RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, BANGALORE, KARNATAKA

FEASIBILITY AND EFFICACY OF LAG SCREWS IN THE MANAGEMENT OF MANDIBULAR SYMPHYSIS AND PARASYMPHYSIS FRACTURES

Dissertation Submitted

in partial fulfillment of the requirements for the degree of

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IN ORAL AND MAXILLOFACIAL SURGERY.

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DR. SANJAY BYAKODE

DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY,

P.M.N.M DENTAL COLLEGE AND HOSPITAL,

BAGALKOT - 587 101, KARNATAKA.

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By

DR. SANJAY BYAKODE

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Under the guidance of

Dr B.C.Sikkerimath. **M.D.S.**
Associate Professor,

DEPARTMENT OF
ORAL AND MAXILLOFACIAL SURGERY,
P.M.N.M DENTAL COLLEGE AND HOSPITAL,
BAGALKOT - 587 101, KARNATAKA.

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Rajiv Gandhi University of Health Sciences,

Karnataka

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I hereby declare that this dissertation/thesis entitled **"FEASIBILITY AND EFFICACY OF LAG SCREWS IN THE MANAGEMENT OF MANDIBULAR SYMPHYSIS AND PARASYMPHYSIS FRACTURES"** is a bonafide and genuine research work carried out by me under the guidance of **Dr B.C.Sikkerimath** M.D.S. Associate Professor, Department Of Oral and Maxillofacial Surgery, P.M.N.M. Dental College and Hospital Bagalkot.

Date: 26/11/2006

Place: Bagalkot.

Dr. SANJAY. BYAKODE.

CERTIFICATE BY THE GUIDE

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Guide:

Date: 26/11/2006

Place: Bagalkot.

Dr B.C.Sikkerimath M.D.S.
Associate Professor
Department of oral and maxillofacial surgery,
P.M.N. Dental College And Hospital,
Bagalkot - 587 101, Karnataka.

ENDORSEMENT BY THE HEAD OF THE DEPARTMENT AND PRINCIPAL/HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"FEASIBILITY AND EFFICACY OF LAG SCREWS IN THE MANAGEMENT OF MANDIBULAR SYMPHYSIS AND PARASYMPHYSIS FRACTURES"** is a bonafide research work done by **Dr.Sanjay Byakode,** postgraduate student under the guidance of **Dr. B.C.Sikkerimath** **M.D.S.** Associate Professor, Department Of Oral and Maxillofacial Surgery, P.M.N.M. Dental College and Hospital Bagalkot.

Head of the Dept.

Dr.Neelakamal. Hallur.**M.D.S.**
Professor,
Department of oral and maxillofacial surgery,
P.M.N.M. Dental College and Hospital,
Bagalkot - 587 101, Karnataka.

Date: 26/11/2006

Place: *Bagalkot.*

Principal:

Dr. Veena Subbarao. M.D.S.
Principal,
P.M.N.M. Dental College and Hospital, Bagalkot - 587 101, Karnataka.

Date: 26/11/2006

Place: *Bagalkot.*

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Place: *Bagalkot.*

Dr. SANJAY BYAKODE.

Dedicated

To

My Beloved Parents

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Date: **26/11/2006**

Place: Bagalkot ***Dr. Sanjay Byakode.***

ABSTRACT

TITLE: FEASIBILITY AND EFFICACY OF LAG SCREWS IN THE MANAGEMENT OF MANDIBULAR SYMPHYSIS AND PARASYMPHYSIS FRACTURES

AUTHORS: Dr Sanjay Byakode* Dr B.C.Sikkerimath ** Dr Neelakamal Hallur*** Dr.Santosh Gudi****.

BACKGROUND: The most commonly used methods for fixation of mandibular fractures are Intermaxillary fixation, non-compression plates, Compression plates and Trans osseous wiring. Since only few studies were reported in the literature regarding Lag Screw fixation for the treatment of mandibular symphysis and parasymphysis fractures, present study was undertaken to evaluate the feasibility and efficacy of lag screws in the management of mandibular symphysis and parasymphysis fractures.

AIMS AND OBJECTIVES:

1. To evaluate the stability of mandibular symphysis and parasymphysis fractures fixed using lag screws.
2. To evaluate the post operative occlusion after lag screw fixation for mandibular symphysis and parasymphysis fractures.
3. Radiographic evaluation of accuracy of reduction & bone healing.

MATERIALS AND METHODS: This study included 10 cases of mandibular symphysis and parasymphysis fractures. These 10 cases were admitted and treated in department of oral and maxillofacial surgery; P.M.N.M. Dental College and Hospital Bagalkot and evaluated as per intraoperative and postoperative protocol.

RESULTS: None of the cases had intraoperative complications. Post operatively stability was obtained in 9 [90%] cases. 9 [90%] patients had good occlusion at six week follow up. 6 weeks post operatively none of the patients had any signs of mental nerve injury [100%]. All the screws in all 10 [100%] cases were in acceptable normal position without causing any damage to the roots or inferior alveolar nerve.

CONCLUSION: Lag screw fixation can be used as a routine technique in the treatment of mandibular symphysis and parasymphysis fractures.

KEY WORDS: Lag Screws; Mandibular fracture; Rigid Osteosynthesis;

* Post Graduate student, **Associate Professor, *** Professor, **** Reader.

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Introduction

Restoration of the facial appearances and function requires surgical attention of the highest order after the injury. Those injuries may be simple and confined to the soft tissues or may be complex and involve the underlying facial skeleton. Any injury to facial skeleton results in deformity and disfigurement primarily due to the complete dependence of the facial features, for their form, on the bony support.

Fractures of the mandible are common facial injuries. Chin being the most prominent part of the face, the mandible is prone to fracture in any automobile collision, industrial, domestic or other accidents and fights. For centuries surgeons have been in search of adequate and better methods of reducing and immobilising bone fractures. Different techniques have been employed for the fixation and immobilization of the fractures of the facial skeleton.

It is a common finding that patients whose fractures are treated by closed reduction and immobilized with MMF alone have a functional, but perhaps not premorbid occlusion post operatively, and that the fractures have not been anatomically reduced when evaluated Radiographically.[1] With the advent of internal fixation techniques came the opportunity to obtain both the re-establishment of the patient's normal occlusion and anatomical bony reduction. Then the question arose that if MMF did not often achieve anatomical reduction, was its use necessary at all, because fracture reduction can be achieved by precise internal fixation techniques, which coincidentally also results in restoration of normal occlusion.[2]

With the recent enthusiasm for rigid forms of internal fixation, experimentation with various forms of plate and screw fixation have, resulted in extremely innovative techniques for providing rigid internal fixation. Various investigations have clearly shown that rigid internal fixation also promotes primary bone healing without the extended use of maxillomandibular fixation and makes the fracture less susceptible to infection.[3]

The use of bone screw and compression plates for the treatment of mandibular fractures is derived from concepts developed in Orthopaedic surgery. Essentially three goals are desired: Anatomical reduction, Fracture fragment compression, and Rigid immobilization. Anatomic reduction is thought to promote primary bone repair, resulting in direct lamellar bone formation in medullary bone without a cartilaginous phase. In cortical bone, longitudinal growth of capillaries and osteogenic cells across the fracture line occurs by way of tunnels. Compression is thought to promote healing, probably because of closer apposition of the bone fragments. Rigid immobilization theoretically allows osteogenesis to occur in an ideal environment without the negative influence of mobility at the fracture site.[4]

The mandibular fractures are extremely susceptible to salivary contamination and subject to strong biomechanical forces. These two factors therefore dictate the use of a particularly stable fixation in their treatment.

The concept of Lag Screw osteosynthesis is defined as the stable union of two bone fragments under pressure with the aid of screws, which in turn, are under tension.[5] The lag screw technique was first introduced to Maxillofacial Surgery by Brons and Boering in 1970[6], who cautioned that at least two screws are necessary to prevent

rotational movements of the fragments in mandibular body fractures. Lag screws provide rigid fixation by causing inter fragmentary compression. Lag Screws have threads on one half of the shaft, with the portion below the head being smooth so that it will not engage the outer cortex. This allows the inner segment to be compressed against the outer segment. They are used successfully in mandibular fractures.[1] In osteosynthesis, the requirement of a minimum of implant material with maximum stability always should be considered. This goal is particularly appropriate for Lag Screw osteosynthesis.[5] In mandibular fractures technique of lag screw fixation was initially limited to oblique mandibular fractures. Its implication in maxillofacial surgery later found widespread usage in the treatment of midline symphyseal fractures, parasymphyseal fractures, oblique fractures of the mandibular body, angle fractures, and condyle fractures. In orthognathic surgery they are used particularly for saggital split osteotomies and genioplasties.

Very few studies have been reported in the literature about the usage of lag screw technique as a treatment of choice in mandibular fractures particularly involving the anterior region. This study was therefore planned with the aim to assess the practicability of the technique and rigidity of lag screw fixation in the treatment of mandibular symphysis and parasymphysis fractures.

Aims and objectives

The aims and objectives of this study were to evaluate lag screws as a method of internal fixation of mandibular symphysis and parasymphysis fractures for the following terms:

1. To evaluate the stability of mandibular symphysis and parasymphysis fractures fixed using lag screws.
2. To evaluate the post operative occlusion after lag screw fixation for mandibular symphysis and parasymphysis fractures.
3. Radiographic evaluation of accuracy of reduction & bone healing.

Review of literature

In a retrospective study they reviewed 41 patients treated by open reduction and internal fixation of anterior mandibular fractures by lag screw technique, 33 patients were males 8 patients were females. They ranged in age from 14 to 59years. 2 lag screws were placed in majority of patients (29), 3 lag screws were placed in 2 patients, 1 lag screw was placed in 7 patients, a single lag screw was combined with a small compression plate (using 2mm screws) in 3 patients. Because of associated fractures, MMF was used in 9 patients. No MMF was used as a supplement to lag screw fixation of symphyseal fractures. The results of the study indicated that lag screw fixation of mandibular anterior fractures does not lead to any post surgical malocclusion. In their study two patients developed post surgical infections, both were thought to be due to a non vital tooth in the line of fracture that was subsequently removed, and were managed by sequestrectomy and external pin fixation respectively. They concluded that apart from rigid fixation, lag screws can be applied more rapidly, since the time consuming task of adapting a bone plate is obviated, this also allows a more anatomical and accurate reduction.[3]

A study carried out to evaluate clinical and radiological results after lag screw fixation of mandibular parasymphyseal and angular fractures. There were 4 female and 19 male patients. Mean age of the patients was 29 years. All patients were dentulous, having at least the second bicuspids as the distal most tooth on both sides and in both jaws. Seven angle and seventeen parasymphyseal fractures in twenty-three adult patients were treated by trans oral reduction and lag screw fixation. 7 patients with parasymphyseal lag screw fixation received MMF for three weeks to treat condylar fractures. In the other patients no MMF was used. Clinical and radiological examination

of these patients during a three month follow-up period was done. Post operative radiographs revealed anatomic reduction without displacement in 21 cases. In 2 cases displacement was mild. In one case osteosynthesis was broken down. There were no signs that the screws had engaged the inferior alveolar canal. After surgery slight occlusal adjustment was needed in five patients. The study concluded that lag screw fixation of mandibular parasymphyseal fractures is a practical and effective way of internal fixation. It leads to good bone healing without permanent neurosensory deficit or increased risk of malocclusion however in mandibular angle fractures lag screw fixation is likely to be too technique sensitive to allow its extensive use. [7]

A prospective study was conducted in 5 patients in whom all the patients were treated by application of minimal access technique with lag screw fixation. Two patients underwent plate fixation of associated mandibular angle fracture, and three patients had closed reduction of condylar neck fracture. Access for drilling and lag screw fixation was obtained by two 1 cm vertical incisions equidistant from the fracture line and minimal periosteal stripping was done. Fractures of the anterior mandible were treated using single lag screw for internal fixation and arch bar as a tension band. The results of study indicated that lag screw fixation of anterior mandibular fractures leads to good bony healing without any occlusal discrepancies, neurosensory disturbances or temporomandibular joint movement problems. In one case drill bit got fractured and was left in place. The study concluded that apart from being simple and effective method of treating anterior mandibular fractures, this technique avoids conventional large degloving

incision hence decreased postoperative swelling and scarring, improved dental hygiene, better nutrition and communication and reduced recovery time.[8]

A study was conducted in 18 patients with mandibular angle fracture; average age of patients was 25.4 years. 16 patients had all their mandibular teeth, 2 had only anterior teeth. Two patients had associated parasymphysis fracture and one patient had subcondylar fracture. All the fractures were fixed with single oblique Lag Screw. The results of the study showed good results except for few minor complications: wound infection in four cases which were treated by opening the incision, placement of iodoform gauze and drain. 17 cases had good post operative occlusion, 5 patients had post operative hypesthesia of inferior alveolar nerve, in one case the drill hole was in wrong direction – the post operative radiographs showed a good result. The duration of the hospital stay was less than 10 days. Authors concluded that this procedure makes repositioning of the fragments with direct visualization possible, assures sufficient interfragmentary pressure and therefore primary bone healing, and requires a relatively simple and quick operative procedure, by use of intra oral approach visible scars were avoided.[9]

