shape,number and biomechanics of plate/screw systems to improve surgical outcomes,persue of this locking plate/screw system was developed which have certain advantages over conventional plate or Screws. Small self-locking systems can now be used where larger systems and more plates were needed in the past. The application of only one locking plate in contrast to two regular plates need a smaller incision and less operation time this leads to less trauma to the periosteum and the soft tissue. The locking plate system has been developed and popularized to obviate the main disadvantage of conventional plate system ,which requires the plate to be perfectly adapted to the underlying bone to avoid gaping of the fracture and associated instability. Thelockingbone-plate system act as an internal-external fixator ,which results in better distribution of the load and prevents load concerntration on a single screw, thus decreasing the risk of a screw's loosening and stripping. Moreover, because anatomic adaptation of the plate to the underlying bone contour is not crucial, there are theoretically fewer interferences with an adjacent vascular supply. Locking plates are designed with threaded holes through which the screw engages. This provide two separate points of

fixation for each screw: into the bone and into the threads of each screw hole. The screw lock to the the plate independent of the bone, and therefore the plate provide fracture stability without requiring direct contact to the bone. Advantages of locking plates over conventional plates -Less screw loosening; Greater stability across the fracture site; Less precision required in plate adaptation because of the "internal/external fixator"; Less alteration in osseous or occlusal relationship upon screw tightening.Gutwald (1999),Ellis and graham (2002) introduced a mini locking system. A stability three times higher than conventional miniplates was observed when mini plates were compared with mini-locking system in an in vitro trial(gutwald,2003). The application of this new plate system required no plate pressure onto the bone to maintain stability. The thread hole of the plate was congruently filled with screw head.both,the screw and the plate were connected via so-called cold welding. At one end the screw was anchored into the plate and at the other end into the outer cortex of the bone.By this a rigid frame was constructed in all three planes.In contrast to conventional fixing technique ,the bone was loaded more evenly under changing directions of force .The principle of the mini-locking system is analogus to external fixation .The main difference is that plate is located closer to the bone,but doesn't have intimate contact.so the term "internal fixation" appears to be appropriate. The directions of forces that are distributed through the anterior mandible vary with the activity of the mandible.5 This means that the classical zones of tension on the superior and compression on the inferior surfaces of the mandible are not absolute, Instead, the anterior mandible undergoes shearing and tensional (twisting) forces during functional activities. When a force is directed along the parasymphysis-body region of the mandible, compressive strain develops along the buccal aspect, whereas tensile strain develops along the lingual aspect. This produces a fracture that begins in the lingual region and spreads toward the buccal aspect. These vector forces separate the inferior border of mandible at the site of fracture. Application of fixation devices must therefore take these factors into consideration.The purpose of the present study was to evaluate prospectively the accuracy and reliability of the use of single locking reconstruction plate in the treatment of Linear,non-communited mandibular parasymphseal fractures, without the use of asecond plate.

II. AIM AND OBJECTIVES

The AIM of the present study is to evaluate prospectively the accuracy and reliability of the use of single locking reconstruction plate in the treatment of Linear,non-communited mandibular parasymphseal fractures, without the use of a second plate.Objective of this prospective study areAnd to evaluate the outcome in terms of -

- Malocclusion
- Infection at surgical site
- Paraesthesia
- Need for removal of plate
- Bitting efficiency
- 6) Reduction, any Malunion, distraction of lower border of mandible using radiographs (opg).



PREOPERATIVE & PROSTOPERATIVE PANAROMIC RADIOGRAPH

III. MATERIALS AND METHODS

- This in-vivo prospective study was carried out in the Department of Oral and
- Maxillofacial Surgery, Sharda university,greater noida from june2012-
- august2014. In this study 20 patients diagnosed as cases of displaced
- mandibular parasymphseal fractures were treated with open reduction and
- internal fixation.
- INCLUSTION CRITERIA
- Displaced mandibular anterior fracture with no associated condylar frature
- where performing osteosynthesis will result in greater stability of fracture and
- rigidity to promote healing and to reduce the chances fo complications like
- infection, malunion, non union etc. during fracture healing.
- Immune status---not compromised
- Age range of 12-45 years
- Dentulous upper and lower arches
- Patients who are highly interested for unrestricted jaw movement
- immediately after treatment
- EXCLUSION CRITERIA