A retrospective study consisted of 30 patients who were treated by open reduction and internal fixation of at least one mandibular angle fracture by lag screw technique, 24 patients were female and 6 patients were male. They ranged in age from 17 to 49. 14 patients had a unilateral angle fracture as their only mandibular fracture, two

patients had bilateral angle fracture, 11 had a combination of angle and symphysis fracture and 3 had a combination of angle and body fracture. The additional fractures were treated with plate and screw or lag screw fixation. 28 patients had tooth in the line of fracture and all were removed during the surgery. The results indicated that following application of lag screw, 22 fixations were stable to aggressive bimanual manipulation of mandible, 8 patients had slight mobility of the fracture, necessitating supplemental methods of fixation. In one patient 2mm compression plate was applied to the lower border. In seven patients post operative MMF was applied for 3 to 4 weeks. Post operatively radiographic evaluation showed excellent reduction in every patient. No patient developed non union or mal union. Two patients were found to have mild occlusal discrepancy in the first two post operative weeks which were managed by 3 to 4 weeks of maxillomandibular elastics. Seven patients developed soft tissue infection/bone exposure within the first few weeks. Three resolved after oral antibiotics while 4 patients required further intervention including removal of the hardware and small sequestra. They concluded that lag screw fixation of mandibular angle fractures is a simple, yet extremely technique sensitive method of rigidly securing the fragments. They also concluded that the lag screw type of rigid fixation have several unique advantages over bone plate fixation like simple technique, less time consuming, accurate anatomical reduction and low cost.[10]

A retrospective study consisted of Sixty nine mandibular fractures in 44 patients treated with lag screw fixation. Fractures were 21 angle, 19 body, 27 symphysis, 2 ramus. Fractures anterior to first molar were treated intra orally

while posterior to first molar were treated extra orally. In 19 fractures a neutralization plate was used and in another 17 the lag screw was applied in combination with a compression plate. In 33 cases at least 3 lag screws were inserted. In one case two wires were also used to keep together some of the fragments of a comminuted fracture. Teeth in the line of fracture were not removed. Complications included two minor malocclusions, one delayed union, two cases of temporary paresis, two cases of transient hypesthesia, two cases of scar formation on the incision line, and a case of temporary trismus. Authors concluded that the lag screw osteosynthesis is a method that provides the advantages of rigid internal fixation with less cost. Minor complications encountered were mostly related to the surgical approach rather than the technique of fixation.[11]

A comparative study was conducted in 40 patients with fractured body of the mandible who were treated randomly by lag screws, Trans osseous wiring or by AO plate fixation with lag screws. 24 patients had unilateral fractures and 16 had bilateral fractures of the mandibular body. 29 patients had a complete or mutilated dentition and 11 were edentulous. 5 patients were treated with plate fixation, 22 patients were treated with wire fixation, and in 13 patients Lag Screw fixation was done. In 39 cases the results were clinically good. One patient died of complications caused by thorax trauma. Malunion or non union did not occur in any of the cases. In one patient fracture redislocated as the lag screw was not of adequate length which was managed with a longer screw. In 9 patients mental nerve hypoesthesia was noted. Radiographically fracture lines disappeared in 6 to

10 weeks in 26 patients, & after 10 weeks in 13 patients. They concluded that AO plate with lag screw fixation gives the most stable fixation for fractured body of the mandible.[6]

A retrospective study consisted of 214 patients who were treated for 270 mandibular fractures using rigid internal fixation method. Dynamic compression plate, eccentric dynamic compression plate, reconstruction plates and lag screws were used for fixation. Only in 48 patients because of associated facial bone fractures MMF with elastics was used for 3 to 4 weeks. The results of the study indicated that good primary bone healing was observed in 93.9% of the patients. Infections, seen in 6 of the patients were related exclusively to inadequate stability of the fracture. Malocclusion, observed in 18.2% of 159 dentate patients, was caused by incorrect plate bending and insufficient fracture reduction. Immediate postoperative dysfunction of the inferior alveolar nerve in 58.1% of the cases, and of the mandibular branch of the facial nerve in 12.7%, was observed, which resolved completely 1 year after surgery. Mean inpatient time was 5.1 days. Authors concluded that rigid internal fixation is a reliable method of treatment, especially indicated for patients with reduced healing capacity and poor co-operation.[12]

A prospective study was conducted, in which thirteen patients underwent open reduction and single oblique lag screw fixation for fractured angle of mandible. 10 were male and 3 were female patients. Seven patients had isolated angle fracture, two patients had contra lateral body fracture treated with dynamic compression plate, one patient had associated parasymphysis fracture treated with dynamic

compression plate, and one patient had associated subcondylar fracture treated with MMF. One more patient was maintained into MMF post operatively for an associated difficult contra lateral body fracture treated with compression plate. The results of their study indicated that lag screw fixation of mandibular angle fractures leads to good bony healing without any occlusal discrepancies. In one case the 2.7 m tap used to thread the proximal fracture fragment sheared off, leaving the 2cm segment within. Successful lag screw placement was performed adjacent to the broken tap. They concluded that after single oblique lag screw fixation for fractured angle of mandible intermaxillary fixation is not necessary, it is an economical and effective technique.[13]

In a prospective pilot study in which authors compared single lag screw osteosynthesis vs. maxillomandibular fixation for isolated mandibular angle fracture, 10 patients underwent single lag screw fixation where as 12 patients under went maxillomandibular fixation. Among lag Screw group four patients were edentulous and their occlusion could not be tested. Two edentulous patients required post operative minor adjustment of dentures. They found that in lag screw group 1 patient developed postoperative mental nerve paresthesia which resolved in 5 weeks. 4 patients were noted to have micro motion at the fracture site intraoperatively but healed without any complication. No non union or malunion was noted in 8 week follow up. Patients treated with MMF also healed well except for 1 case of massetric space abcess. They concluded that lag screw technique has a high rate of success and low complication rate, it also overcomes most of the disadvantages of maxillomandibular fixation like discomfort due to MMF, restricted diet and weight loss, speech problems, immediate post operative

danger of vomiting and aspiration, maintenance of oral hygiene. This technique also has the added advantage of compression osteosynthesis.[14]

A study was conducted to compare the accuracy of two accepted methods of inserting Lag Screws. To simulate cortical bone, 48 pairs of round Nylon disks, 2 inches in diameter with a thickness of 1/8 inches were used. To simulate different clinical situations, the distance between the outer and inner disks was controlled by insertion of Styrofoam spacers with 5mm and 10mm thickness. The first method was conventional method of using drill guide while drilling the inner cortex where as in the second method both cortices were drilled with 2.1mm diameter drill bit, then the outer cortex hole was over drilled with a 2.7mm drill bit. The ability of the two techniques to produce concentrically drilled holes between the inner and outer cortices, the ability to accurately over drill a small hole, and the displacement of the cortices following application and tightening of the lag screw were investigated using an experimental model of bony cortices. The results indicate that when the gap between the cortices is large, both methods of Lag Screw insertion are equally inaccurate. For smaller gaps between the cortices, the drill guide technique is more accurate than the other.[15]

In a prospective comparative study of intraosseous wire fixation versus rigid osseous fixation of mandibular fractures, 75 patients (55 males and 20 females; age range 14 to 53 years) were included. 43 fractures involved the angle region (34.1%), 20 the body (15.9%), 45 the parasymphysis (35.7%), one ramus fracture, 18 condylar region fractures (14.3%). 34 patients with 52 fractures of mandible underwent open reduction

and compression plate fixation whereas 41 patients with 74 fractures of mandible underwent open reduction and intraosseous wire fixation. In their study there was no statistically significant difference in infection rate between the two groups. Operating time for intraosseous wire fixation was on an average 1.8 hours whereas for compression plating it was 2.2 hours. In Intraosseous wire fixation group there was one case of non union that was subsequently treated by bone plating. Only two cases of malocclusion were experienced in compression plating group. They concluded that compression plating system is superior to intraosseous wire fixation as it obviates the need for the MMF.[16]

A study was conducted to evaluate biomechanical validation of the solitary lag screw technique for reducing mandibular angle fractures. The purpose of this study was to determine whether the solitary lag screw technique meets the biomechanical demands of angle fractures. Simulated angle fractures in four cadaveric mandibles were reduced using solitary lag screws and the load-displacement relationships determined under functional loading of the individual mandibles. Subsequently, an angle fracture in a photoelastic mandible analog was fixed with a lag screw and subjected to similar loading. The mechanisms by which the solitary lag screw transferred functional loading were observed and recorded in a circular polariscope. Concomitant distraction tendencies were monitored and measured using displacement transducers. Correlation of the force-displacement measurements to photoelastic observation substantiated that the solitary lag screw functions as a tension band to provide a sufficient degree of inter fragmentary compression and stability to withstand functional loading of the mandible.[17]

In a prospective clinical evaluation of the use of compression plates and screws in the management of mandible fractures, 71 patients with 102 fractures of mandible underwent compression plating. Of the 71 patients, 63 were male and 8 were female with a mean age of 28 years. The distribution of mandibular fractures was 21 parasymphysis fractures, 24 body fractures, 32 angle fractures and 25 condylar and subcondylar fractures. Authors noted 8.8% of infections. In 6 of 9 cases associated with infection, the plate was removed and the patients were placed into MMF. In one case screw was inadvertently placed into the inferior alveolar canal and it lead to permanent loss of inferior alveolar nerve sensation. Two cases of non union occurred due to infection. They concluded that compression plating has many advantages like production of three dimensional stable fracture site under axial compression, resulting in clinical rigidity and primary bone healing, immediate postoperative jaw function, and elimination or shortening of the period of MMF. These advantages combined with low rate of complications offer the maxillofacial surgeon a reliable alternative in the management of mandibular fractures.[18]

A study conducted on rigid internal fixation of mandibular fractures, in which 45 patients were included in the study, 28 were male 17 were females. Most of the fractures plated were body fractures of mandible followed by angular, and symphysis fractures. In 4 cases the fractures caused by gunshots, were compound ones. In majority of patients good primary healing was observed. Infection rate was 13%. Potential infection due to tooth in the line of fracture was recorded in 35 cases. The mean operation time was 3.6 hours. In 11% of cases postoperative

motor nerve disturbance of lower lip was noted, 11% increase in postoperative sensory disturbance of lower lip was also noted. Slight occlusal disturbances were registered in 23% cases. The mean hospitalization time was 4.4 days. It was concluded that compression bone plating is an effective method for fixation of several different types of mandibular fractures, it has added advantage of not requiring post operative MMF.[19]

A study was conducted to evaluate the clinical and radiological results after open reduction and lag screw osteosynthesis of fractured mandibular condyles. Eleven adult patients underwent surgery for displaced or dislocated mandibular condyle fracture via a submandibular approach. The repositioned fragments were fixed using lag screws. MMF was used post operatively for 2.6 weeks on average in nine patients. Results of the study revealed that slight transient weakness of the mandibular branch of the facial nerve occurred in three cases. Occlusal adjustment was needed in another three cases. Radiologically, the fracture line disappeared in 22.5 weeks on average. Three screws had to be removed because of loosening. There were signs that the screws had migrated caudally from their original position in seven cases. Clinically all patients had a stable occlusion and symmetry of the face. Healing in malposition occurred in four cases and there was considerable shortening of the mandibular ramus in four cases. Authors concluded that despite good clinical results, lag screws do not meet the needs for rigid internal fixation in the treatment of mandibular condyle fractures.[20]

In a clinical study sensory disturbances associated with rigid internal fixation of mandibular fractures were evaluated. Sensory status of the inferior alveolar nerve was monitored in 133 patients with 150 fractures in the region of the mandibular canal treated with rigid internal fixation preoperatively and 6 weeks postoperatively. Eighty five of the patients were re evaluated on final follow up at an average of 15.9 months. Preoperative sensory disturbance (58.5%) correlated significantly only with the presence of fracture displacement. The occurrence of post operative paresthesia (76.0% at 6.2 weeks, 46.6% at 15.9 months) correlated significantly with the degree of mandibular edentulousness. Patients with edentulous mandibles, especially when a compression plate was used, suffered significantly more often from nerve injury than fully dentate patients. The results indicated that the sensory disturbance was caused by the surgical procedure. In contrast to previous assumptions, displacement of the fracture and preoperative sensory status did not correlate with post-operative occurrence of paresthesia.[21]

In a retrospective study, 76 patients with mandibular fractures treated by compression osteosynthesis, 67 were male, 9 were females. Various types of fractures were: parasymphysis 39, body 28, subcondylar 30, angle 28, ramus 8. Their results showed that healing and long term postoperative course were uneventful in 83% of the cases. The total complication rate was 17%. Postoperative malocclusions were encountered in 6 patients. Post-operative soft tissue infection occurred in 9.2% of the cases, necessitating plate removal in 6 cases. One patient developed Osteomyelitis which was successfully treated by plate removal and hyperbaric oxygen. From the study they concluded that the relatively low rate of complications can be further reduced by careful

selection of patients and meticulous performance of the technique, the compression plating technique is a useful and effective method for mandibular fractures with an advantage of not requiring post-operative MMF.[22]

A study was conducted in 26 cases of mandibular fractures treated by dynamic compression osteosynthesis. 10 cases were edentulous, 16 cases had some standing teeth. In 24 cases there was good bony healing. In 2 cases who had pre existing infections from wired fractures, the plates were placed in the infected area and still healed quite satisfactorily. In one case the plate was incorrectly adapted to the mandible and the occlusion was unacceptable, and the plate had to be removed post-operatively and the fracture was wired. In one case the compression plate was not tightened completely as it was found intraoperatively that there was a triangular piece of bone at the fracture site. It healed without any complication. Only seven dentate patients required MMF for 1 to 3 weeks for occlusal correction. They concluded that compression plating has the advantages like: more rapid healing, less infection, absence of callus formation, reduction or absence of maxillomandibular fixation.[23]

In a retrospective study 35 patients who had total of 43 fractures of the mandible, all the patients had undergone open reduction and compression osteosynthesis using dynamic compression plates. Six patients were edentulous, 2 patients were mentally retarded and three patients had significant psychiatric disorders. In the study MMF was released in immediate post operative period in 24 patients while 11 remained in fixation for an average of three weeks. In 4 of the 11 patients associated mid face fractures

necessitated the maintenance of the fixation to ensure the stabilization of the fractured mid face. In the remaining 7 patients it was felt that MMF was needed for 10-14 days. Complications were encountered in 4 patients. 2 plates were removed for persistent paresthesia, in one case due to screw placed in the canal. One plate was removed six weeks after placement due to infection and fistula formation, and one plate required revision due to malocclusion noted in the immediate post operative period. They concluded that it is possible to treat most mandibular fractures utilizing rigid internal fixation with dynamic compression plates, Dynamic compression plating results in high degree of efficacy and a low rate of morbidity.[24]

In a retrospective study to know the complications associated with rigid internal fixation of facial bone fractures 223 patients (267 sites) treated with rigid internal fixation were included. 121 sites were treated with EDCP plates, 18 with DCP plates, 120 with mini plates, 3 with reconstruction plates, and 5 with lag screws. There were 164 mandibular cases and 59 cases of mid face fractures. 31 complications were recorded in patients with rigid fixation, which is 12.8% of the patients or 10.8% of the treated sites. Among the mandibular fractures treated by rigid internal fixation 4.9% of early infection, 1.2% of late infection, 4.9% of delayed union, 4.9% of malocclusion, 1.2% of paresthesia was found. They concluded that bone plates can be used exclusively to treat fractures except lateral midface which can be effectively treated by intraosseous wiring. Cost of plates and instruments can be a factor with rigid fixation, although it may be compensated by the reduced hospitalization period.[25]

A study consisted of 20 patients in whom Dynamic compression plates and Eccentric dynamic compression plates were used for management of mandibular fractures and continuity defects. A total of 31 ASIF plates were used. 13 patients were diagnosed as having either intraorally compounded fractures or recent infection at the existing fracture site. 10 patients had a history of treatment failure by previous traditional approaches such as closed reduction, intra osseous wiring, and biphasic pinning. Authors noted transient seventh nerve weakness in 3 patients and postoperative infection with plate removal in one patient. Remainder of cases treated with bone grafting and rigid fixation resolved successfully. They concluded that Dynamic compression plate and Eccentric dynamic compression plates are effective means of treating mandibular fractures and continuity defects with added advantage of not requiring post operative maxillomandibular fixation.[26]

In a retrospective study on morbidity associated with extra oral open reduction of mandibular fractures in 100 extra oral open reduction and internal fixation performed on 82 patients, Authors noted that 13 of 100 fractures had some form of postoperative morbidity. 49 fractures were in the angle region, 26 were in the body, 18 were in the parasymphysis, 6 were in the symphysis, and one was in the ramus. There was an obvious association with fracture site and complications. 10 of the 49 angle fractures treated extra orally resulted in complications, in 8 fractures delayed union was noted, wound infections developed in 4 fractures, 6 patients had infections of the fracture sites that required one or more sequestrectomies. In one operative site hypertrophic scar was found. Seven operative sites needed postoperative scar revision. Nonunion, malunion, and nerve palsy

were not seen in any of the cases. They concluded that complications are influenced by the location of fracture and by the presence of tooth in the line of fracture. Complications are most likely to occur in the angle fracture in which an involved tooth was removed in conjunction with an extra oral open reduction and internal fixation.[27]

In a study the occurrence of complications where teeth are retained in the line of mandibular fractures (124 cases) was compared with the situation when teeth are removed (102 cases). 191 patients were included in the study among which 158 were male and 33 were females. The frequency of complications was found to be 16.1% in the teeth retained group (total of - 11 delayed unions, 1 non union, 7 infections) and 13.7% in the teeth removed group (total of 9 delayed union, 3non unions, 5 infections). There was no statistically significant difference between the two groups. This finding supports the view that teeth in the line of mandibular fractures can be preserved when antibiotics are used prophylactically.[28]

A prospective study was conducted to compare standard therapy: closed or open reduction with 4 weeks of maxillomandibular fixation to rigid internal fixation with compression plates for the treatment of mandibular fractures. 92 patients with a male to female ratio of 9.2:1, the mean age was 28.9 years. 143 fractures were evaluated and treated. There were 24 sub condylar, 56 angle, 31 parasymphysis, and 32 mandibular body fractures. 53 patients received standard treatment and 39 received rigid internal fixation done from an extra oral approach. Patients in RIF sample were older, had fewer simple fractures, and had more

fractures per patient than those in standard group. Overall, 76 patients (82.6%) (30/39 RIF, 46/53 MMF) had a successful result characterized by anatomic reduction, clinical union, restoration of pre traumatic occlusion and normal function. There was no statistically significant difference in the treatment results between the two groups, despite a bias in the distribution of study variables that favoured the standard therapy.[29]

A study was conducted to evaluate the bone healing in mandible by histologic and biometric comparison between rigid and semi rigid fixation. Five male African green monkeys were included in the study. The mandible was transected from retromolar pad area superiorly to the antegonial notch inferiorly with the help of a Stryker reciprocating saw to produce a 0.75 mm defect bilaterally. The fractured fragments were fixed by use of cobalt chrome alloy mandibular mesh. Four screws were used on one side for rigid fixation, and two screws were used on the other side for semi rigid fixation. Maxillomandibular fixation was not used in any of the cases. The animals were restricted to soft diet for three days. All the animals were killed six weeks post operatively and the soft tissues were dissected from the mandible. The mesh and screws were removed in preparation for testing. Gross examination results revealed that rigidly fixed sides showed no external callus formation, and it was sometimes difficult to determine the site of the fracture. The semi rigid sides however, had large excrescences of eternal callus, which were most extensive at the inferior border and lingual surfaces. When the specimens were tested biometrically, they all fractured through

the original defect. The rigid sides were twice as strong as the semi rigid sides. The results of histological study also showed large quantities of external callus formation in semi rigid specimens, where as it was absent in rigid fixation specimens.[30]

Materials and methods

In this study ten maxillofacial trauma patients with mandibular symphysis and parasymphysis fractures reported to the Department Of Oral and Maxillofacial Surgery, P.M.N.M. Dental College and Hospital Bagalkot, were included.

After explaining about the study to the subjects, an informed consent was obtained. A detailed history with thorough clinical and radiographic examination was done and findings were recorded in a specially prepared case history proforma.

Selection Criteria:

Inclusion criteria:

1) Patients with symphysis and parasymphysis fracture of mandible were included in the study.
2) Patients above the age of 14 years were included in the study.

Exclusion criteria:

1) Comminuted symphysis and parasymphysis fractures.
2) Patients with pre existing infection at fracture site.
3) Completely edentulous patients.
4) Immuno compromised patients.
5) Patients with other systemic conditions contraindicated for surgery.

METHOD OF COLLECTION OF DATA:

Patients with mandibular symphysis and parasymphysis fractures were subjected to thorough pre-operative history, clinical examination and radiographic examination. Patients were subjected to routine hematological investigations and antibiotics were given and continued postoperatively for 5 to 7 days.

SURGICAL PROCEDURE:

After stabilization of the occlusion with Erich Arch Bar and inter maxillary fixation with elastics or 26 gauge stainless steel wire, proposed vestibular incision site and surgical field is infiltrated with 2% Lignocaine hydrochloride with 1:80,000 Epinephrine solution. Anterior to the first premolar, the incision was either taken into the lip, splitting the mentalis muscle into two layers to facilitate two layer closure or, in the sulcus 4 -5 mm below the attached gingival to facilitate single layer closure. Care was taken not to injure the branches of mental nerve. Mucoperiosteal flap is elevated to expose the fracture site.

The entire fracture was examined following slight distraction to note the obliquity and relationship of the cortices and is compared with the pre operative radiographs then the direction of insertion of lag screws is decided. Once the fracture has been examined and cleared off all debris, a towel clip with tips bent slightly outwards was used as a bone clamp to assist in firmly reducing and stabilizing the fracture before application of lag screws. Simultaneously occlusion was maintained by inter maxillary fixation.

Selection of the proper point of entry for drilling hole into the buccal cortex was based on placing it sufficiently away from the fracture, at an angle perpendicular to the line of fracture so that sufficient amount of bone is present between the head of the lag screw and fracture after drilling and countersinking. The first screw was placed just above the lower border so that sufficient space was available for a second screw. In cases where placing a second screw was not possible Erich arch bar was used as tension band.

After establishing the proper point of entry, with the help of a small round bur a depression is made in the near cortex. This depressed point prevents the extra long drill bit from slipping over the cortical bone while making the drill hole. 1.5 mm extra long drill bit inserted through drill guide, was then used to the selected angulation (perpendicular to the fracture line) to drill hole through the buccal cortex, medullary bone and far cortex. During the process copious amount of irrigation is used and repeatedly drill bit is withdrawn to prevent clogging and heat generation.

Mucoperiosteal flap and adjacent soft tissues are retracted and held with Langen Beck retractors and Periosteal elevators to permit proper adaptation of drill guide, and angulation of extra long drill bit while drilling.

Next step which followed was creating a sunken area by using a large round bur. Care was taken not to countersink deep into the bone to the point where the screw head rested on medullary instead of cortical bone. The depth gauge was then inserted through the hole to determine the length of the screw required for fixation.

Now with the help of 2mm hand tap threads are cut in both near as well as far cortex and the drill hole is irrigated thoroughly to clear of debris. Now the hole for Lag Screw fixation is completely prepared. With the help of 2 mm screw holder and screw

driver lag screw is tightened. Lag screws provide rigid fixation by causing inter fragmentary compression. As lag screws have threads on one half of the shaft, with the portion below the head being smooth so that it will not engage the outer cortex. This allows the inner segment to be compressed against the outer segment. Care is taken not to over tighten the screw.

The application of the second lag screw also proceeds in the same way. In case of fractures in the vicinity of mental foramina where it is not possible to place the second lag screw Erich arch bar is maintained as a tension band for a period of three weeks.

The incision was closed in two layers. Maxillomandibular fixation was removed and patient was advised soft diet for a period of 2 weeks.

Patients were evaluated as per clinical and radiographic assessment protocols.

CLINICAL ASSESSMENT.

1. Intra operative complications if any were recorded like:-

    * Breakage of screw.

    * Breakage of drill bit.

    * Breakage of bur.

    * Others.

    * None.

2. Stability of the fracture.

Stability of the fracture after fixation was checked by forceful bimanual manipulation of the segments, to know if the mobility is present or absent. Findings were recorded intra operatively, one day post operatively, two weeks post operatively and six weeks post operatively. (Table I)

3. Occlusion.

Occlusion was checked clinically, to know if there was any step in the occlusal plane, gap in the occlusal plane while teeth in occlusion. When all the teeth in either of the fracture fragments were out of occlusion, were considered as complete derangement of occlusion. When only few teeth in either of the fracture fragments or both fragments were out of occlusion was considered as mild occlusal discrepancy. The findings were recorded intra operatively, one day post operatively, two weeks post operatively and six weeks post operatively. (Table II)

4. Mental nerve injury.

Mental nerve function was evaluated by stroking the skin in the region of mental nerve and chin with cotton wool and by pricking the same area with a dental probe. The subjective sensations of the patient were recorded. The findings were recorded one day post operatively, two weeks post operatively and six weeks post operatively. (Table III)

RADIOGRAPHIC ASSESSMENT

Orthopantamogram and lower occlusal radiographs were used for radiographic assessment.

1. Screw position assessment.

Screw position was assessed using Orthopantamogram and lower Occlusal radiographs to see if the screws penetrated into the Inferior alveolar canal, adjacent roots, or if present in acceptable normal anatomical position. Findings were noted immediate post operatively and six weeks post operatively to look for any displacement of screws when compared to immediate post operative radiographs. (Table IV)

2. Accuracy of reduction.

Accuracy of reduction was assessed using Orthopantamogram and lower Occlusal radiographs to see if there was any discrepancy in the continuity of the labial cortex, lingual cortex, or inferior border of the mandible. Findings were noted immediate post operatively and six weeks post operatively. (Table V)

3. Bone healing.

Bone healing was assessed using Orthopantamogram and lower Occlusal radiographs to observe if there is a visible radiolucent gaping at the fracture line, visible radiolucent line at the fracture line or absence of any rediolucency at the fracture line. Absence of rediolucency at the fracture line was considered as complete bony union and presence of radiolucent gaping at the fracture line or visible radiolucent line at the

fracture line was considered as incomplete bony union. Findings were noted immediate post operatively and six weeks post operatively. (Table VI)

TABLE I

Stability of the fracture. (Manipulation of segments)

Time interval	Variables	
	Mobility Absent	Mobility Present
Intra operative		
1Day post operative		
2Week post operative		
6Week post operative		

TABLE II

Evaluation of Occlusion.

Time interval	Variables		
	Occlusion Present	Occlusion Deranged.	Mild discrepancy
Intra operative			
1Day post operative			
2Week post operative			
6Week post operative			

TABLE III

Assessment of Mental nerve injury.