- Patients less than 12 years or more than 45 years of age.
- Multiple fractures.
- Communited mandibular fractures
- Neurological injuries
- Uncontrolled seizures
- Pre-exsting mental disabilities
- Patients with compromised nasotracheal airway
- Pathologic fractures
- Hematological disorders
- Edentulous ridge
- Following criterious were assessed in the study:
- Malocclusion
- Infection at the fracture site
- Paraesthesia
- Need for removal of plate
- Bitting efficiency
- Reduction, any Malunion, distraction of lower border of mandible using
- radiographs (opg).
- MATERIAL USED
- 2.0mm locking titanium plates with 8mm or 10mm monocortical screws were
- used.
- Chemical composition of the titanium was as follows:
- It consists of high strength titanium alloy enriched with niobium and
- aluminium.
- Dimension of the locking plate– 2.0mm
- Screw Reference
- Thread diameter : 2.0 mm
- Screw type: Cortex
- Drill bit for: 1.1 mm
- threaded hole
- Tap : self-tapping
- Drive type : 1.5 mm/2.0 mm cruciform
- Surgical Protocol
- The entire surgical method consisted of the following steps
- Diagnostic work up
- Pre operative preparation of the patients
- Surgical technique
- Post operative management
- Follow up
- Diagnostic work up
- Detailed history and through clinical examination of each patient was carried
- out to arrive at a provisional diagnosis. Necessary radiographs which included orthopantomogam (O.P.G) and PA view mandible were taken to make the final diagnosis and to assess the extent, displacement and direction of fracture line. Routine blood profile of the patient (hemogramalog with HIV and HbsAg) was carried out. All patients were evaluated for fitness for surgery and anesthesia.
- Pre surgical occlusion
- Dental status
- Fracture severity
- Location of fracture
- Pre – operative preparation

Written informed consent from patient's relatives was taken for anesthesiaand surgery.

Preoperatively all patients were prescribed I gram Amoxicillin and

Diclofenac Sodium 150mg/day in divided doses via oral or intramuscular route.Part preparation of the patient was done (facial shaving).Surgical techniqueAll procedures were performed either under General Anethesia with nasotracheal intubation or under Local Anethesia. Local infiltration of 2% lignocaine hydrochloride with 1:2,00,000 adrenaline was given in and around surgical site.A strict aseptic protocol was followed which included extraoral painting with 5% povidine-iodine solution and draping the patientMandibular intraoral vestibular surgical approach Depending upon the fracture line an incision was made inraorally, the extension was kept to a mininmum and placed 4-5mm below the attachment of mucosa and gingival. Incision ws carried through the mucosa only and thenthe second incision.OBESERVATIONSwas made at right angles to the underlying bone and carried down through the submucosa, muscles and periosteum and a mucoperiosteal flap was raised. Care was taken to avoid injury to mental nerve. The periosteum was handled carefully. In some cases where an existing laceration (extraoral) was present fracture site was exposed through the laceration only.Stabilization of occlusionAfter adequate exposure of the fracture line, the fracture margins would be irrigated and curetted to remove all debris, trapped muscle and unhealthy tissue, then the fragments were reduced either manually or by bony hooks and bone clamps were placed to stabilize the fragments in proper reduction.Following reduction, occlusion was checked and secured either by hand adaptation or by intermaxillary fixation performed to preoperatively placed arch bars Mini plate fixation was done in accordance with the principles of mini plates placement. With a modeling pliers and levers the miniplate was adapted to the outer cortical surface at the level just above the lower border.

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After drilling a hole the screw was inserted and only then next hole was drilled. After that the plate was fixed with two screws on one side of the fracture and care was taken to drill the first in the other fragment so that optimal adaptation of fracture fragments was achieved. The drill was held perpendicular to the bonesurface, an angulation of only up to 300 was done. To neutralize the torsional forces two parallel plates were used with a gap of 4mm to 10mm. The lower plate was fixed first using the bicrotical screws and then the subapical plate was placed and fixed with monocortical screwsAfter fixation was done IMF was released and occlusion was waschecked.After adequate hemostasis and irrigation suturing of the flap was done.Compressiondynaplast bandage is put on the chin to minimize the post –operative oedema and swelling.