Time interval	Variables	
	Mental nerve injury absent.	Mental nerve injury present.
1Day post operative		
2Week post operative		
6Week post operative		

TABLE IV

Screw position assessment.

Time interval	Variables		
	In acceptable normal position.	Penetrating into adjacent roots.	Penetrating into inferior alveolar canal.
Immediate post operative			
6Week post operative			

TABLE V

Assessment of Accuracy of reduction.

Time interval	Variables	
	No Displacement	Displacement
Immediate post operative		
6 Week post operative		

TABLE VI

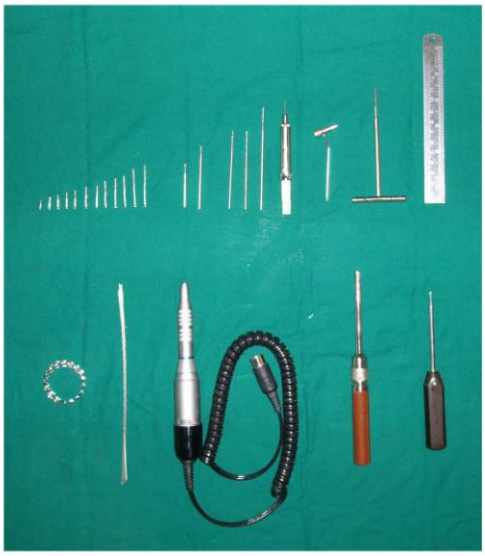
Assessment of Bone healing at fracture site.

Time interval	Variables		
	Visible gaping at fracture site.	Visible radiolucent line.	Complete bony union.
Immediate post operative			
6Week post operative			

Armamentarium

ARMAMENTARIUM
GENERAL SURGICAL INSTRUMENTS

INSTRUMENTS FOR LAG SCREW FIXATION



Armamentarium for Lag Screw fixation used in this study consisted of:-

1) Lag Screws.
2) Small round bur.
3) Large round bur.
4) Drill bit 1.5mm.
5) Depth gauge.
6) Hand tap.
7) Scale.
8) Erich arch bar.
9) 26 Gauge wire.
10) Micro motor hand piece.
11) Screw holder.
12) Screw driver.

Illustrations

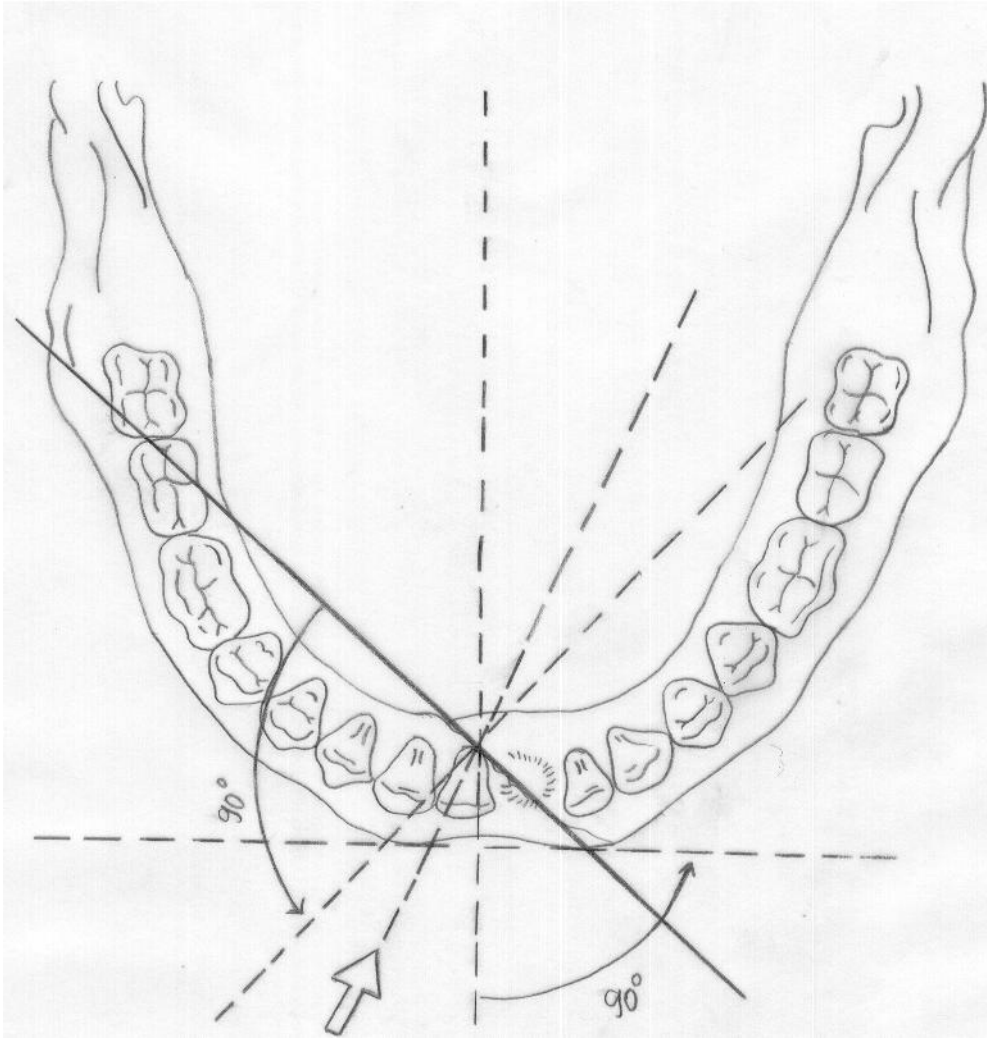


Fig 1

Schematic Diagram of Screw Axis
For Lag Screw Osteosynthesis.

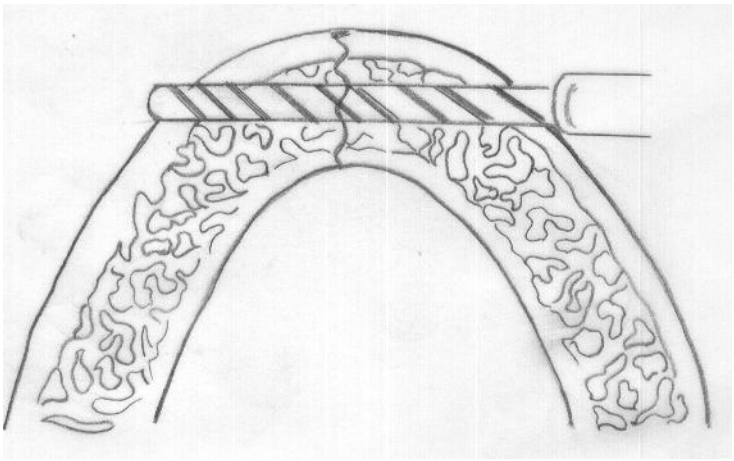


Fig 2

Preparation of the drill hole.

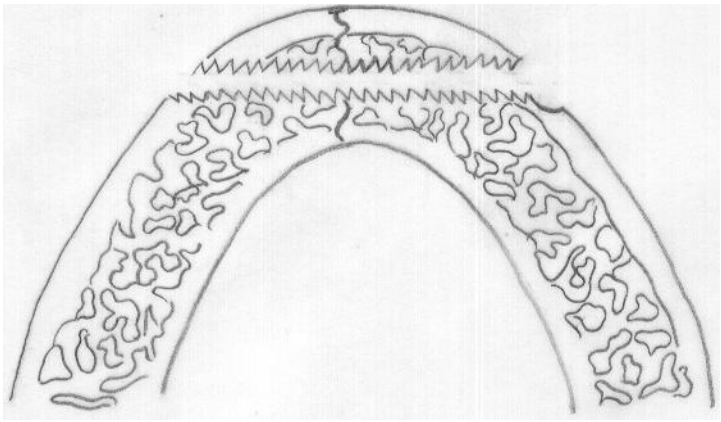


Fig 3

After Tapping and Countersinking of the Drill Hole.

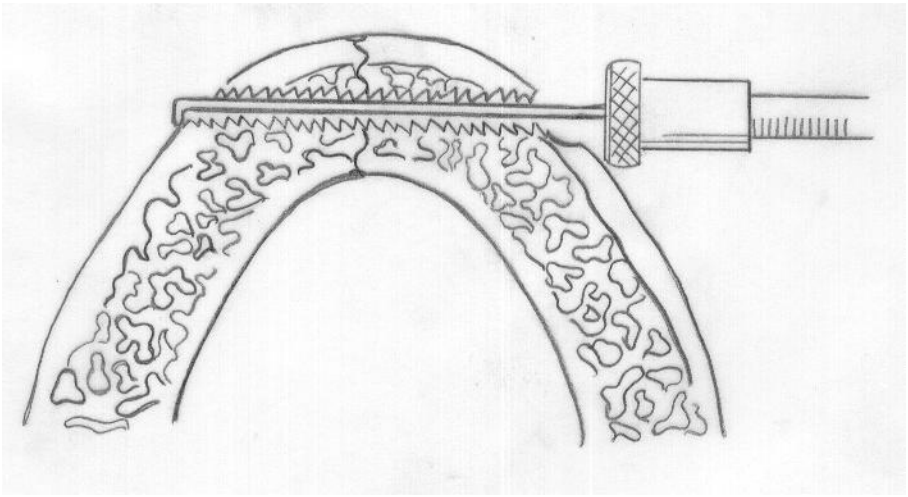


Fig 4

Depth Gauge to Determine Screw Length.

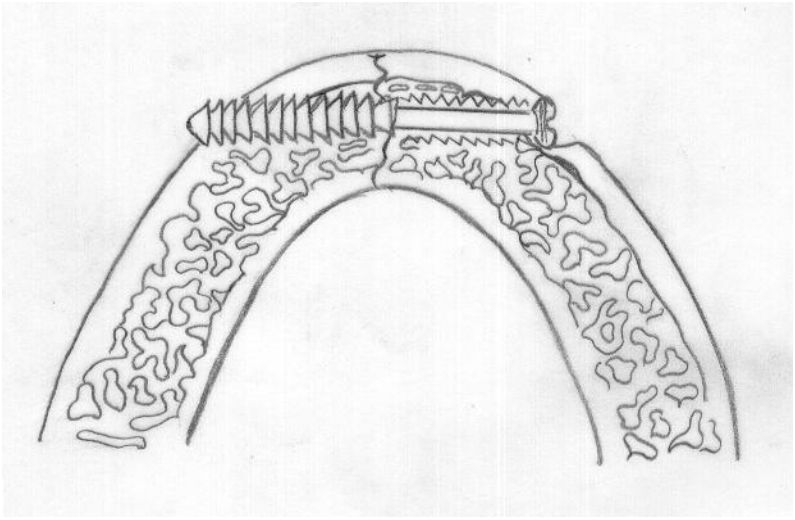
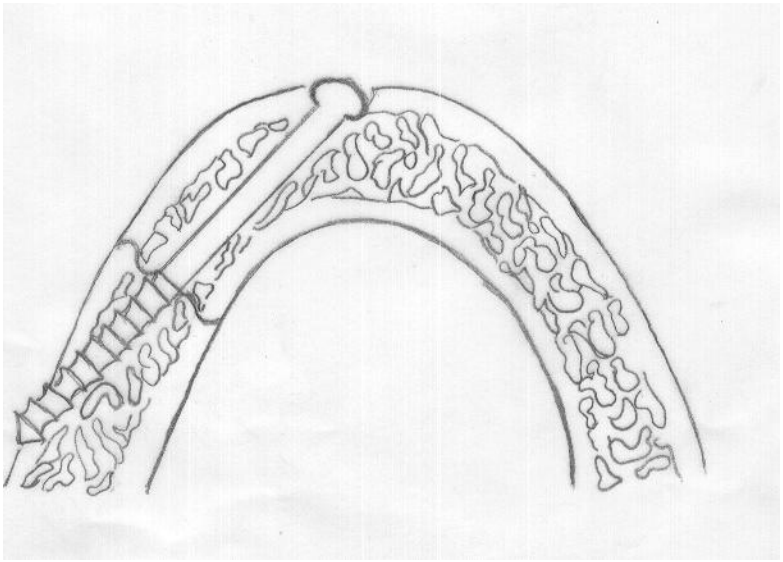
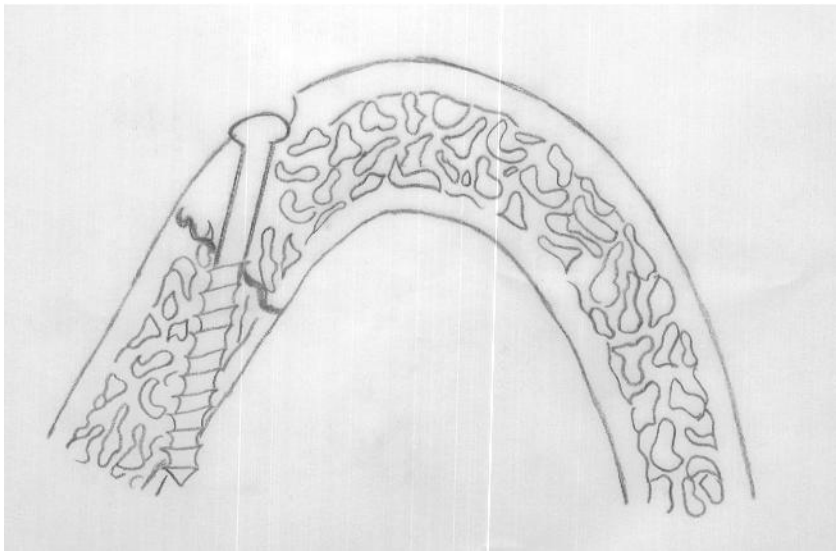


Fig 5
Screw Inserted.