POST OPERATIVE MANAGEMENT

Patients treated under general anesthesis were put on intra venous infusion post operatively. Oral fluid intake was permitted after the patients recovered uneventfully froim the effect of general anesthesia.Preoperatively all patients were prescribed 1gram Amoxicillin IVand Dexamethasone 8mg IV Stat via oral or parental route was prescribed to the patient postoperatively for 5 days.Patients were strictly asked to maintain oral hygiene by normal saline rinses suture removal was done on 7th day postoperatively. Assessment for any post operative complication done before discharging the patient..

- RADIOLOGICAL ASSESSMENT OF POST OPERATIVE RESULTS.
- An OPG to assess for reduction achieved after surgery. On evaluation of lower border if fragment are at distance of less than 2mm then it wasdesignated as compromised.
- FOLLOW UP AND POST OPERATIVE EVALUATION

patient's were discharged and put on soft, liquid diet for the first two weeks and then diet pattern was changed on subsequent follow up visit after assessing the recovery of the patient. Subsequent follow up was done on 2nd, 4th, 6th ,8th week ,3RD month,6thmonth postoperatively. During every follow up patient was assessed clinically for infection, malocclusion, loosening of plate/screw, sensory disturbance, plate fracture, malunion/non-union, devitalisation of assosicated dentoalveolar segment and bite force measurement done on 2nd week,3rd month and 6th month. Radiographs were taken if necessary and patients were further assessed for any complaint

MEASUREMENT OF BITE FORCE

It is measured in kilograms pound using a bite force transducer . The measurements were taken second week,third month and sixth month post operative2.0-mm locking AO synthes plates with self tapping screws will be used.The following implants and instruments will be used in the study –Titanium locking plates (2.0mm system - 4 hole)Titanium bone screws, self tapping Length 6.0mm/8.0mmPlate bending pliersStraight Three prong plier Plate holding forceps Reduction forcepsScrew driver with screw holding device twist drills of 1.5 mmSterilizing containerOther surgical instruments as routinely used for open reduction and internal fixation of mandibular fracturesself retaining cheek retractor

IV. RESULTS

Twenty patients were included in this randomized controlled in vivo study. These patients were treated with single AO titanium locking plate..

- FRACUTRE SITE NO. OF PATIENTS
- Midline symphysis 5
- Right
- parasymphysis 10

Left parasymphysis 5

All data relevant to each parameter bite force was collected. The numerical values were recorded for bite force using a bite force transducer on 2nd week, 3RD Month, 6thmonth post operatively.In the 20 patients ,10 had a single fracture, 6 had a double fracture, and 4 has a triple fracture. The mean age of patient was 32 years (range 11 to 61 years) with a male predominance (n=32,71.1%). The mean delay between admission to the hospital and surgery was 40 hours (range 1hour to 20 days). The mechanism of injury was traffic accident in 10 patients,fall in 4,sporting accident in 2,interpersonal violence in 2, and work accident in 2.An intraoral approach was performed in all patients.A preoperative MMF was performed in all patients.Teeth were present in the fracture area in all patients were never removed.

A single 2.0 mm locking reconstruction plate was fixed to each stable fragments with 3 screws at the basilar border of the mandible. All incisionswere closed with suction drains, which were removed 24 to 48 hours postoperatively.follow up ranged from 8 weeks to 12 months with a mean of 10 months. There were no intraoperative omplications.6 patients wth an associated subcondylar fracture and 1 patient with a le fort fracture required postoperative MMF with traction elastics for 3 to 6 weeks

postoperatively.ten patients developed hypoesthesia of the inferior alveolar nerve.,and 1 developed minor malocclusion. We did not not any dental necrosis due to a screw within the dental root.none of the patients developed major complications.anatomic reduction of fractures and sound bone healing were shown radiographically in all patients.During the second post operative week ,fractured side bite forces were still well below control values opf 9 to 37 kp .Fractured side masseter muscle forces at this time ranged from 1.3 to 9.9 kp. At 3rd month follow up ,the fractured site bite force ranged from 11 to 42 kp.Fractured site masseter forces during this time ranged from 4.3 to 10.7 kp,still well below the control values. The bite force in all the measured regions, namely the region of the molar on the side of the fracture ,those on the opposite side and between centralincisors,increased during six month period.