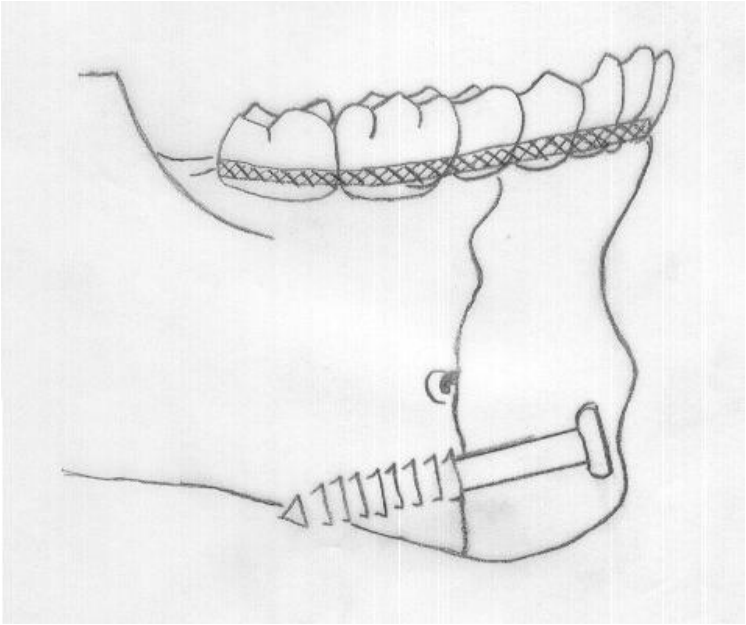
Application Of Lag Screws In The Vicinity Of Mental Foramen.



Screw Placement From Buccal To Buccal.



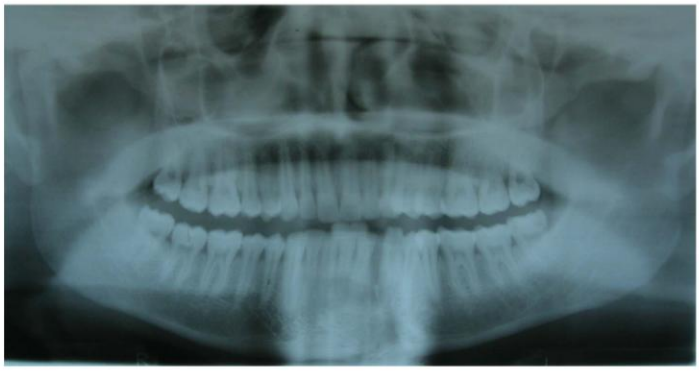
Screw Placement From Buccal To Lingual.



Lag Screw Fixation Combined
With Arch Bar As Tension Band.

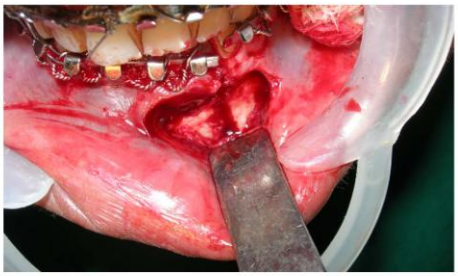
CASE NO 2

PRE OPERATIVE



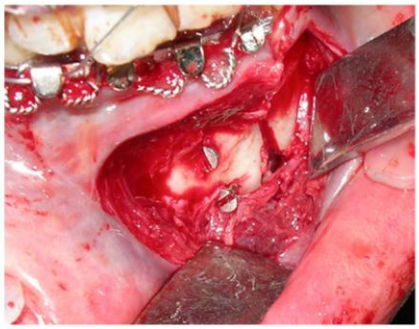
PRE OPERATIVE OPG

OCCLUSAL

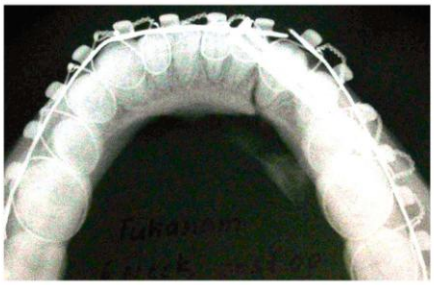


EXPOSURE

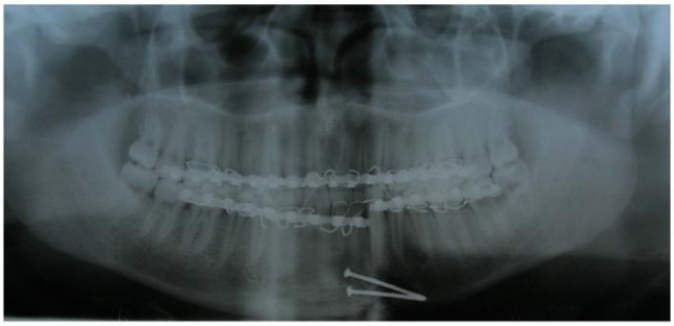
CASE NO 2



LAG SCREW FIXATION



POST OPERATIVE OCCLUSAL



POST OPERATIVE OPG

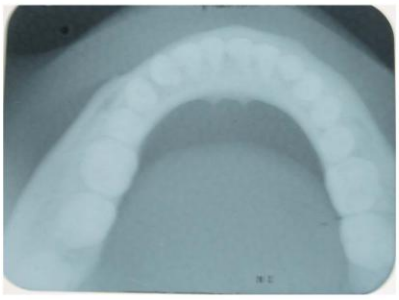
POST OPERATIVE

POST OPERATIVE OCCLUSION

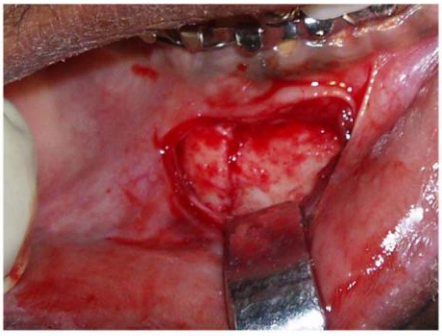
CASE NO 6

PRE OPERATIVE

PRE OPERATIVE OPG



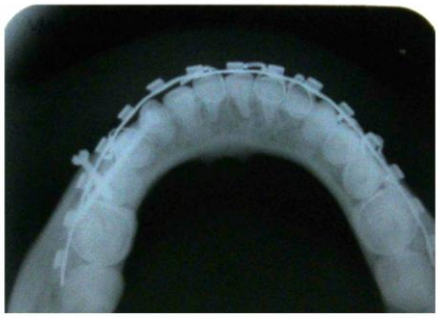
OCCLUSAL



EXPOSURE

CASE NO 6

LAG SCREW FIXATION



POST OPERATIVE OCCLUSAL

POST OPERATIVE OPG

POST OPERATIVE

POST OPERATIVE OCCLUSION

Results

The present study was undertaken to evaluate Feasibility and efficacy of lag screws in the management of mandibular symphysis and parasymphysis fractures. 10 Patients with mandibular symphysis and parasymphysis fractures were included in the study after obtaining the informed consent for participation. 9 Patients were male and 1 patient was female, with an age range of 18 yrs to 50 yrs, with the mean age being 27.4 yrs as depicted in table VII.

Feasibility and efficacy of lag screws in the management of mandibular symphysis and parasymphysis fractures was evaluated for following terms.

CLINICAL ASSESSMENT.

1) Intra operative complications.
2) Stability of the fracture.
3) Occlusion.
4) Mental nerve injury.

RADIOGRAPHIC ASSESSMENT

1) Assessment of screw position.
2) Accuracy of reduction.
3) Bone healing at fracture site.

The fallowing observations were made;

1.None of the cases had intraoperative complications. (Table VII)

2. Intra operatively stability was obtained in all the 10 [100%] cases after fixation. One day post operatively in one case [10%] screw got displaced fracturing a portion of buccal cortical plate, mild mobility was noted which was treated by MMF for a period of 3 weeks. 6 weeks post operatively stability was present in all the 10 [100%] cases. (Table VIII) (Graph I)
3. Intra operatively proper occlusion was obtained in all the 10 [100%] cases. One day post operatively mild occlusal discrepancy was noted in one case [10%] due to screw displacement. 6 weeks post operatively mild occlusal discrepancy was noted in one case [10%], this patient had associated bilateral subcondylar and right angle fractures. 9 [90%] patients had good occlusion at six week follow up. (Table IX) (Graph II)
4. One day post operatively 2 [20%] patients had signs of mental nerve injury and there were no such signs in other 8 [80%] cases. 2 weeks post operatively and 6 weeks post operatively none of the patients had any signs of mental nerve injury [100%]. (Table X) (Graph III)
5. All the screws in all 10 [100%] cases were in acceptable normal position without causing any damage to the roots or inferior alveolar nerve. Out of two screws in case no 1 one screw did not cross the fracture line to hold the far cortex. Out of two screws in case No 8 one screw was longer than the required length. (Table XI) (Graph IV)
6. No displacement of the fracture fragments after fixation was noted in 9 [90%] cases. Displacement of the fragments after fixation was noted in case No 8 [10%]

immediate post operatively as well as 6 weeks post operatively. One day post operatively in case No 5 screw got displaced fracturing a portion of buccal cortical plate but that did not cause any significant displacement of the fracture fragments. (Table XII) (Graph V)

7. Immediate post operatively visible radiolucent line was noted in 7 [70%] cases where as radiolucent gap was noted in 3 [30%] cases. 6 week post operatively radiolucent line was noted in 8 [80%] cases where as radiolucent gap was noted in 2[20%] cases. (Table XIII) (Graph VI)
8. Fractures in 8 cases were treated using 2 lag screws where as only one lag screw was used in 2 cases with arch bar as tension band maintained for a period of 3 weeks.
9. Six cases [60%] did not require MMF; in three cases [30%] MMF was required for a period of 4 weeks due to other associated fractures, in one case [10%] MMF was required for a period of 3 weeks due to displaced screw.
10. Out of 18 screws used in 10 cases; Out of two screws in case no 1 one screw did not cross the fracture line to hold the far cortex. Out of two screws in case No 8 one screw was longer than the required length.
11. No cases had wound dehiscence or infection.

TABLE VII

- Mean age: - 27.4 yrs.

Serial No.	Age of the Patient	Cause of fracture.	Associated fractures.	No. of screws/ Arch bar	Intra Operative Complications.	Post operative period of MMF in days.	Wound dehiscence.	Wound Infection.
1.	18yrs	Fall.	Right sub condylar fracture.	Two Screws.	None.	28Days.	None.	None.
2.	20yrs	Fall.	---------	Two Screws.	None.	Nil.	None.	None.
3.	50yrs	Trauma by moving object.	Bilateral sub condylar fracture + Right angle fracture.	Two Screws.	None.	28 Days.	None.	None.
4.	45yrs	Fall.	---------	One Screw + Arch bar.	None.	Nil.	None.	None.
5.	30yrs	Trauma by moving object.	---------	One Screw + Arch bar.	None.	21 Days.	None.	None.
6.	18yrs	R.T.A.	---------	Two Screws.	None.	Nil.	None.	None.
7.	20yrs	R.T.A.	---------	Two Screws.	None.	Nil.	None.	None.
8.	18yrs	Fall.	Le-Fort II Fracture.	Two Screws.	None.	28 Days.	None.	None.
9.	28yrs	R.T.A.	----------	Two Screws.	None.	Nil.	None.	None.
10.	27yrs	R.T.A.	----------	Two Screws.	None.	Nil.	None.	None.

TABLE VIII

Stability of the fracture. (Manipulation of segments)

Time interval	Variables	
	Mobility Absent	Mobility Present
Intra operative	10 [100%]	0
1Day post operative	9 [90%]	1 [10%]
2Week post operative	6 [60%]	0
6Week post operative	10 [100%]	0

- Case No 1, 3 & 8 were under MMF for other associated fractures for 4 weeks.
- Case No 5 was under MMF for 3 weeks as screw displacement was noted one day post operatively.

GRAPH I

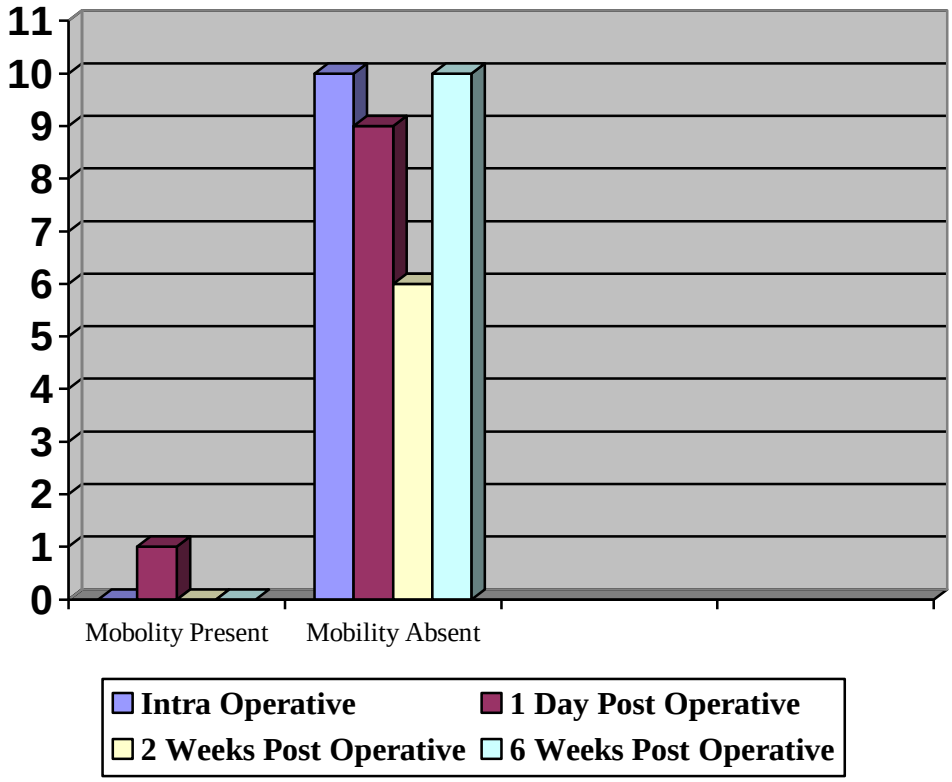


TABLE IX

Evaluation of Occlusion.

Time interval	Variables		
	Occlusion Present	Occlusion Deranged.	Mild discrepancy
Intra operative	10 [100%]	0	0
1Day post operative	9 [90%]	0	1 [10%]
2Week post operative	10 [100%]	0	0
6Week post operative	9 [90%]	0	1 [10%]

GRAPH II

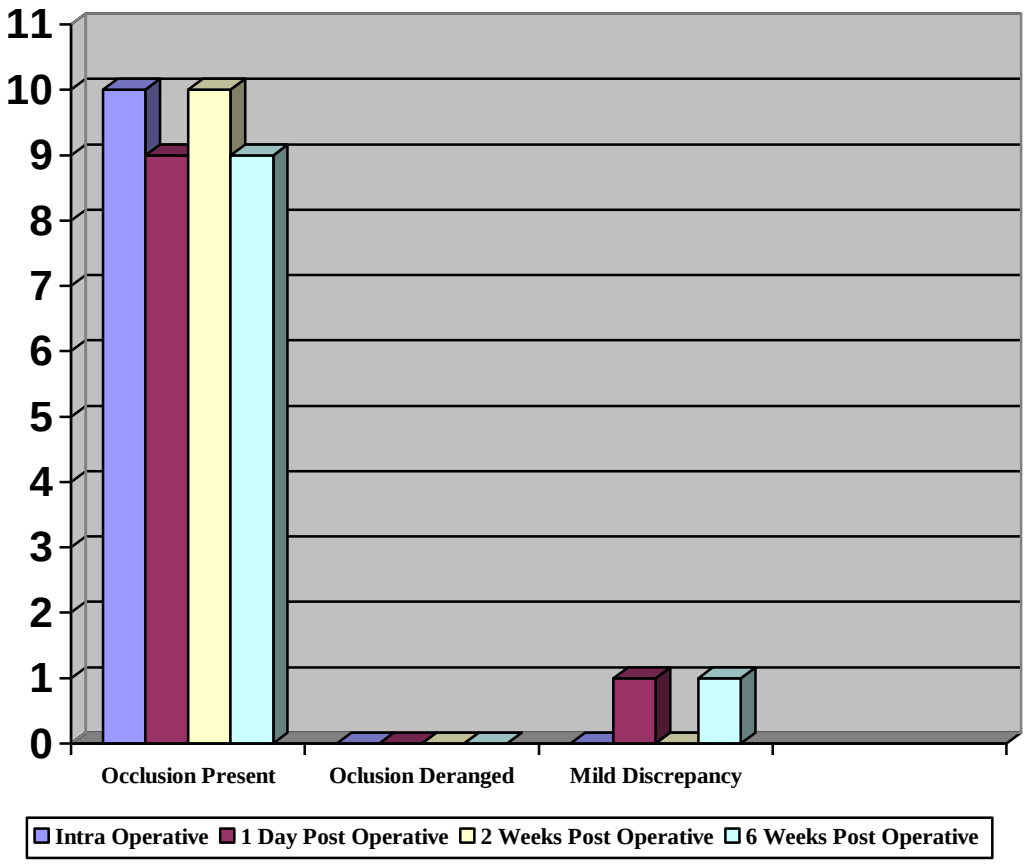


TABLE X

Assessment of Mental nerve injury.

Time interval	Variables	
	Mental nerve injury absent.	Mental nerve injury present.
1Day post operative	8 [80%]	2 [20%]
2Week post operative	10 [100%]	0
6Week post operative	10 [100%]	0

GRAPH III

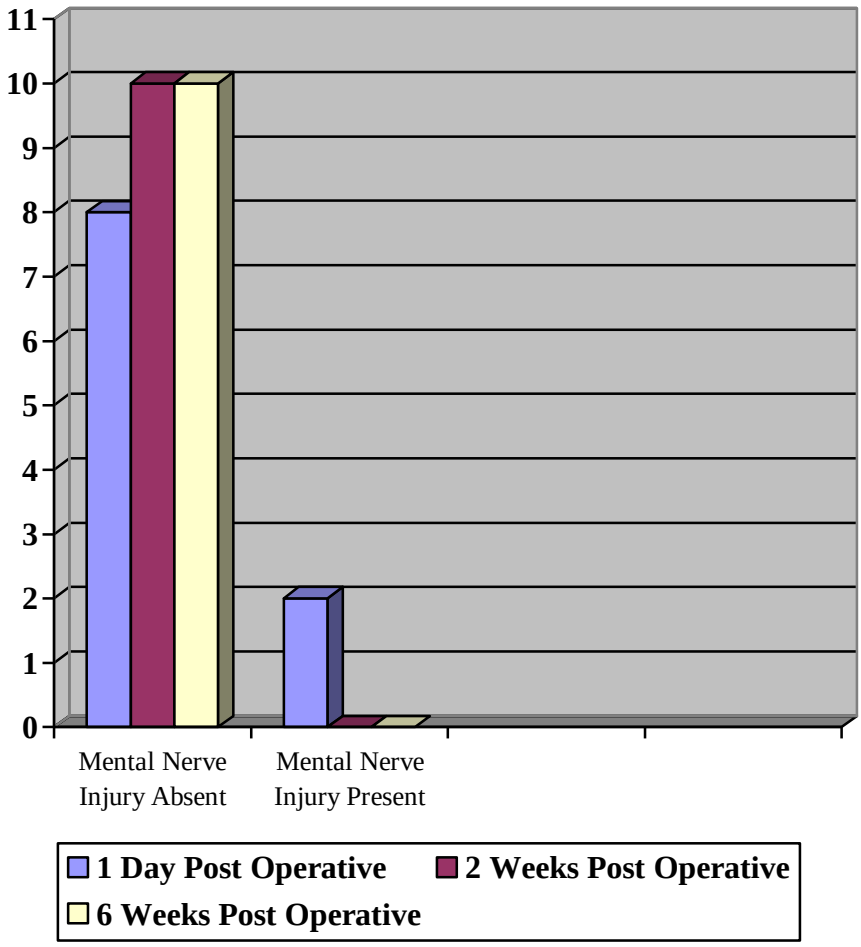


TABLE XI

Screw position assessment.

Time interval	Variables		
	In acceptable normal position.	Penetrating into adjacent roots.	Penetrating into inferior alveolar canal.
Immediate post operative	10 [100%]	0	0
6Week post operative	10 [100%]	0	0

- Out of two screws in case no 1 one screw did not cross the fracture line to hold the far cortex.
- Out of two screws in case No 8 one screw was longer than the required length.

GRAPH IV

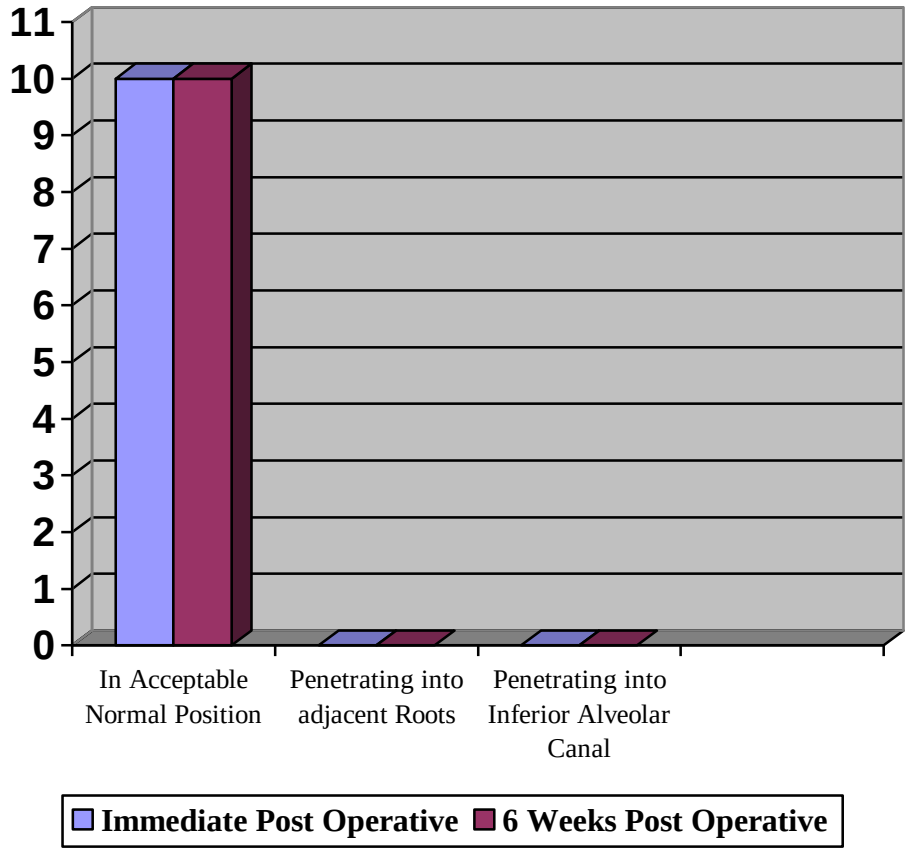


TABLE XII

Assessment of Accuracy of reduction.

Time interval	Variables	
	No Displacement	Displacement
Immediate post operative	9 [90%]	1 [10%]
6 Week post operative	9 [90%]	1 [10%]

- In case No 5 immediate post operatively it was noted that screw got displaced fracturing the buccal cortical plate but that did not cause any displacement of the fracture fragments.

GRAPH V

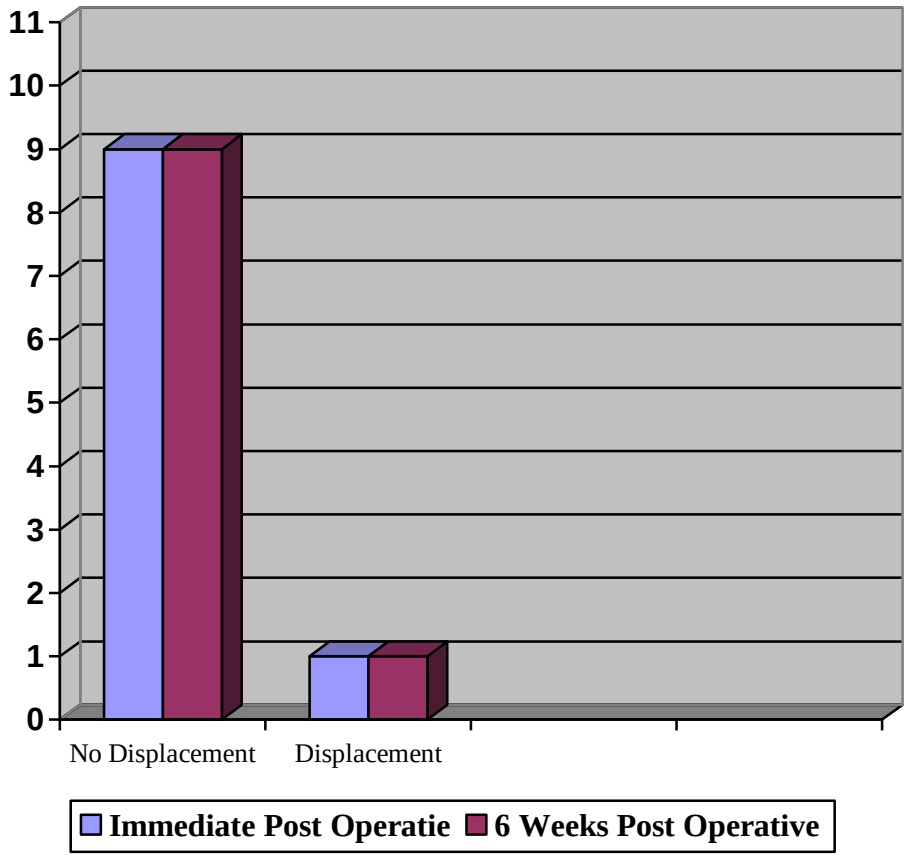
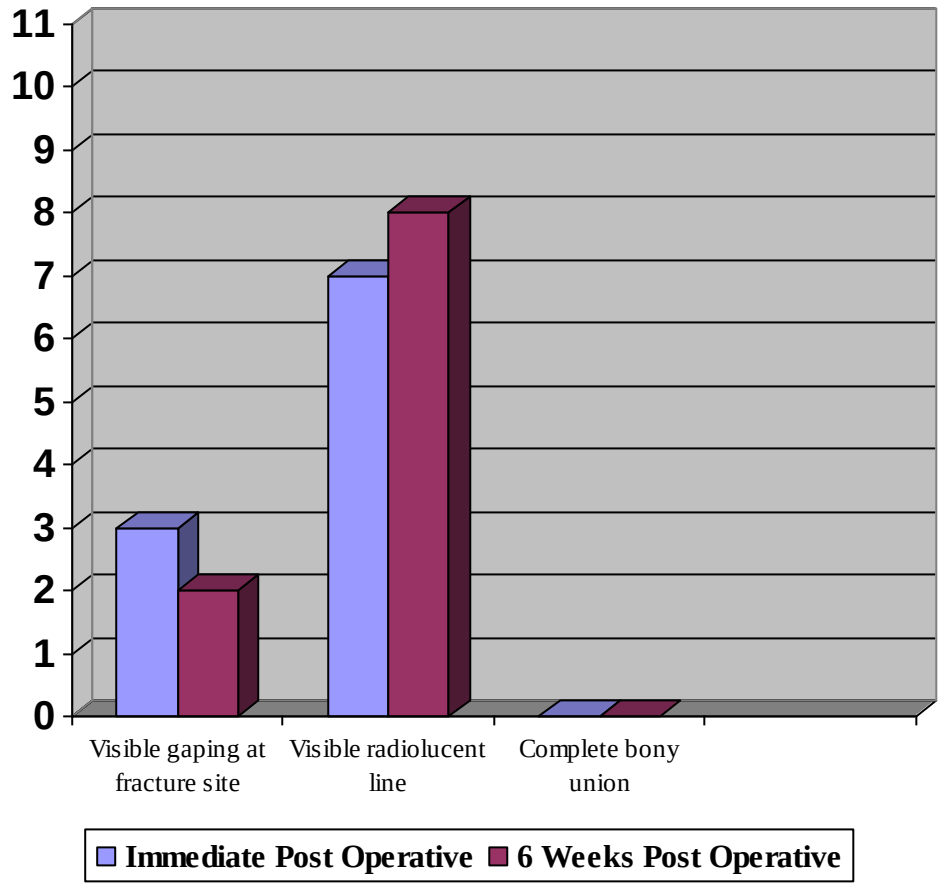