V. DISCUSSION

Linear noncomminuted mandibular fractures have been treated for years by placing a tension band plate at the superior border and a dynamic compression plate at the inferior border of the mandible.this plating system allows for a sharing of masticatory compressive and tension forces among the bone,plate and screws and conversion of these forces to shear stress at the bone-plate interface,which increases stability.In the 2003 launch in Switzerland a new international low-profile miniatured2.0 mm mini locking system, there is a favor to use a single 2.0 mm locking reconstruction plate at the inferior border and no tension band plate at the alveolar border of the mandible to treat all linear noncomminuted mandibular fractures.These studies have shown strikingly improved stability of this system compared with the non locking miniplates ,especially in decreasing the torsion and opening of the fracture site.the 2.0 mm lock reconstruction plates have 3 primary charcteristics that make it an ideal plate :a low profile ,locking screw-plate system and high- strength titanium alloy enriched with niobium and aluminium.Our study showed the absence of major complications ,which allow for more rapid and undisturbed bone healing and decreased risk of delayed union,nounion or infection . first , the absence of pressure under the plate prevents the cortical blood supply from being disrupted and allows periosteumgrowth under the plate.second,stress shielding below the plate is eliminated ,which prevents chronic inflammation and subsequent bone necrosis Moreover, AO 2.0 mm locking reconstruction plates offer the advantages resulting from buttress plates,which can support a full functional load by acting as load bearing devices and counter and convert shear forces to compressive axial forces at the fracture site.this , improves the stability of the construct which decreases the gap strain and the mechanical susceptibility to infection that occurs when adequate stabilization is no longer guaranteed.The author showed that bite force values increased during the evaluation Period but was reduced there after.Bite force value remained lower during 6thweek.Gerlach and Schwarz et al performed a bite force study in the region of the molars ,canine and incisors in 22 patients with mandible fractures treated with champytechnique.Those author showed that the maximum bite force achieved achieved by themand treated in the first week was 31% and that the force reached 58% in the sixth and the final week of the evaluation.In the present study ,6 months after surgery the bite force values in the region of first molars is 70% and in the region of central incisors the bite force values were (95.4%).Thus far to the best of our knowledge,Ellis and graham were the only investigators to report on the clinical use of AO 2.0 mm locking reconstruction plates for mandibular fractures.In a series of 20 patients with 20 mandibular fractures ,these researchers reported the use of 20 AO 2.0 mm locking plate,but they found sound bone healing radiographically in all patients

VI. CONCLUSION

Fracture of mandible occurs more frequently than any other fracture of the facial skeleton . Despite the fact that the mandible is the largest and strongest facial bone ,it is very commonly fractured ,generally occurring 2-3 times as often as midfacial fractures. This is due to its relative prominent position. Mandibular fracture occurs in people of various ages and races ,in a wide range of social settings.The purpose of this study is to evaluate the efficacy of 2.0mm locking plates in the mandibular parasymphseal region in terms of Malocclusion (premature contact, open bite, cross bite), Infection at surgical site, Paraesthesia, Need for removal of plate, Bitting efficiency, Reduction, Malunion, distraction of lower border of mandible using radiographs (opg).Subsequent follow up was done on 2ndweek,3rd month and 6th month postoperatively, During every follow up patient was assessed clinically for infection, malocclusion, loosening of plate/screw, sensory disturbance, plate fracture, malunion /non-union, devitalisation of associated dentalveolar segment and masticatory efficiency. Radigographs were taken if necessary and patients were further assessed for any complaint.During the second post

operative week ,fractured side bite forces were still well below control values opf 9 to 37 kp .Fractured side masseter muscle forces at this time ranged from 1.3 to 9.9 kp. At 3rd month follow up ,the fractured site bite force ranged from 11 to 42 kp.Fractured site masseter forces during this time ranged from 4.3 to 10.7 kp,still well below the controlvalues. The bite force in all the measured regions, namely the region of the molar on the side of the fracture ,those on the opposite side and between central incisors,increased during six month period.In conclusion, the present study has demonstrated that treating linearnoncomminuted mandibular fractures with a single AO 2.0 mm locking reconstruction plate allows sound bone healing and is not associated with major complications. Moreover, this study showed that the AO 2.0 mm locking reconstruction plates placed at the inferior border of the mandible seem capable of neutralizing compression and tensile forces,thus making unnecessary the use of a second plate at the superior border of the mandible.Although , this report is promising , it should be interpreted with caution because only a prospective study comparing the conventional plating with the locking plating would allow definitive conclusions to be drawn

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