TABLE XIII

Assessment of Bone healing at fracture site.

Time interval	Variables		
	Visible gaping at fracture site.	Visible radiolucent line.	Complete bony union.
Immediate post operative	3 [30%]	7 [70%]	0
6Week post operative	2 [20%]	8 [80%]	0

GRAPH VI



Discussion

The therapeutic goal of fracture management is to restore form and function as soon as possible without any morbidity. The management of mandibular fractures should be guided by several Dental and Orthopedic principles:[24]

1. Reduction of fracture site to its correct anatomical position.
2. Restoration of premorbid occlusion.
3. Rigid immobilization of the fragments to facilitate healing.
4. Optimal and early restoration of function.
5. Prevention of infection and malunion or non union of the fracture.

The use of maxillomandibular fixation with or without open reduction and wire osteosynthesis has been the conventional approach for applying these principles in the treatment of most uncomplicated mandibular fractures.[16] Maxillomandibular fixation supplemented with wire osteosynthesis results in a semi rigid fixation and healing with secondary intention. It has a potential for associated morbidity such as weight loss, poor oral hygiene, loss of function, social and communication difficulties, loss of effective work time, physical discomfort and difficulty in recovering a normal range of jaw movements.[24] It is also difficult to manage fractures involving edentulous or partially edentulous mandible and fractures in patients with medical and social problems with this conventional approach. On the other hand rigid internal fixation obviates the need for maxillomandibular fixation, meets the principles of fracture management, achieves absolute stability of fracture fragments and permits primary bone healing by causing interfragmentary compression.[31]

In our study six cases [60%] which had fractures involving only symphysis or parasymphysis region, no maxillomandibular fixation was given post operatively. In three

cases [30%] MMF was required for a period of 4 weeks due to other associated fractures, in one case [10%] of parasymphysis fracture MMF was required for a period of 3 weeks due to displaced screw.

Lag screw technique finds wide application in mandibular fractures. Several authors have successfully used lag screws in the treatment of mandibular fractures. The lag screw technique was first introduced to Maxillofacial Surgery by Brons and Boering in 1970[6], who cautioned that at least two screws are necessary to prevent rotational movements of the fragments in mandibular body fractures.[6]

Prein et al [31] advocated the use of lag screws in those fractures that run obliquely or involve overlapping of fragments.

Niederdellman[5] reserved this technique for only very special circumstances. In his results, he reported excellent stability and function of fracture Mandible using lag screws alone in wide lamellar fractures. Niederdellman et al[9] introduced a new procedure for treating mandibular angle fractures using single oblique lag screw.

Ellis and Ghali[3] expanded the uses of lag screws for functional stabilization of mandibular fractures. The results of their retrospective study of 41 patients showed that lag screw fixation of anterior mandibular fractures is an extremely simple and successful method of rigidly securing the fragments, permitting active use of the mandible during healing. Only two patients in their study experienced problems that required intervention. All seven patients treated by only one lag screw and arch bar as tension band had no post operative difficulties. These patients were all cautioned to maintain a soft diet. However they still do not recommend the use of only one lag screw for anterior mandibular fractures. Schwimmer[32] also expressed his concern regarding the use of single lag screw

and an arch bar as the means of stable fixation and stated that it is an unstable configuration.

In our study lag screw fixation has been used for treating symphysis and parasymphysis fracture. The results of this study, wherein no maxillomandibular fixation was given to supplement symphyseal fractures go in favour of the retrospective study by Ellis and Ghalli.[3]

The anterior mandible is uniquely suited to the application of lag screws for three reasons.[3]

1) Curvature of the mandible.

This allows placement of lag screws across the symphysis, from one side to the other side, for saggital fractures and from anterior to posterior for oblique fractures and those of anterior body region.

2) Thickness of bony cortices.

Thick bony cortices provide extremely secure fixation when the screws are properly inserted.

3) Absence of anatomic hinderances.

There are no anatomic hazards below the apices of the teeth until the mental foramina are encountered. This makes lag screw placement extremely simple.

Within the mandibular symphysis the tractional and compressive forces produce torsional movements that increase in strength towards the midline.[33] Champy[33] studied these movements with regard to a mathematical model and as a result was able to determine the ideal line of osteosynthesis to overcome these displacing forces.

In our study by placing two screws corresponding to these lines of osteosynthesis in the region of symphysis an excellent stability and restoration of function of the reduced fracture was achieved. This result substantiates the results obtained by Ellis and Ghali.[3] In two patients, wherein placement of second lag screw was not possible due to the presence of mental foramina, arch bar was used as a tension band splint.[3,8] In one case fracture healing was uneventful, whereas in other case the screw was noticed to be displaced one day post operatively on radiographic examination. This was probably due to improper countersink preparation.

In a study conducted by Christopher R. Forrest[8], who used lag screw fixation in 5 parasymphysis fractures, used single lag screw in all the cases and arch bar as tension band did not come across any adverse outcomes. However authors used light dental elastic intermaxillary fixation for one to two weeks, and recommended soft "no chew" diet for six weeks.

It is essential to have lag screws ranging from 12 – 40 mm in length when using this technique for providing rigid fixation of mandibular symphysis and parasymphysis fractures.[3] Therefore lag screws lengths up to 40 mm were made available for every case in this study.

Most authors who use rigid fixation believes that strict attention to recommended surgical technique are mandatory.[32] Lag screw technique appears to be easily executed; however any surgeon attempting to use this technique must be familiar with basic principles of rigid internal fixation.

Like Ellis and Ghalli[3], Kallela I[7] we believe that the orthopedic principle demanding placement of lag screws along a course that bisects the angle between the

outer cortex and the line of fracture with tip of the screw penetrating the inner cortex can be neglected in performing lag screw fixation in mandibular parasymphyseal fractures.

In our study we did not encounter any intra operative complications like fracturing of the drill bit or lag screw. Similar results were found in study conducted by Ellis and Ghali.[3]

In a study conducted by Ilka Kallela et al[7] who used lag screw fixation in 17 parasymphysis fractures encountered fractured drill bit in one case. They relate it to their failure to use a sharp drill bit and to withdraw and advance the drill bit at times during drilling to prevent the tendency of the bit to clog in the far cortex.

In a study conducted by Christopher R. Forrest[8], who used lag screw fixation in 5 parasymphysis fractures encountered fractured drill bit in one case. Author relates this complication to flexibility of the extra long drill bits and the tendency of extra long drill bits to bend when they encounter the inner surface of the distal cortex at an oblique angle.

The stability of the fixation elements is the primary condition for firm fixation.[34] The device used for rigid internal fixation should prevent motion between fracture fragments after fixation. Plates or screws are useful only if they guarantee absolute stability. Absence of stability increases the risk of infection.[31]

In our study Intra operatively stability was obtained in all the 10 [100%] cases after fixation. One day post operatively in one case [10%] screw got displaced fracturing a portion of buccal cortical plate (probably due to improper countersink preparation), mild mobility was noted which was treated by MMF for a period of 3 weeks. 6 weeks post operatively stability was present in all the 10 [100%] cases. All the patients were advised soft diet for a period of two weeks.

In study conducted by Ellis and Ghali[3] out of 41 patients treated by lag screw fixation, encountered slight mobility of the fracture fragments in one case three weeks post operatively and it was due to infected tooth in the line of fracture.

In a study conducted by Ilka Kallela et al[7] who used lag screw fixation for Seven angle and seventeen parasymphyseal fractures in twenty-three adult patients encountered instability of the fracture fragments in three cases due to infection.

One of the most important goals of mandibular fracture repair is the restoration of the pre injury occlusion. Before any hardware is applied, the occlusion must be established with maxillomandibular fixation.[35]

In our study in every case prior to Lag Screw fixation occlusion was obtained by Erich arch bars and Elastics/26 gauge tie wires. We encountered with two (20%) cases of occlusal discrepancy. In one case mild occlusal discrepancy was noted one day post operatively. It was due to displaced screw which was treated by maxillomandibular fixation for 3 weeks. In other case mild occlusal discrepancy was noted six weeks post operatively, this patient had associated bilateral condylar fractures and right angle fracture.

In study conducted by Ellis and Ghalli[3] no post surgical mal occlusion was found.

In study conducted by Kallela I, Ilzuka T[7] "Lag-screw fixation of mandibular parasymphyseal and angle fractures" in 23 patients slight occlusal adjustment was needed in 5 (23%) patients.

There are several different factors that may result in sensory disturbances. Nerve injury can be caused by the trauma, but also by the treatment. During the operative procedure, the nerve may be involved in traction and/ compression. Manipulation of

fragments during reduction and stabilization of the fracture or extraction of a third molar also could cause injury to the inferior alveolar nerve. Additionally, a bicortical screw placed near the mandibular canal might irritate or damage the nerve.[12]

In our study no patients had pre operative neurosensory disturbances. Immediate post operatively we encountered with two cases of mental nerve paresthesia which resolved in two weeks. Six weeks post operatively none of the patients had any signs of mental nerve injury. None of the screws used in our study were found to damage inferior alveolar nerve canal radiographically. Hence we relate our two cases of neurosensory disturbances to stretching of the mental nerve and soft tissues during operation.

In study conducted by Kallela I, Ilzuka T[7] in patients with only parasymphyseal fractures no neurosensory disturbances were noted before surgery. After surgery there were 8 (68%) patients who showed neurosensory disturbances in the region of mental nerve, chin or both. All of these recovered within 5.4 weeks on average. Authors relate this to stretching of the mental nerve and soft tissues during operation.

Christopher[8] who used lag screw fixation for anterior mandibular fracture did not encounter any neurosensory disturbances. Author relates this to their minimal access technique in which they use small incisions, trans mucosal or per cutaneous lag screw fixation, and minimal soft tissue stripping.

The anterior mandible is uniquely suited to the application of lag screws there are no anatomical hazards below the apices of the teeth until the mental foramina are encountered. This makes lag screw placement extremely simple.[3]

In our study we did not find any screw damaging the inferior alveolar canal or roots of the lower anterior teeth. Our results were in accordance with that of Kallela I.[7]

Wilfried Schilli[34] states that internal fixation screws appears to be more reliable. In the use of self tapping screws, there is a danger that a very small fragments are broken up and squeezed, causing post operative resorption of bone chips and loosening of the screws. So authors advocate tapping of screw hole and copious irrigation to remove all bone chips. The entire screw in the tapped hole is then in direct contact with the bone. The force exerted by the screw is then spread over a large area and better fixation.

Champy[33] who advocates only one small bone plate in most regions of the mandible, always places two bone plates in the symphysis. This prevents tortional movement in the anterior mandible. In accordance with Champy's views in our study we used two lag screws in most of the cases.

In our study we did not encounter displacement of fracture after reduction in 9 (90%) cases but for one (10%) case in which fracture fragments were found to be displaced in immediate post operative period. This was due to failure to determine proper length of the screw. The longer screw which was used did not cause desired compression of the fractured fragments and they remained in the displaced position.

In study conducted by Kallela I, Ilzuka T[7] prospective radiographs revealed anatomic reduction without detectable displacement in lag screw fixation of fractures in 21 (88%) cases, in 2 (8%) cases displacement was slight, in one (4%) case osteosynthesis had broken down.

Fractured bones can also heal by primary intention. Monty Reitzik[30] has demonstrated this type of repair with rigid internal fixation and excellent anatomic position. Fractures treated with rigid fixation show evidence of primary bone healing without any signs of fibrous tissue or cartilage during the healing process.

No external callus is formed and all the classic early stages of bone repair are circumvented. The stage of remodeling occurs immediately. New osteons replace those damaged by the fracture within six weeks.

John K Jones[35] States that primary bone healing is characterized by direct restoration of lamellar bone. However, medullary and cortical bone will heal at their own respective rates. When medullary surfaces are placed in intimate apposition, osteogenic elements and capillary blood supply readily traverses the fracture line and result in direct longitudinal bony healing with little subsequent remodeling in as little as three to four weeks. Primary repair of cortical bone occurs by longitudinal growth of capillaries and osteogenic cells across the fracture line by the way of cortical tunnels. This type of primary repair is called contact healing and is considered to be more difficult and time consuming to achieve than the repair of medullary bone. Under ideal conditions repair of cortical bone would be complete approximately 16 weeks after fracture fixation. The difference in healing rates is probably due to the denseness and relative paucity of capillary blood supply and osteogenic cells of cortical bone as compared with medullary bone.

In our study immediate post operatively visible radiolucent line was noted in 7 [70%] cases where as radiolucent gap was noted in 3 [30%] cases. 6 week post operatively radiolucent line was noted in 8 [80%] cases where as radiolucent gap was noted in 2 [20%] cases.

In study conducted by Ellis and Ghalli[3] in one case at six weeks post surgery noted soft tissue dehiscence and exposed non vital bone. This patient had a large segment of bone that included the inferior border maintained in position using a third lag screw

during surgery. The case was managed by sequestrectomy at 6 weeks post operatively. Thereafter healing was uneventful.

In study conducted by Kallela I, Ilzuka T[7] at six week post operative period the fracture line was more visible in seven (37%) patients, than it had been in the immediate post operative radiograph. In six (32%) patients the appearance was exactly the same as in the post operative view. In two (10%) patients the fracture gap was considered to have narrowed. In four (21%) it was invisible.

Compression osteosynthesis using dynamic compression plates or screws gives rigid fixation. This approach is particularly useful for osteosynthesis of the mandible, which is subject to strong biomechanical forces. On the horizontal ramus masticatory forces create within the body of mandible elongation strains along the alveolar border and compression strains along the lower border. In the anterior mandible these forces are tortional and their magnitude increases more near the midline.[33]

Besides the many advantages that rigid fixation of mandibular fractures offer, the use of lag screws as a type of rigid fixation has many unique advantages over bone plate fixation. The major advantage is it can be applied more rapidly, since the time consuming task of adapting the bone plate is obviated. This allows a more anatomically accurate reduction because it takes considerable skill to perfectly adapt a bone plate to the complex contours of the mandible. Even a slight discrepancy in contouring the plate may lead to displacement of the fracture. Displacement of the bone segments almost never occurs while applying lag screws, when one strictly adheres to the principles of lag screw fixation. Lag screws achieve maximum stability with minimum of implant material. It allows exact repositioning of the fragments by an approach that is essentially intra oral

and allows occlusion to be checked at every stage. It also avoids all the complications which are associated with the extra oral approach such as facial nerve injury and scar formation. Another advantage is the cost incurred; these are greatly diminished because the screws cost much less than a bone plate.

Therefore, through this study one realizes that in mandibular symphysis and parasymphysis fractures, the technique of lag screw fixation is quite practicable in terms of time and cost incurred both to the patient and surgeon. It provides functional stable fixation obviating the need of maxillomandibular fixation.

However it is felt that a study of larger sample and longer follow up is required to show the reliability of lag screw fixation for mandibular symphysis and parasymphysis fractures.

Summery and conclusion

The primary goal of this project was to evaluate the feasibility and efficacy of lag screws in the management of mandibular symphysis and parasymphysis fractures. 10 Patients with mandibular symphysis and parasymphysis fractures reporting to department of oral and maxillofacial surgery; P.M.N.M. Dental College and Hospital Bagalkot were included in the study. 9 [90%] Patients were male and 1 [10%] patient was female, with an age range of 18 yrs to 50 yrs, with the mean age being 27.4 yrs. Follow up period was minimum of 6 weeks.

All the patients underwent open reduction and lag screw fixation. The feasibility and efficacy of lag screws in the management of mandibular symphysis and parasymphysis fractures were evaluated for the following terms.

CLINICAL ASSESSMENT.

1) Intra operative complications.
5) Stability of the fracture.
6) Occlusion.
7) Mental nerve injury.

RADIOGRAPHIC ASSESSMENT

4) Assessment of screw position.
5) Accuracy of reduction.
6) Bone healing at fracture site.

The fallowing observations were made;

1. None of the cases had intraoperative complications.
2. Intra operatively stability was obtained in all the 10 [100%] cases after fixation. One day post operatively in one case [10%] screw got displaced fracturing a portion of buccal cortical plate, mild mobility was noted which was treated by MMF for a period of 3 weeks. 6 weeks post operatively stability was present in all the 10 [100%] cases.
3. Intra operatively proper occlusion was obtained in all the 10 [100%] cases. One day post operatively mild occlusal discrepancy was noted in one case [10%] due to screw displacement. 6 weeks post operatively mild occlusal discrepancy was noted in one case [10%], this patient had associated bilateral subcondylar and right angle fractures. 9 [90%] patients had good occlusion at six week follow up.
4. One day post operatively 2 [20%] patients had signs of mental nerve injury and there were no such signs in other 8 [80%] cases. 2 weeks post operatively and 6 weeks post operatively none of the patients had any signs of mental nerve injury [100%].
5. All the screws in all 10 [100%] cases were in acceptable normal position without causing any damage to the roots or inferior alveolar nerve. Out of two screws in case no 1 one screw did not cross the fracture line to hold the far cortex. Out of two screws in case No 8 one screw was longer than the required length.
6. No displacement of the fracture fragments after fixation was noted in 9 [90%] cases. Displacement of the fragments after fixation was noted in case No 8 [10%] immediate post operatively as well as 6 weeks post operatively. One day post

operatively in case No 5 screw got displaced fracturing a portion of buccal cortical plate but that did not cause any significant displacement of the fracture fragments.

7. Immediate post operatively visible radiolucent line was noted in 7 [70%] cases where as radiolucent gap was noted in 3 [30%] cases. 6 week post operatively radiolucent line was noted in 8 [80%] cases where as radiolucent gap was noted in 2 [20%] cases.
8. Fractures in 8 cases were treated using 2 lag screws where as only one lag screw was used in 2 cases with arch bar as tension band maintained for a period of 3 weeks.
9. Six cases [60%] did not require MMF; in three cases [30%] MMF was required for a period of 4 weeks due to other associated fractures, in one case [10%] MMF was required for a period of 3 weeks due to displaced screw.
10. Out of 18 screws used in 10 cases; Out of two screws in case no 1 one screw did not cross the fracture line to hold the far cortex. Out of two screws in case No 8 one screw was longer than the required length.
11. No cases had wound dehiscence or infection.

From the findings of this study and the results obtained, the following conclusions have been drawn.

1. Lag screw fixation can be used as a routine technique in the treatment of mandibular symphysis and parasymphysis fractures.
2. With experience and skill this technique can be executed in very short time.
3. Lag screw fixation in mandibular symphysis and parasymphysis fractures need not be supplemented by maxillomandibular fixation.
4. Two lag screws should always be used wherever possible. If however, the use of two lag screws is not possible due to anatomic constraints the single lag screw should be supplemented with arch bar as a tension band.
5. Rigidity achieved by the lag screw fixation is excellent and can be compared to any other form of the rigid fixation.
6. Lag Screw fixation leads to good bone healing without permanent neurosensory deficit or increased risk of malocclusion.

This technique enables the experienced surgeon to achieve optimal stability and function with a minimum of material and time. The possible post operative complications of an extra oral approach are avoided and the length of hospital stay and patient discomfort are drastically reduced. In view of the multiple advantages it offer the surgeon anaesthesiologist, and patient, lag screw osteosynthesis can be advocated as a valid treatment modality in the management mandibular symphysis and parasymphysis fractures.

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Annexures

ANNEXURE I

DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY.

P.M.N.M. DENTAL COLLEGE AND HOSPITAL BAGALKOT.

CASE HISTORY PROFORMA.

Name of the patient:

Age & Sex:

Address:

Date & Time:

OPD.No:

Chief complaint:

History of injury:

Date & Time of injury:

Date & Time of admission of the patient in this hospital:

Past medical & dental history:

GENERAL PHYSICAL EXAMINATION:

Glassgow Coma Scale:

A: Eye opening

Spontaneously	**4**
Opens eyes to voice	**3**
Opens eye to pain	**2**
No eye opening	**1**

B: Best Motor response

Obeys commands	**6**
Localizes to pain	**5**
Withdraws to pain	**4**
Abnormal Flexor response	**3**

Abnormal Extensor response **2**

No movement **1**

C: Verbal response

Appropriate & Oriented **5**

Confused conversation **4**

Inappropriate words **3**

Incomprehensible Sounds **2**

No Sounds **1**

B.P:

Pulse:

Temperature:

Pallor:

Icterus:

EXTRA-ORAL EXAMINATION:

Bleeding from

Nose:

Ear:

Mouth:

C.S.F. Leakage from

Nose:

Ears:

Circum Orbital ecchymosis:

Subconjunctival Ecchymosis:

Diplopia:

Enopthalmosis:

Pupils:

Right: Normal/Dilated/Contracted

Light reflex: Brisk/Slow/Absent.

Left: Normal/Dilated/Contracted

Light reflex: Brisk/Slow/Absent.

Lacerations:

Abrasion:

On palpation pain or Tenderness at:

Orbital margin: **Normal/Deranged.**

Nasal bones: **Normal/Deranged.**

Zygoma: **Displaced/undisplaced.**

Rt/Lt/Both

Zygomatic arch: **Normal/Deranged.**

Rt/Lt/Both

Condyles: **Normal/Deranged.**

Rt/Lt/Both

Mandibular border continuity: **Normal/Deranged**

Site:

Mental nerve: **Normal/Anesthesia/Paresthesia.**

Rt/Lt/Both

Nasoethmoidal complex: Normal/Deranged.

INTRA ORAL EXAMINATION:

Mouth opening:

Ecchymosis:

Laceration of mucosa:

Swelling:

Midline deviation:

Occlusion:

No of teeth present:

Fracture fragment mobility:

Fracture : **1. Displaced**

2. Undisplaced.

Fracture sites of middle third:

1. **Dentoalveolar fracture**
2. **Teeth fracture**
3. **Palatal fracture**
4. **Le-Fort I fracture**
5. **Le-Fort II fracture**
6. **Le-Fort III fracture**
7. **Zygoma fracture:** **Lt/Rt/both.**
8. **Zygomatic arch:** **Lt/Rt/both.**
9. **Nasal bone fracture:**
10. **Any other:**

Fracture sites of Mandible:

1. **Dentoalveolar fracture:**
2. **Teeth fracture:**

3. **Body fracture: Lt/Rt/both.**
4. **Coronoid fracture: Lt/Rt/both.**
5. **Angle of the mandible: Lt/Rt/both.**
6. **Para Symphysis fracture: Lt/Rt/both.**
7. **Ramus fracture: Lt/Rt/both.**
8. **Condyle fracture: Lt/Rt/both.**

PROVISIONAL DIAGNOSIS:

INVESTIGATIONS:

RADIOGRAPHS:

1. **Orthopantamogram.**
2. **Occlusal.**
3. **P.N.S.**
4. **Lateral Cephalogram.**
5. **PA skull.**

Any other

Radiological Interpretation:

BLOOD INVESTIGATIONS:

Haemog1obin %:

R.B.C.Count:

W.B.C.Total count:

E.S.R.:

<u>Differential count:</u>

Neutrophils:

Lymphocytes:

Eosinophils:

Monocytes:

Basophils:

Bleeding time:

Clotting time :

Blood group:

Random blood glucose level:

Blood urea:

Urine analysis:

Urine sugar:

Urine albumin:

HIV 1&2:

HbsAg:

FINAL DIAGNOSIS:

TREATMENT PLAN:

TREATMENT DONE:

ANNEXURE II

CONSENT FORM

DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY.

P.M.N.M. DENTAL COLLEGE AND HOSPITAL BAGALKOT.

FEASIBILITY AND EFFICACY OF LAG SCREWS IN THE MANAGEMENT OF MANDIBULAR SYMPHYSIS AND PARASYMPHYSIS FRACTURES

I have been explained by Dr. Sanjay. Byakode. in my spoken language that my Ward / my Child / am / is suffering from fractured mandible and_____, and my ward / my child / am needs to undergo open reduction and fixation for fractured mandible and _____. The risk of anaesthesia, surgery and other required medical procedures is Regular / Moderate / High / Very high. The surgical procedure may change on the patients need and the patient may move from one risk category to another during or after the procedure.

The patient may have complications during the surgical procedure or after the procedure. The complications include allergic reaction to drugs, delayed recovery, jaundice, cardiac arrest etc. and these complications may lead to prolonged hospitalisation and aggressive treatment procedures which may be expensive and even be fatal. Having understood all the above to my satisfaction, I give my unreserved consent for anaesthesia, surgeon and any other procedure that may be required for me / my ward / my child. The hospital, anaesthetist, staff or the surgeon shall not be held responsible in case of an adverse outcome.

SIGNATURE: SIGNATURE:

Name of the attendant Name of the patient.

Date: