COMPARISON OF SUPERIOR BORDER AND INFERIOR BORDER FIXATION FOR DISPLACED MANDIBULAR ANGLE FRACTURES

A Dissertation submitted in
Partial fulfillment of the requirements
for the degree of

MASTER OF DENTAL SURGERY

BRANCH – III
ORAL AND MAXilloFACIAL SURGERY

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI – 600 032

2012 - 2015
CERTIFICATE

This is to certify that Dr. SATISH VASANTH.D, Post Graduate student (2012–2015) in the Department of Oral and maxillofacial Surgery, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003 has done this dissertation titled “COMPARISON OF SUPERIOR BORDER AND INFERIOR BORDER FIXATION FOR DISPLACED MANDIBULAR ANGLE FRACTURES” under my direct guidance and supervision in partial fulfillment of the regulations laid down by The Tamil Nadu Dr. M.G.R. Medical University, Chennai – 600 032 for M.D.S., (Branch – III) Oral and Maxillofacial Surgery degree examination.

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Professor and Guide Professor and HOD

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DECLARATION

I, DR. D. SATISH VASANTH, do hereby declare that the dissertation titled “COMPARISON OF SUPERIOR BORDER AND INFERIOR BORDER FIXATION FOR DISPLACED MANDIBULAR ANGLE FRACTURES” was done in the Department of Oral and Maxillofacial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai-600 003. I have utilized the facilities provided in the Government dental college for the study in partial fulfillment of the requirements for the degree of Master of Dental Surgery in the speciality of Oral and Maxillofacial Surgery (Branch III) during the course period 2010-2013 under the conceptualisation and guidance of my dissertation guide, Prof. Dr. D. Durairaj, M.D.S. I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Government Dental College & Hospital. I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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And

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1.

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ACKNOWLEDGEMENT

“Gratitude can transform common days into thanksgivings, turn routine jobs into joy, and turn ordinary opportunities into blessings.”

- William Arthur Ward

Let me begin this acknowledgement by thanking the Almighty for showering His bountiful blessings on me and giving me this opportunity.

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Lastly, I would like to thank all my friends & colleagues who were the silver lining and the pillar of strength when the days were dark and gloomy for their unwilling support.
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Ref.No. 0430/ DE/ 2014 Date: 07.08.2014

Title of the work: "Comparison of Superior Border and inferior Border fixation for displaced mandibular angle fractures Study"

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The request for an approval from the Institutional Ethical Committee (IEC) considered on the IEC meeting held on 31.07.2014 at the Principal’s Chambers Tamil Nadu Government Dental College and Hospital, Chennai – 3

"Advised to proceed with the study"

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ABSTRACT

BACKGROUND:

The purpose of this prospective study is to compare the efficacy of superior border fixation and inferior border fixation in displaced mandibular angle fractures.

MATERIALS AND METHODS:

The total study sample was fourteen and was divided into two groups. Group A (Intra oral) was treated with open reduction and internal fixation by means of 2 × 4 hole titanium miniplate with 2 × 8mm screws over the superior border of angle of mandible in accordance with champy’s principle. Group B (Extra oral) was treated with 2 × 4 hole titanium miniplate with 2 × 10mm screws over the inferior border of angle of mandible. The efficacy and complications associated with both techniques were evaluated.

RESULTS:

There were no significant differences in terms of complications, the clinical union of fracture, radiographic assessment of fracture after surgery, occlusal harmony between the two groups although the parameters like patient satisfaction, mouth opening at the end of 3 months follow up, duration of intra operative time, ease of surgery were in favor of extra oral group. Also the incidence of usual demerits associated with the extra oral approach such as facial nerve paresis and scarring were less compared to other studies.

CONCLUSION:

Although Champy’s miniplate fixation through intra oral approach is followed worldwide for fixation of angle fracture, the displaced angle fractures are better reduced and fixed with inferior border plating which provides easy access, adaptation of plates, short surgical time with minimal complications.

KEY WORDS: Mandibular Displaced Angle Fractures; Superior Border; Inferior Border; Miniplate Fixation.
LIST OF ABBREVIATIONS

M - Male

F - Female

OPG - Orthopantomogram

CT - Computed Tomography

ORIF - Open reduction and Internal Fixation

SD - Standard Deviation

IMF - Intermaxillary Fixation

IO - Intra Oral

EO - Extra Oral

3M - Third Molar

IMFS - Intermaxillary Fixation screws

IAN - Inferior Alveolar Nerve
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“The face is a picture of the mind with the eyes as its interpreter.”

— Marcus Tullius Cicero

Facial fractures are one of the most common presenting injuries to the hospitals worldwide. It is usually associated with head injuries thereby increasing the morbidity of these patients. There must be proper understanding of the principles of evaluation and surgical treatment for adequate management and rehabilitation of these patients. The treatment of these fractures have gained valuable significance since it deals with the aesthetics and facial contour and any failure to treat, will lead to a life with secondary deformity and that of poor quality. In the maxillofacial region, mandibular fractures causes significant facial deformity as well as loss of masticatory efficiency and speech. The fracture of condyle is the most common of the facial fractures. Next in line is the mandibular angle fracture which constitutes about 23-42% of all mandibular fractures. The cause, patterns and frequency of these fractures are diverse varying on the mode of injury.

The distinct anatomical shape of the mandible plays a role in the fracture pattern involving the mandible. It is a tubular bone which is bent into a blunt v shape. Its strength depends in its dense cortical plates. The cortical bone is very thick anteriorly and at lower border of mandible, while posteriorly the lower border is relatively thin. This scenario makes mandible strongest anteriorly in the midline with progressively less strength towards condyles. This basic shape is further altered by the functional processes namely angle, coronoid and alveolar
bone. Masseter muscle and medial pterygoid muscle is attached to the angle while temporalis muscle relates to the coronoid process. The form of alveolar process relies upon the presence of teeth and force transmitted through it. Also it is said that mandible is not a smooth curve of uniform cross section but a v shaped specimen. Because of this there are parts of mandible that has greater force per unit area and so tensile strain develops in these locations.³

The angle of mandible is not a precise anatomical site but a region. The clinical angle is the junction between alveolar bone and ramus of mandible at the origin of internal oblique line. The junction between the mandibular body and the ramus at origin of external oblique line is called is called surgical angle. The place where the lower border meets the posterior border of the ramus is designated as anatomical angle or gonion.

The most persistent cause of facial fractures include Road traffic Accidents and assaults. The other causes comprise sport injuries and falls⁴. The primary goal of mandibular fracture treatment is the restoration of anatomical form and proper function with priority to achieve adequate occlusion. Of all the mandibular fractures the mandibular angle fractures is associated with highest post surgical complications⁵.

The management of these fractures has gone through various stages of evolution ranging from closed to open treatment. The appropriate option depends on the nature of the fracture, age of the patient and also the medical and psychological status, cost, and occasionally surgeon preference and training.⁶
Conservative management is achieved by the reduction of fracture segments with adequate occlusion by using direct or indirect interdental wiring to accomplish immobilisation in that position by means of maxillo mandibular fixation. The possible demerits include inconvenience to the patient and obstruction of airway.

The open treatment by means of internal fixation provides proper maintenance of aligned fracture fragments and obviates the post operative MMF period. The advantage of this method is convenience to the patient by avoiding complications of immobilisation. Various options available are single plate at superior border or inferior border, two plates, lag screws, 3d plates or bioresorbable plates. Although undisplaced fractures can be managed by intra oral means, displaced fractures can be treated by various means. The intra oral method provides good access to superior oblique ridge but it doesn’t provide any access to the inferior border to reduce the segments accurately. The extra oral method provides direct visualisation and fixation of the displaced fracture segments but there is possibility of scar and facial nerve injury.
Aim and Objectives

AIM

The aim of this prospective study was to compare the Open Reduction and Internal Fixation (ORIF) of the fracture via an intraoral approach with a single monocortical titanium miniplate at the superior border versus extraoral approach with a single titanium miniplate with bicortical screws at the inferior border for displaced mandibular angle fractures.

OBJECTIVES

The following parameters were compared with the two surgical approaches 1) superior border fixation by transoral technique 2) inferior border fixation by submandibular approach for management of displaced mandibular angle fractures.

1. Surgical ease and exposure.
2. Intraoperative time of surgery.
3. Patient satisfaction.
4. Preoperative and post operative mouth opening.
5. Preoperative and post operative occlusion.
7. Facial nerve paresis.
10. Fracture reduction after 3 months with radiographs.
The examination, diagnosis and treatment of the mandibular fractures and other surgical treatments began as early as 1650 B.C as described by an Egyptian papyrus. Hippocrates (460 to 375 B.C) "Father of medicine" was the first one to describe the basic principles of modern fracture repair, reduction and stabilisation. He used circumdental wiring for the reapproximation of fracture segments. He also advocated the use of adjacent teeth and external bandaging of the face to make the fracture immobile. He insisted that reapproximation and immobilisation are paramount for treatment of mandibular fractures. Salerno from Italy has written a textbook describing the importance of establishing proper occlusion. In 1492,"Cyrugia” authored by Guglielmo Salicetti spoke about the theory of maxillomandibular fixation by stating that ‘tie the teeth of uninjured jaw to the teeth of injured jaw’. In the year 1795, Chopart and Desault described the effects of elevator muscles and depressor muscles on mandibular fragments.

In the nineteenth century, Buck, used an iron loop and kinlock using a silver wire to treat mandibular fractures with an open reduction. In the year 1881, Gilmer described the use of 2 heavy rods placed on either side of the fracture line that were wired together.

In 1886, Hansmann from Hamburg used the corrosion free metal plates for mandibular fracture fixation.

Schede (1888), is credited with the first use of true bone plate made up of steel and secured with four screws. In 1960s, Luhr developed the vitallium mandibular compression plating.
In the early 1970s AO/ASIF developed the concept of dynamic compression plating for mandible using the eccentrically placed screws to generate compression. In 1970s, Michelet introduced the concept of non compression plating which was later popularised by Champy and co workers and now being used widely.\textsuperscript{14}

**INCIDENCE:**

There are many possible causes for mandibular fractures but vehicular accidents\textsuperscript{(43\%)} and assaults \textsuperscript{(34\%)} are one of the most common causes of mandibular fractures.\textsuperscript{4}

**Ellis** (1985) in his study has stated that angle of mandible is the second most common site for fractures caused by alleged assaults and the third most fractured region in the event of falls.\textsuperscript{15}

**Mohammed Hosein** (2003) in his study of assessment of maxillofacial fractures had suggested that assault is the most common cause of maxillofacial fracture in developed countries and traffic accidents remain the most frequent cause of fractures in the developing countries.\textsuperscript{16}

Also it is said that the most common site of mandibular fractures in cases of assault is mandibular body while in fractures due to fall, fracture is most likely to happen in condyles. In cases where trauma occurs due to road traffic accident the common site is condyle or body region.\textsuperscript{16}
The age of the patient also plays a significant role in influencing the site of fracture and it is said that the condylar fractures are more common in children\textsuperscript{16}.

According to Alleyson (2008), Angle fractures are the most common fractures accounting for 30% of all the mandibular fractures\textsuperscript{17}.

Considering the gender difference, fractures occur more commonly in male population and are often associated with alcohol consumption.

Pathologic fractures can result from conditions like osteo-radionecrosis, bisphosphonates-related osteonecrosis, and benign or malignant tumours or cysts that weaken the structure of the angle to the point where a fracture occurs from minimal or no trauma\textsuperscript{18}.

**CLASSIFICATION:**

The mandibular angle can be best described as an anatomic region rather than a precise anatomic location. This area is designated as a triangular area with the superior edge being the junction of the horizontal body and the vertical ramus, usually where the third molar is or was located. The anterior border of the masseter muscle forms the anterior limiting border and the posterior border of the triangle is formed by an oblique line which extends from the third molar region to the posterior superior attachment of the masseter muscle\textsuperscript{18}.

Fractures through the mandibular angle can be classified in different ways. First, they can be described as either closed or open fractures. A closed fracture
never communicates to the outside environment; whereas an open fracture is partially or completely exposed intraorally or extraorally. Extraoral open fractures occurs rarely and happens only in high-velocity or penetrating injuries. Intraoral open fractures occurs due to tearing of the gingiva overlying the angle at its superior border. Communication of the fracture to the mouth through the periodontal ligament also creates an open fracture.  

Angle fractures can also be classified as simple or communited. Simple fractures involve only a single break through the bone whereas the communited fractures display multiple breaks. The communited fractures are more often caused by high impact trauma such as gunshot wounds and high velocity motor vehicles accidents.  

The degree of fracture separation can be another basis for classification and is classified as complete or greenstick fractures. Complete fractures occur when there is disruption of both the medial and lateral cortices. Greenstick fractures, which are usually rare, occurs with disturbance of only one cortex.  

Mandibular angle fractures can also be classified as favorable or unfavorable. A favourable fracture occurs when the masseter and medial pterygoid muscle act on the proximal and distal segments of the fracture and help to reduce it. The more common unfavorable fracture is the one that involves separation of the proximal and distal segments due to muscle pull. An unfavorable fracture is further classified as horizontally or vertically unfavorable. In the case of horizontally unfavorable fracture, the action of the masseter and medial
pterygoid muscles distracts the proximal segment superiorly and the suprathyroid muscles act to distract the distal segment inferiorly. A vertically unfavorable fracture is the one when this fracture pattern allows for the distal segment to be pulled medially by the medial pterygoid muscle.\(^1^8\)

Mandibular angle fractures may also occur in combination with many other facial or mandibular fractures. When angle fractures occur in combination with any other mandibular fractures, the most common secondary fracture site will be at the contralateral parasymphysis.\(^1^9\)

The presence of bilateral mandibular angle fractures is quite rare but, when present, it requires special attention because of the possibility that the dentate segment can become displaced posteriorly, resulting in airway compromise. Close observation of patients with these types of fractures is a must to prevent airway collapse.\(^1^8\)

**DIAGNOSIS:**

Because of the routine use of CT scans in emergency departments, the importance of the physical examination is often overlooked. The extraoral examination should begin first with a visual inspection. Swelling, ecchymosis, step deformity and tenderness on palpation at the inferior border may be a sign of an angle fracture. A thorough cranial nerve examination should be a routine practice in any physical examination, with special attention regarding potential changes in the third division of the fifth cranial nerve. Mandibular angle fractures, especially when there is some degree of displacement, most likely causes
hypoesthesia, anesthesia, or dysesthesia of inferior alveolar nerve. Facial nerve (cranial nerve VII) injury is rare with angle fractures, but this can occur with penetrating trauma. It is imperative to document those findings in the preoperative evaluation as a baseline for postoperative monitoring of the patient.\textsuperscript{18}

Intraoral examination of the patient can reveal ecchymosis, gingival lacerations, and bleeding in the posterior buccal and lingual vestibules. Evaluation of the occlusion may reveal a malocclusion, with premature tooth contact on the fractured side and an open bite on the contralateral side. In a case of bilateral mandibular angle fractures, an anterior open bite and posterior displacement of the tooth-bearing segment can occur.\textsuperscript{18}

When using plain films, at least 2 views of the mandible should be obtained. The radiographs should be perpendicular from each other to ensure proper evaluation of fracture. The use of plain films has fallen out of favour due to the availability of CT scans in most hospital emergency departments. Axial CT scans along with sagittal and coronal reconstructions provide excellent visualization of all dimensions of the fracture and are the gold standard in diagnosis. In the clinic and as an initial screening tool, a panoramic radiograph is still a valuable tool, especially when considering the ease of obtaining them, the low cost, and minimal radiation exposure to the patients.\textsuperscript{18}
TREATMENT:

There has been considerable change in the treatment of mandibular angle fractures over the past 3 decades. There is still wide acceptance of the usage of closed and open treatment of these fractures. The alternatives are dictated by the nature of the fracture, age of the patient and medical and the psychological status, cost, and occasionally surgeon preference and training.18

Closed reduction treatment for mandibular angle fractures can only be used with favourable fracture patterns. In favourable fractures, the elevator muscles of mandible are less probable to cause the rotation of proximal segment superiorly and anteriorly when the segment is not securely fixed to dentate part of the mandible. In such circumstances, closed reduction is usually achieved with fixation screws. The use of arch bars gives no added stability of the proximal segment of the angle because, unlike in the dentate portions of the mandible, an arch bar will not be able to provide a superior tension band at the angle of mandible.18

After the closed reduction of fracture, an immediate postoperative panoramic radiograph should be obtained to confirm the proper reduction of the fracture segments. Maxillo mandibular fixation can also be used alone or be used in combination with external pin fixation devices when there is a comminuted fracture with several small bony fragments that cannot be stabilized using standard plate and screw fixation.18
Pranav D. Ingole (2014) using a total of 50 patients with minimally displaced mandibular fractures established the supremacy of InterMaxillary Fixation Screws (IMFS) when comparing with the eyelet interdental wiring. IMFS is a safe as well as time saving technique. It is a cost-effective, straightforward, and a viable alternative to the cumbersome eyelet interdental and other wiring techniques that are usually used for providing IMF, in the presence of satisfactory occlusion during closed reduction or intraoperative open reduction and internal fixation of fractures. In addition to that, oral hygiene can be maintained, and the chance of glove perforation rate was very low using IMFS. 20

Moshood F. Adeyemi (2012) compared the healing outcome of a short period of (2weeks) intermaxillary fixation (IMF) with the conventional (4-6 weeks) IMF in the management of fractures of the mandibular tooth-bearing segment. The healing outcome was quite comparable in both the groups. But, the healing time was significantly longer in the group with the short IMF period. Also the recovery of maximal mouth opening, oral hygiene status, and loss of body weight in the study group were significantly better than those that of control group. This study suggested that a short period (2 weeks) of IMF in the management of minimally displaced mandibular fractures of the tooth-bearing area in the young adults is a suitable alternative to the usual method in terms of the healing outcome. 21

Anshul Rai (2012) compared the efficacy of eyelet wiring and direct interdental (Gilmer) wiring to achieve intermaxillary fixation (IMF). He states that eyelet wiring is preferable to direct interdental wiring as it has fewer
complications, and requires a shorter operating time with minimally displaced fractures.\textsuperscript{22}

Kyle Tracy (2012) compared the outcomes of mandible fractures treated by open reduction and internal fixation and adjunctive intermaxillary fixation (IMF) using 2 different techniques, the embrasure wires vs arch bars. Patients treated with embrasure wire IMF had slightly better clinical outcomes in comparison to arch bar IMF. But, there is a significant cost reduction for patients treated with embrasure wire for IMF.\textsuperscript{23}

Griffin Harold West (2014) assessed whether simple mandibular fractures could be treated successfully in an open or closed method by using maxillomandibular fixation (MMF) screws. Uncomplicated mandibular fractures were successfully treated by using MMF screws in open and closed methods. But, the utility in closed treatment was low because of the significant screw failure and patient’s noncompliance. There was a minimal long-term damage to the periodontium and the dental roots. The cost of screws was negligible compared to time savings.\textsuperscript{24}

G.C.S. Cousin (2009) did a study consisting of a total of 150 successive patients treated with wire-free fixation of 146 mandibular and 5 maxillary fractures. He had stated that IMF using wire has certain disadvantages. IMF application increases the operating time and also the costs of fracture management. Eyelets, particularly the arch bars, usually do compromise gingival health, and a second procedure is required to remove the wires. Nurses and
surgeons are at great risk of needle stick injuries, and of acquiring blood-borne virus infections and so the avoidance of jaw wiring has its advantages.\textsuperscript{25}

**SURGERY:**

Aleysson O. Paza, 2008 did a retrospective study from April 1999 until July 2004. 114 patients were treated for 115 fractures of the angle of the mandible. The results showed that the use of either an extraoral ORIF with the AO/ASIF reconstruction plate, or intraoral ORIF, using a single miniplate, is associated with the fewest complications, ranging from 0\% to 7.5\%. Severity of the trauma and the social risk, including alcohol abuse, smoking, intravenous and non intravenous drug abuse, were the factors that contributed to the development of postoperative infection.\textsuperscript{26}

R. Bryan Bell 2008 conducted a retrospective cohort study of 162 patients. The purpose of the study was to analyze the complications associated with a series of mandibular angle fractures which were treated by ORIF and to find if the method of intraoperative maxillomandibular fixation (MMF) affected the patient’s outcome. It was concluded that the use of intraoperative interdental wire fixation (arch bars or “Stout wires”) used as an aid to the open reduction, stabilization, and fixation was not always necessary for successful clinical outcomes in selected patients. The clinician should in a position to select the appropriate technique based on the patient’s injury pattern, expected compliance and also treating surgeon’s experience and available resources. Larger and more well-powered studies are needed to determine equivalency between the treatment methods.\textsuperscript{27}
Paolo Scolozzi 2008 evaluated prospectively the accuracy and also the reliability of a specific ad hoc reduction compression forceps used in the intraoral open reduction of transverse and well displaced mandibular angle fractures and established that it results in a high rate of success. 28

Alparslan Esen 2008 performed an experimental in vitro study to compare the stability of titanium and absorbable plate and screw fixation systems for mandibular angle fractures. 21 sheep hemi-mandibles were used to evaluate 3 different plating techniques. The study demonstrated that the system of titanium plate and screw fixation had greater resistance to occlusal loads when compared to absorbable plate and screw systems. Also, a second absorbable plate fixation provides a more favorable biomechanical behavior in comparison to a single absorbable plate placement. 29

Peter Bui, 2009 conducted a study to determine the rate of postoperative infection and the efficacy of removing tooth in the line of mandibular angle fractures treated with 2.0-mm 8-hole titanium curved strut plates. The use of this plate is said to be associated with a low infection rate (8.2%). He further added that the infection rate for those mandibular angle fractures with teeth in the line of fracture retained was about 14% compared with 5.6% in those fractures with the teeth in the line of fracture extracted. 30

Burak Bayram, 2009 compared the fixation reliability and stability of the titanium and resorbable plates and screws by simulating chewing forces in
eleven sheep hemimandibles. The stability of mandibular angle fractures fixed with titanium miniplates under simulated chewing forces was significantly higher than that of the resorbable system. Metallic and resorbable fixation systems therefore cannot be used interchangeably to treat the mandibular angle fractures under similar loading conditions.\textsuperscript{31}

\textbf{A. W. Sugar}, 2009 compared the fixation of simple mandibular angle fractures using a single miniplate either placed from a combined transbuccal and intraoral approach, or intra-orally alone in 140 consecutive patients. He demonstrated that the combined transbuccal and oral procedure was, on the basis of the principal outcome measure (probability of plate removal and infection requiring further surgery), safer and more effective than the standard intra-oral technique. The combined approach was overwhelmingly preferred by the surgeons who carried out both procedures.\textsuperscript{32}

\textbf{Edward Ellis} 2010 worked about to evaluate treatment outcomes prospectively when isolated mandibular angle fractures are treated by 1) nonrigid fixation that includes five to six weeks of maxillomandibular fixation, 2) nonrigid but functionally stable fixation by using a single miniplate, and 3) rigid fixation using 2 miniplates. It was concluded that the use of a single miniplate was associated with fewer complications when compared to use of 2 plates or if an interosseous wire and MMF were employed. It was also found to be the least difficult internal fixation scheme to master.\textsuperscript{33}
**Krushna Bhatt** 2010 did a study using bioresorbable fixation versus titanium for equivalence in terms of clinical union and complications by using the American Association of Oral and Maxillofacial Surgeons parameters of care. The small sample size of the study did not allow any meaningful conclusion to be extracted from the present study in terms of the primary question of achieving union. Both groups matched in outcomes when evaluated only on a clinical basis of patients. The avoidance of repeat surgery for hardware removal is a definite advantage of using resorbable plates. But, the results are still inconclusive in favor of any particular plating system.\(^{34}\)

**Ribeiro-Junior** 2010 performed a in vitro study to evaluate the influence of the type of miniplate and the number of screws installed in the proximal and also the distal segments on the stability and resistance of Champy’s osteosynthesis lines in mandibular angle fractures. The results demonstrated that locking miniplates offer more resistance in comparison to conventional miniplates and that long locking miniplates provide greater stability compared to short locking miniplates.\(^{35}\)

**Edward A. Longwe** 2010 did a retrospective study of 337 fractures of the angle, body, and parasympyseal regions of the mandible in the period from 2001 to 2006. The study advocates the use of a 2.0-mm miniplate adapted along Champy’s line of ideal osteosynthesis using an intraoral, transmucosal approach and fixation with monocortical (where feasible, bicortical) screws plus two weeks of IMF is a viable treatment modality for the noncomminuted, noninfected angle,
body, and symphyseal mandibular fractures and it results in a low complication rate.\textsuperscript{36}

\textbf{L. A. Bregagnolo} 2010 orchestrated a in vitro study to compare, by mechanical in vitro testing, a 2.0-mm system made with polyL-DL-lactide acid with an analogue titanium based system. He postulated that despite more failures, the polyL-DL-lactic acid-based system was found to be effective.\textsuperscript{37}

\textbf{Mohammad Bayat}, 2010 evaluated the treatment of mandibular angle fractures using a single biodegradable plate and addressed the possible complications such as malocclusion, infection, wound dehiscence, and non-union in these patients. Based on this limited series of patients, it was formulated that the use of a single biodegradable plate for unilateral mandibular angle fractures is a reliable fixation scheme with minor complications.\textsuperscript{38}

\textbf{Anil Kumar Danda}, 2010 compared the postoperative complications that occur after the fixation of mandibular angle fractures with two non compression miniplates, in which a single plate is fixed on the superior border of the mandible and the other plate is fixed to the lateral aspect of the mandible, with the standard technique of a single noncompression miniplate fixed on the superior border of the mandible in 54 patients. Results of the study showed that the use of non compression miniplates used for treating noncomminuted fractures of the mandibular angle does not seem to have any advantage over the use of a single plate.\textsuperscript{39}
Heidrun Schaaf, 2011 did a retrospective investigation comparing the patients treated with miniplates and with lag screws. The major parameters for the outcome analysis were fracture gaps at four defined measuring points on postoperative radiography. This study demonstrated a smaller fracture gap when using the lag screw fixation. This fixation method using 2 miniplates showed wider fracture gaps in comparison with 1 miniplate. The main advantage of the lag screw lies in providing compression to the fracture fragments so that primary bone healing can be obtained. The lag screw offers the advantages of a minimally invasive technique, short surgery time, no need of plate contouring, and less osteosynthesis material, and hence minimal cost. An intraoral approach is possible for lag-screw fixation, with a minimal transbuccal approach for correct screw angulation alone.\textsuperscript{40}

Alparslan Esen orchestrated an in vitro experimental study to test the reliability of a single malleable titanium miniplate for fixing fractures of the mandibular angle. 18 sheep hemimandibles were used to evaluate the 2 plating techniques. The groups were tested with a single non compression titanium miniplate or a single malleable titanium miniplate. Their results clearly show that malleable plates alone had insufficient stability to support fractures of the mandibular angle. From a clinical point, we think that intermaxillary fixation may be needed to support the malleable miniplate fixation during the early postoperative period after a fracture of the mandibular angle.\textsuperscript{41}

Eduardo Hochuli-Vieira 2011 performed a study to evaluate the clinical outcome of patients with mandibular angle fractures treated by intraoral access
and a rectangular grid miniplate with 4 holes and stabilisation with monocortical screws. The rectangular grid miniplate that was used in this study was stable for the treatment of simple mandibular angle fractures through intraoral access had lower complication rates, easy handling and adjustment, and a low cost. As for other methods, the use of a smaller sized plate with less rigidity in the presence of other existing mandibular fractures may increase the rate of complications. It is therefore important to emphasize that the use of the rectangular grid miniplate should be indicated mandatorily in fractures with sufficient interfragmentary contact.\(^\text{42}\)

**Z. O. Pektas** 2012 conducted a study to evaluate the effects of horizontally favourable and unfavourable mandibular fracture patterns on the basis of fixation stability of titanium plates and screws by simulating chewing forces. Favourable and unfavourable mandibular fractures on twenty two sheep hemimandibles were fixed with 4-hole straight titanium plates and 2.0 mm titanium screws according to the Champy’s principle. It was found that there was no evidence for the need to apply different treatment modalities for mandibular fractures regardless of whether the fractures are favourable or not.\(^\text{43}\)

**S. Laverick** 2012 designed a study to investigate the null hypothesis that there is no difference in the incidence of post operative removal of an infected plate. Miniplates placed on the mandibular external oblique ridge and that placed on the buccal surface of the mandible by a transbuccal approach to treat the fracture of the angle of the mandible were compared. They found that the transbuccal plating leads to fewer plates being removed for infection in
comparison to ridge plating in the treatment of angle fractures. Transbuccal plating is not more time consuming than ridge plating and there is no significant scarring or facial nerve damage in association with this approach. If mandibular fractures are being treated according to the Champy’s principles it is therefore recommended that angle fractures should be treated with a monocortical osteosynthesis plate that can be placed against the buccal side of the mandible using transbuccal method.44

**David R. Kang**, 2013 did a retrospective evaluation of 10 patients over a 2-year period using a 7-hole angle plate for stabilisation for their angle fracture. The patients were evaluated for post-operative complications including pain, malocclusion, and infection. The 7-hole angle plate was found to be a good first option when more rigid or semi rigid fixation is required and the best alternative when the Champy technique was found to be ineffective.45

**B.T.Suer**, 2014 did a in vitro experimental study to test the stability and resistance to mechanical force of a new titanium miniplate design. 30 fresh sheep hemimandibles, sectioned at the angle region, were used to evaluate the two plating techniques. The results of this in vitro study cannot be actually compared to a actual patient care but the findings demonstrate that this new design miniplate offers more resistance and stability to the lateral displacing forces occurring at the fracture site than conventional single miniplates. Also this new design titanium miniplate could be useful in the treatment of non-comminuted, non-complicated, and minimally displaced angle fractures of mandible.46
**Julie Kimsal**, 2014 did a finite element analysis to biomechanically evaluate the different fixation methods used to fixate mandibular angle fractures. 3 fixation scenarios were considered: a single tension band onto the superior mandibular border, a single bicortical angle compression plate placed at the inferior border and the tension band with bicortical plate used together. A single tension band placed on the superior border provided more angle fracture stability in comparison to a single bicortical plate which was placed inferiorly and provided comparable stability to the combination plate fixation scheme. High stress over the single tension band configuration may explain the clinical observations of plate failure.\(^{47}\)

**F.B. Trivellato** 2014 designed a in vitro study to determine the mechanical resistance of a 2.0-mm titanium system applied to the mandibular angle, in cases with or without continuity of the inferior border of the mandible. He found better results in the group with continuity of the inferior border of the mandible in comparison to the subgroup without continuity. He further added that discontinuity of the inferior border of the mandible did not decrease the mechanical resistance of the fixation.\(^{48}\)

**Joseph E. Cillo Jr**, 2014 did a study to determine the incidence, etiology, and the outcomes of bilateral mandibular angle fractures treated with the transoral method of rigid fixation on one side and non rigid fixation on the other side. The fixation method used in their study was the angle fracture treated with rigid fixation (2 plates) and the other group was treated with non-rigid fixation (single miniplate). Although there is no alternate group with a different fixation scheme
for comparison, the results of the present study show that this same principle holds when treating bilateral fractures of the angle. \(^{49}\)

**THIRD MOLAR AND ANGLE FRACTURE:**

**D. H. Duan,** 2008 did a retrospective study from January 1991 to April 2005, and totally 902 patients were treated for mandible fractures at Peking University. The incidence of fractures was compared in 700 patients with and without impacted mandibular 3\(^{rd}\) molars (M3s). The results showed that the patients with impacted M3s had a significantly lower risk of condylar fracture but a higher risk of angle fracture than those without impacted M3s when injured by a moderate trauma force.\(^ {50}\)

**Krishnaraj Subhashraj,** 2009 evaluated the relationship between the status and position of mandibular third molars and the angle fractures of mandible. The study confirmed an increase in risk of angle fractures in the presence of a lower third molar, and also as a variable risk for angle fracture, depending on the position of third molar.\(^ {51}\)

**A. Thangavelu** 2010 did a retrospective cohort designed for patients attending the Division of Oral and Maxillofacial Surgery from January 2001 till October 2008. The primary predictor variable was patients with impacted mandibular 3\(^{rd}\) molars were 3 times more likely to develop angle fractures and are less likely to develop condylar fractures in comparison to those without
impacted M3s. This study provides significant clinical evidence to suggest that the removal of unerupted mandibular third molars predisposes the mandible to increased chances of condyle fractures.\textsuperscript{52}

**Pavan M. Patil** 2012, designed a study to assess the influence of the presence and status of impaction of mandibular third molars on the incidence of fractures of the angle and condyle of mandible. He concluded that the condylar fractures were significantly more common among patients presenting with erupted or absent third molars, while there were significantly more angle fractures in those with incompletely erupted third molars.\textsuperscript{53}

**A.N.Bobrowski**, 2013 did a study and concluded that when proper surgical techniques and guidelines recommended in the literature are observed and when adequate principles of functionally stable fixation are used and when socioeconomic conditions, nutrition, proper oral hygiene, bad habits, and the acceptance of postoperative orientations are individualized, the possibility of eventual postoperative infectious complications will decrease.\textsuperscript{54}

**Saba Naghipur**, 2014 designed a study to determine whether any relationship exists between the presence of mandibular third molars (M3s) and fractures of mandibular angle and condyle and whether the risk of these fractures varies with the M3 position. He came to a conclusion that the presence of impacted M3s increased the risk of angle fracture and simultaneously decreases the risk of condylar fracture. However there appears to be no relation between M3 position and fracture pattern.\textsuperscript{55}
COMPLICATIONS

Rudolf Seemann, 2010 published a retrospective study and the complication rates of mandibular angle fractures treated by open reduction were assessed. Here the rate of revision surgery (6.31%) was slightly increased in comparison with other studies. Wound-healing disturbances accounted for most of the complications, followed by infections. No significant differences were found between the angle fractures treated with 1 miniplate or using 2 miniplates.56

Lipa Bodner 2011 did a review of 189 documented cases of iatrogenic fractures of the mandible (IFM) associated with the teeth removal. The reasons for its occurrence are thought to be multi-factorial and it includes age, sex, degree of tooth impaction, relative volume of the tooth in the jaws, pre-existing infection or any bony lesions, failure to maintain a soft diet in the early postoperative period, and the surgical technique used.57

INTRA ORAL VS EXTRA ORAL:

Vincent thoma, 2002 did a retrospective study to evaluate results and complications associated with transoral and extraoral approaches for open reduction and internal fixation of mandibular body, angle, and ramus fractures. They concluded that the decisions regarding treatment approaches for open reduction and fixation of mandible fractures often relate to surgeon’s experience and training, modifying factors that can affect uncomplicated healing such as fracture locations and its displacement, comminution of the fracture, any infection, dentition of the patient and atrophic changes of the mandible. In some
cases, the choice of approach is affected by availability of equipment and experience of operating room personnel. It is said that more difficult cases involving an edentulous, atrophic mandible or comminution should be considered for an extraoral exposure.\textsuperscript{58}

**Pushkar Mehra**, 2008 compared the treatment outcomes between the rigid extra-oral fixation and semi-rigid intra oral fixation for the management of isolated angle fractures of mandible and to develop a protocol for successfully managing those fractures in an indigent population. Isolated mandibular angle fractures can be effectively treated in an indigent population with intraoral monocortical fixation or an extraoral bicortical fixation techniques. Use of a standard protocol involving early surgical management with limitation of periosteal reflection, concomitant removal of third molars associated with fractures, and short-term maxilla mandibular fixation ensures a predictable success with a low incidence of complications.\textsuperscript{59}
Marginal Mandibular Branch of the Facial Nerve:

After the facial nerve divides into temporofacial and cervicofacial divisions, the marginal mandibular branch takes origin and extends anteriorly and inferiorly within the substance of the parotid gland. The marginal mandibular branch or branches, which supply motor fibers to the facial muscles in the lower lip and chin, represent the most important anatomic hazard when performing the submandibular approach to the mandible. Studies have shown that the nerve passes below the inferior border of the mandible in a significant minority of cases. In Dingman and Grabb's classic dissection of 100 facial halves, the marginal mandibular branch was as much as 1 cm below the inferior border in 19% of cases. Anterior to the point where the nerve crossed the facial artery, all dissections displayed the nerve above the inferior border of the mandible.60

Ziarah and Atkinson found an even higher number of cases in which the marginal mandibular branch passed below the inferior border. In 53% of 76 facial halves, they found the marginal mandibular branch below the inferior border reaching the facial vessels, and in 6%, the nerve continued for a farther distance of as much as 1.5 cm before turning upward and crossing the mandible. The farthest distance between a marginal mandibular branch and the inferior border of the mandible was 1.2 cm. In view of these findings, most surgeons recommend that the incision and deeper dissection be at least 1.5 cm below the inferior border of the mandible. Another important finding in the study by Dingman and Grabb was that only 21% of cases had a single marginal mandibular branch between the angle of the mandible and the facial vessels; 67% had two branches, 9% had three branches, and 3% had four.60
Facial Artery

After its origin from the external carotid, the facial artery follows a cervical course, during which it is carried upward medial to the mandible and in fairly close contact with the pharynx. It runs superiorly, deep to the posterior belly of the digastric and stylohyoid muscles, and then crosses above them to descend on the medial surface of the mandible, grooving or passing through the submandibular salivary gland as it rounds the lower border of the mandible. It appears on the external surface of the mandible around the anterior border of the masseter muscle. Above the inferior border of the mandible, it lies anterior to the facial vein and is tortuous.60

Facial Vein

The facial (anterior facial) vein is the primary venous outlet of the face. It begins as the angular vein, in the angle between the nose and eye. It generally courses with the facial artery above the level of the inferior mandibular border, but it is posterior to the artery. Unlike the facial artery, the facial vein runs across the surface of the submandibular gland to end in the internal jugular vein.60
Fig 1-Cadaveric dissection showing facial artery, facial vein and facial nerve

*Courtesy-Surgical Approach To Facial Skeleton-Edward Ellis*
PATIENTS:

The patients with angle fractures who reported to the Department of Oral and Maxillofacial Surgery, Tamil Nadu Government Dental College and Hospital, Chennai were selected for the study using the criteria as discussed below.

METHODOLOGY:

The patients who reported with angle fractures were categorised as displaced, if displacement of Inferior Alveolar Nerve (IAN) canal was greater than 2mm and then were randomly assigned into two groups Group A and Group B. The Group A patients were treated with superior border fixation by transoral approach and Group B patients were treated with inferior border fixation by submandibular approach.

INCLUSION CRITERIA

1. Displaced Angle fractures (displacement of inferior alveolar canal greater than 2mm).
2. All healthy Individuals between 18-55 yrs of age, of both sexes will be included.
3. Patient who were willing for follow up of 3 months.

EXCLUSION CRITERIA

1. Severely Comminuted fractures.
2. Medically compromised patients.
3. Age <18 years.
4. Infected fractures.
STUDY DESIGN: Prospective Study

SAMPLE SIZE: 14

The patients who reported with angle fractures to our department were carefully examined after proper recording of the mode of injury, any relevant past medical / surgical history, history of drug allergies if any. After that these patients were sent for routine blood investigations and digital Orthopantomogram (OPG) to assess whether the fracture falls into our criteria of displaced fracture (>2mm of displacement of IAN canal). If it does, the patients were randomly assigned into two groups- group A (intra oral) & group B (extra oral). The surgical procedures were explained to the patient clearly and informed consent was obtained. All the other required investigations were obtained and surgery was carried out under local / general anaesthesia after getting assessment from the concerned anaesthetist. The following parameters were assessed in these patients

A) INTRA –OP ASSESSMENT:

1. Surgical ease and exposure.
2. Intraoperative time

B) POST – OPERATIVE ASSESSMENT:

1. Patient satisfaction
2. Mouth opening
3. Occlusion
4. Wound infection & dehiscence
5. Facial nerve paresis
6. Clinical union
7. Scar assessment.
8. Fracture reduction after 3 months with radiographs

PATIENT SATISFACTION
The satisfaction of the patient was assessed by the patients in scale of 0 to 2

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<th>Score</th>
<th>Description</th>
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<td>Very satisfied</td>
</tr>
<tr>
<td>1</td>
<td>Satisfied</td>
</tr>
<tr>
<td>2</td>
<td>Not satisfied</td>
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FACIAL NERVE PARESIS:
The facial nerve paresis is assessed in the scale of 0 to 2

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<tr>
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<td>Temporary facial nerve paresis</td>
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<tr>
<td>2</td>
<td>Permanent facial nerve paresis</td>
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SCAR ASSESSMENT
The scar was assessed with the values ranging from 0 to 2

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<th>Score</th>
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<tr>
<td>1</td>
<td>Barely noticeable (barely visible)</td>
</tr>
<tr>
<td>2</td>
<td>Noticeable (visible)</td>
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</table>
Materials and Methods

Fig 2
SUBMANDIBULAR APPROACH

Step 1. Preparation and Draping

Pertinent landmarks useful during dissection should be exposed throughout the procedure. For operations involving the mandibular ramus/angle, the corner of the mouth and lower lip was exposed within the surgical field anteriorly and the ear, or at least the ear lobe, posteriorly. These landmarks helps the surgeon to mentally visualize the course of the facial nerve and to see whether the lip moves if stimulated.

Step 2. Marking the Incision and Vasoconstriction

The skin was marked before injection of a vasoconstrictor. The incision is 1.5 to 2 cm inferior to the mandible. Some surgeons prefer to parallel the inferior border of the mandible; others place the incision in or parallel to a neck crease. Incisions made parallel to the inferior border of the mandible may be unobtrusive in some patient; however, extensions of this incision may be noticeable unless hidden in the submandibular shadow. A less conspicuous scar result when the incision is made in or parallel to a skin crease. It should be noted that skin creases below the mandible do not parallel the inferior border of the mandible but run obliquely, posterosuperiorly to anteroinferiorly. Thus, the further anterior the surgeon makes an incision in or parallel to a skin crease, the greater the distance to dissect to reach the inferior border of the mandible. Both incisions can be extended posteriorly to the mastoid region if necessary. See fig.3
Mandibular fractures that shorten the vertical height of the ramus by their displacement (i.e., condylar fractures in patients without posterior teeth or those not placed into maxillomandibular fixation) will cause the angle of the mandible to be more superior than it would be following reduction and fixation. Therefore, the incision should be 1.5 to 2 cm inferior to the anticipated location of the inferior border. The incision is located along a suitable skin crease in whatever anteroposterior position needed for mandibular exposure. For a fracture that extends toward the gonial angle, the incision should begin behind and above the gonial angle, extending downward and forward until it is in front of the gonial angle. For fractures located more anterior than the gonial angle, the incision does not have to extend behind and/or above the gonial angle, but may extend farther anteriorly.

Vasoconstrictors with local anesthesia injected subcutaneously to aid in hemostasis should not be placed deep to the platysma muscle because the marginal mandibular branch of the facial nerve may be rendered nonconductive, making electrical testing impossible. Alternatively, a vasoconstrictor without local anesthesia can be used both superficially and deeply to promote hemostasis.

**Step 3. Skin Incision**

The initial incision is carried through skin and subcutaneous tissues to the level of the platysma muscle. The skin was undermined with scissor dissection in all directions to facilitate closure. The superior portion of the incision was undermined approximately 1 cm; the inferior portion was undermined approximately 2 cm or more. The ends of the incision can be undermined
Surgical Approach

extensively to allow retraction of the skin anteriorly or posteriorly to increase the amount of mandibular exposure. In this manner, a shorter skin incision can provide a great amount of exposure. Hemostasis can then be achieved with electrocoagulation of bleeding subdermal vessels. See fig 4.

Step 4. Incising the Platysma Muscle

Retraction of the skin edges reveals the underlying platysma muscle, the fibres of which run superoinferiorly. Division of the fibres can be performed sharply, although a more controlled method is to dissect through the platysma muscle at one end of the skin incision with the tip of a hemostat or Metzenbaum scissor. After undermining the platysma muscle over the white superficial layer of deep cervical fascia, the tips of the instrument were pushed back through the platysma muscle at the other end of the incision. With the instrument deep to the platysma muscle, a scalpel is used to incise the muscle from one end of the skin incision to the other. The anterior and posterior skin edges can be retracted sequentially to allow a greater length of platysma muscle division than the length of the skin incision.

The platysma muscle passively contracts once it is divided, exposing the underlying superficial layer of deep cervical fascia. The submandibular salivary gland can also be visualized through the fascia, which helps form its capsule.

Step 5. Dissection to the Pterygomasseteric Muscular Sling

Dissection through the superficial layer of deep cervical fascia is the step that requires the most care because of the anatomic structures with which it is...
Surgical Approach

associated. The facial vein and artery are usually encountered when approaching the area of the premasseteric notch of the mandible, as may the marginal mandibular branch of the facial nerve. The facial vessels can be isolated, clamped, and ligated if they are in the way of the area of interest. See fig.6. When approaching the mandible posterior to the premasseteric notch, these vascular structures generally are not encountered; if they are easily retracted anteriorly. The marginal mandibular branch, however, occasionally is inferior to the mandible posterior to the premasseteric notch, so care must be taken.

Dissection through the superficial layer of deep cervical fascia was accomplished by nicking it with a scalpel and bluntly undermining with a hemostat or Metzenbaum scissors. The level of the incision and undermining of the fascia should be at least 1.5 cm inferior to the mandible to help protect the marginal mandibular branch of the facial nerve. Thus, dissection through the fascia at the level of the initial skin incision was performed, followed by dissection superiorly to the level of the periosteum of the mandible. See fig 5. The capsule of the submandibular salivary gland if often entered during this dissection, and the gland is retracted inferiorly. A consistent submandibular lymph node (node of Stahr) is usually encountered in the area of the premasseteric notch and can be retracted superiorly or inferiorly. Its presence should alert the surgeon to the facial artery just anterior to the node, deep to the superficial layer of the deep cervical fascia. If encountered it was ligated as in fig 6. The marginal mandibular branch of the facial nerve may be located close by, within or just deep to the superficial layer of deep cervical fascia, passing superficial to the facial vein and artery. An electrical nerve stimulator can be used to identify the nerve so that it
can be retracted superiorly. In many instances, however, this facial nerve branch is superior to the area of dissection and is not encountered. Dissection continues until the only tissue remaining on the inferior border of the mandible is the periosteum (anterior to the premasseteric notch) or the pterygomasseteric sling (posterior to the premasseteric notch).

**Step 6. Division of the Pterygomasseteric Sling and Submasseteric Dissection**

With retraction of the dissected tissue superiorly and placement of a broad ribbon retractor just below the inferior border of the mandible to retract the submandibular tissues medially, the inferior border of the mandible is visualized. The pterygomasseteric sling was sharply incised with a scalpel along the inferior border, the most avascular portion of the sling. Incisions on the lateral surface of the mandible into the masseter muscle often produce bothersome haemorrhage. Increased exposure of the mandible was made possible by sequentially retracting the overlying tissues anteriorly and posteriorly, permitting more exposure of the inferior border for incision.

The sharp end of a periosteal elevator was drawn along the length of the periosteal incision to begin stripping the masseter muscle from the lateral ramus. Care is taken to keep the elevator in intimate contact with the bone or shredding of the masseter results, causing bleeding and making retraction of the shredded tissue difficult. The entire lateral surface of the mandibular ramus (including the coronoid process) and the body can be exposed to the level of the TMJ capsule, being sure to avoid perforating into the oral cavity along the retromolar area if this is not desired. The only tissue separating the oral cavity from the dissection
once the buccinator muscle has been stripped from the retromolar area is the oral mucosa. Retraction of the masseter muscle is facilitated by inserting a suitable retractor into the sigmoid notch (channel retractor, sigmoid notch retractor). More anterior in the mandibular body, care is needed to avoid damage to the mental neurovascular bundle, which exits the mental foramen, close to the apices of the bicuspid teeth. Thus the fracture site is exposed. See fig. 7

**Step 7. Closure**

The masseter and medial pterygoid muscle are sutured together with interrupted resorbable sutures. It is often difficult to pass the suture needle through the medial pterygoid muscle because it is thin on the inferior border of the mandible. To facilitate closure, it is possible to strip the edge of the muscle for easier passage of the needle. The superficial layer of deep cervical fascia does not require definitive suturing. The platysma muscle may be closed with a running resorbable suture. Subcutaneous resorbable sutures are placed, followed by skin sutures. See fig. 10, 11, 12.
MANDIBULAR VESTIBULAR APPROACH

The mandibular vestibular approach is useful for a wide variety of procedures. It allows relatively safe access to the entire facial surface of the mandibular skeleton, from the condyle to the symphysis. An advantage of this approach is the ability of constantly access the dental occlusion during surgery. The greatest benefit to the patient is the hidden intraoral scar. The approach is also relatively rapid and simple, although access is limited in some regions, such as the lower border of the mandible at the angle and parts of the ramus.

TECHNIQUE

The length of the incision and the extend of subperiosteal dissection, depend on the area of interest and the extent of surgical intervention.

Step 1. Injection of Vasoconstrictor

The oral mucosa, submucosa, and facial muscle are lushly vascularized. Submucosal injection of a vasoconstrictor can dramatically reduce the amount of haemorrhage during incision and dissection.

Step 2. Incision

The posterior extend of the incision was made over the external oblique ridge, traversing mucosa, submucosa, buccinator muscle, buccopharyngeal fascia, and periosteum. The incision is usually no more superior then the occlusal plane of the mandibular teeth to help prevent herniation of the buccal fat pad into the
surgical field, a nuisance during surgery. The buccal portion of the buccal fat pad is usually not more inferior than the level of the occlusal plane. Placement of the incision at this level also may spare severing the buccal artery and nerve, although damage to them is more a nuisance than a clinical problem. If the buccal artery is severed, it is easily controlled by coagulation.

Step 3. Subperiosteal Dissection of the Mandible

Subperiosteal dissection up the anterior edge of the ascending ramus strips the buccinators attachments, which allows the muscle to retract upward, minimizing the chance of herniation of the buccal fat pad. Temporalis muscle fibres may be easily stripped by inserting the sharp end of a periosteal elevator between the fibres and the bone as high on the coronoid process as possible, and stripping downward. A notched right-angle retractor may be placed on the anterior border of the coronoid process to retract the mucosa, buccinator, and temporalis tendon superiorly during stripping. Stripping some of the tissue from the medial side of the ramus will widen the access. After stripping of the upper one third of the coronoid process, a curved Kocher clamp can be used as a self-retaining retractor grasping the coronoid process. The fracture segment is thus exposed as in fig 13.

Step 4. Closure

Closure is adequate in one layer, except in the anterior region. Closure may begin in the posterior areas with resorbable suture. The pass of the needle should grab mucosa, submucosa, cut edge of the facial muscles, and periosteum, if possible. A suspension dressing, such as elastic tape, is useful for several days
after the mandibular buccal vestibular approach to prevent hematoma and to maintain the position of the repositioned facial muscles. See fig 15.
SUBMANDIBULAR APPROACH

Fig. 3 - Marking of the Incision

Fig. 4 - Skin Incision
Surgical Procedures

Fig. 5 - Layer wise Dissection

Fig. 6 - Ligation of Facial Artery
Fig. 7 - Exposure of the Fracture Segments

Fig. 8 - Reduction of the Fracture
Fig. 9 - Fixation of the Fracture

Fig. 10 - Layer wise Closure
Surgical Procedures

Fig.11-Layer wise Closure

Fig.12-Skin Closure
MANDIBULAR VESTIBULAR APPROACH

Fig. 13 - Exposure of the Fracture Segment

Fig. 14 - Fixation of the Fracture
Fig.15-Closure of the Oral Mucosa
CASE SHEET-1

Name : Mrs. Priya

Age / sex : 28 / F

Chief complaint: c/o pain and swelling in the right side of face

Duration of presenting illness: 10 days

Past medical / surgical history: NAD

Local examination:

Extra Oral:
Step deformity - present
Condylar movements - palpable and non tender
Mouth opening - 20 mm
Tenderness on palpation - present

Intra oral:
Occlusion - deranged
Compound fracture - nil
Teeth in line of fracture - present

Investigations:
Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis: Fracture of Right Angle and Left Body of Mandible

Treatment Group: Group A (intra oral)

Treatment done: ORIF by 2 × 4 hole plate with 2×8 mm screws at superior border of angle, ORIF by a 2 ×4 hole plate with four 2×8 mm screws at body of mandible.

Complications if any: nil
CASE SHEET-2

Name : Mr Sambath
Age / sex : 30/ M

Chief complaint: c/o pain in the whole of face

Duration of presenting illness: 15 days

Past medical / surgical history: NAD

Local examination:

Extra Oral :
Step deformity - present
Condylar movements - non tender & palpable
Mouth opening - 25mm
Tenderness on palpation - present

Intra oral :
Occlusion - deranged
Compound fracture - nil
Teeth in line of fracture - present

Investigations:
Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis: Fracture of Right Angle of Mandible

Treatment Group: Group A (Intra Oral )

Treatment done: ORIF by a 2 x 4 hole plate with four 2x8 mm screws at superior border of angle of mandible.

Complications if any: nil
CASE SHEET-3

Name : Mr. Solayappan

Age / sex : 21/m

Chief complaint: c/o pain in the right side of face

Duration of presenting illness: 12 days

Past medical / surgical history: NAD

Local examination:

Extra Oral:
Step deformity - Present
Condylar Movements - Non Tender & Palpable
Mouth Opening - 20 mm
Tenderness on palpation - present

Intra oral:
Occlusion - deranged
Compound fracture - nil
Teeth in line of fracture - present

Investigations:
Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis: Fracture of Right Angle of Mandible

Treatment Group: Group B (Extra Oral)

Treatment done: ORIF by 2 ×4 hole plate with 2×8 mm screws at inferior border

Complications if any: Extraction of 48 after 3 weeks to get ideal occlusion
CASE SHEET-4

Name : Mr. Vadivelu

Age / sex : 22/M

Chief complaint: c/o pain in the right side of face

Duration of presenting illness: 15 days

Past medical / surgical history: NAD

Local examination:

Extra Oral :
Step deformity - present
Condylar movements - non tender and palpable
Mouth opening - 28 mm
Tenderness on palpation - present

Intra oral :
Occlusion - deranged
Compound fracture - nil
Teeth in line of fracture - present

Investigations:
Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis: Fracture of Right Angle & Left Parasymphysis Of Mandible

Treatment Group: Group B (Extra Oral)

Treatment done: ORIF by a 2 ×4 hole plate with four 2×8 mm screws at inferior border of angle, ORIF by two 2 ×4 hole plates with eight 2×8 mm screws at parasymphysis of mandible.

Complications if any: nil
CASE SHEET-4

Name   : Mr. Bhaskar
Age / sex   : 22/M

Chief complaint: c/o pain in the right side of face

Duration of presenting illness: 13 days

Past medical / surgical history: NAD

Local examination:

Extra Oral:
Step deformity - present
Condylar movements - non tender and palpable
Mouth opening - 25 mm
Tenderness on palpation - present

Intra oral :
Occlusion - deranged
Compound fracture - nil
Teeth in line of fracture - present

Investigations:
Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group,
Digital OPG

Diagnosis: Fracture of Right Angle & Left Parasympysis of Mandible

Treatment Group: Group B (Extra Oral)

Treatment done: ORIF by a 2 ×4 hole plate with four 2×8 mm screws at inferior border of angle, ORIF by two 2 ×4 hole plates with eight 2×8 mm screws at parasympysis of mandible.

Complications if any: nil
GROUP A (INTRA ORAL)-CASE 1- Fig.16

Profile view

Occlusion

Mouth opening
Pre-operative Digital OPG

Post-operative Digital OPG
GROUP A (INTRA ORAL)- CASE 2- Fig.17

Pre-operative

Post-operative

Profile view

Occlusion

Mouth opening
Case Reports

Pre-operative Digital OPG

Post-operative Digital OPG
GROUP B (EXTRA ORAL)-CASE 3-Fig.18

**Pre-operative**

**Post-operative**

(Profile view)

(Occlusion)

(Mouth opening)
Case Reports

Extra oral scar

Pre-operative Digital OPG

Post-operative Digital OPG
GROUP B (EXTRA ORAL)-case 4-Fig.19

Pre-operative

Post-operative

Profile view

Occlusion

Mouth opening
Case Reports

Extra oral scar

Pre-operative Digital OPG

Post-operative Digital OPG
GROUP B (EXTRA ORAL)-CASE 5-Fig.20

**Pre-operative**

**Post-operative**

*Profile view*

*Occlusion*

*Mouth opening*
Extra oral scar

Pre-operative Digital OPG

Post-operative Digital OPG
A total of 14 patients were included in the study were randomised into two groups. The parameters for this study included demographic data, duration of surgery, surgeons assessment of ease of surgery, scar assessment, patient satisfaction, mouth opening, occlusal discrepancy, facial nerve paresis and presence of any wound infection/dehiscence.

The Software used was SPSS (Statistical Package For Social Sciences Version 18).

**DEMOGRAPHIC RESULTS:**

In the present study the mean age at the time of injury was 27.86 years. Among the 14 patients in the study, 12 were male and the remaining 2 were female and points to a male:female ratio of 6:1.

**DURATION OF SURGERY:**

The duration of surgery in group A (intraoral) ranged from 42-61 min, with a mean of 54 min(SD 7.53). In group B (extraoral), the duration ranged from 38 to 50 min, with a mean of 43.86 min(SD 4.14). There was a low statistically significant difference between the two groups in terms of the duration of surgery (\( P = 0.009 \)) by means of Independent Sample t Test. see table 1.

**SURGEON’S ASSESSMENT OF THE EASE OF SURGERY:**

For group A (intra oral) only 14.28% (n=1) of surgeons assessed the procedure as ‘simple’ and 42.85% (n=3) rated it as ‘mild difficulty’ and the same percentage (n=3) going for ‘very difficult’. In group B (extra oral) 71.4% (n=5) rated the surgery as ‘simple’, while 28.5% (n=2) assessed it as ‘mild
Observation and Results

difficult’ and none of the surgeons assessed it as ‘very difficult’. By means of Chi Square test a statistically significant difference was obtained between the two groups in terms of surgeons assessment of ease of surgery (P= 0.048). see table 2.

SCAR ASSESMENT:

The scars of the patients in the group B (extra oral) were assessed in terms of cosmetics. 57.4% of patients’ scars were rated as ‘unnoticeable’ and 42.8% were noted as barely noticeable while none of the patients were categorized as ‘noticeable’. See table 3.

PATIENT SATISFACTION:

For group A patients (intra oral) 42.8% were ‘satisfied’ post operatively and 28.5% in both the groups of ‘very satisfactory’ and ‘not satisfactory’. For group B patients (extra oral) 71.4% were in the class of ‘very satisfactory’ while 14.2% were in the group ‘satisfactory’ and ‘not satisfactory’. By means of Chi Square Test, there was no statistically significant difference between the two groups in terms of patient satisfaction (P= 0.270). see table 4.

MOUTH OPENING:

At the end of 3 months follow up, mouth opening was greater in group B (36.57±3.21) (P= 0.003) when compared to group A (28.86± 2.54) (P= 0.0007). By Repeated Measures ANOVA and Pair wise Comparison using Bonferroni Correction and Independent Sample t test there was a statistically significant difference between the two groups in terms of mouth opening. See table 5,6,7.
FACIAL NERVE PARESIS:

Of the total seven patients in the extra oral group one patient had temporary facial nerve paresis which resolved in 4 weeks. This value was not found to be significant. See table 8.

OCCLUSAL DISCREPANCY:

Of the total 14 patients in the study, 14.2 % (n=2) patients did not present with occlusal derangement after injury and the remaining 85.7% presented with occlusal discrepancy at the time of clinical examination. After surgery, in both the groups the occlusal discrepancy was nil in all patients. See table 9.

WOUND INFECTION/ DEHISCENCE:

Among the 14 patients in our study, only one patient in the intra oral group had wound dehiscence and plate exposure (P=1.00) which was not statistically significant. See table 10. See fig 21, 22.

CLINICAL UNION:

Among the patients in the study no patients experienced clinical non union or inter fragmentary mobility in the study period in both the groups. By Fischer Exact Test this was not significant See table 11.
QUANTITATIVE:

A) DURATION OF SURGERY

Table 1

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Duration of Surgery in min</th>
<th>P Value</th>
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Mean ± SD

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<th>Extra-Oral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of Surgery</td>
<td>54 ± 7.53</td>
<td>43.86 ± 4.14</td>
</tr>
</tbody>
</table>

*Independent Sample t Test

B) SURGEONS ASSESSMENT OF EASE OF SURGERY

Table 2

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Ease of Surgery – Surgeons Assessment (Grading)</th>
<th>P Value</th>
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</thead>
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<tr>
<td>7</td>
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<td>1</td>
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</table>

*Chi Square Test

SCALE: 0-Simple; 1-mild difficulty; 2-very difficult
C) SCAR ASSESSMENT-EXTRA ORAL

Table 3

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<th>CASES</th>
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<tr>
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</table>

SCALE: 0-unnoticeable; 1-barely noticeable; 2-noticeable

D) PATIENT SATISFACTORY SCALE

Table 4

<table>
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<tr>
<th>S.No.</th>
<th>Patient Satisfactory Scale (Grading)</th>
<th>P Value</th>
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Chi Square Test

SCALE: 0-very satisfied: 1-satisfied : 2- not satisfied
**E) MOUTH OPENING – EXTRA ORAL**

Table 5

<table>
<thead>
<tr>
<th>CASES</th>
<th>PRE OP MO</th>
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<tr>
<td><strong>MEAN ± SD</strong></td>
<td><strong>23.71±3.5</strong></td>
<td><strong>25±3.27</strong></td>
<td><strong>36.57±3.21</strong></td>
<td><strong>0.003</strong></td>
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*Repeated Measures ANOVA*

**F) MOUTH OPENING – INTRA ORAL**

Table 6

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<tr>
<td><strong>MEAN ± SD</strong></td>
<td><strong>20.43±4.24</strong></td>
<td><strong>22.57±3.6</strong></td>
<td><strong>28.86±2.54</strong></td>
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*Repeated Measures ANOVA*
G) COMPARISON OF IO and EO MOUTH OPENING:

Table 7

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<tr>
<td>MEAN ± SD</td>
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*Independent Sample t Test

H) FACIAL NERVE PARESIS:

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0-no facial nerve paresis; 1-temporary paresis; 2-permanent paresis
QUALITATIVE:
A) OCCLUSAL DISCREPANCY

Table 9

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<tr>
<th>Cases</th>
<th>INTRA ORAL</th>
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B) WOUND INFECTION/DEHISCENCE

Table 10

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*Fischer Exact Test
D) CLINICAL UNION:

Table 11

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<th>cases</th>
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</tbody>
</table>
Observation and Results

Chart 1
Mean Duration of Surgery in min

- Intra-Oral
- Extra-Oral

Chart 2
Surgeons assessment of ease

- Simple
- Mild difficulty
- Very Difficult

Intra Oral
Extra Oral
Observation and Results

Chart 3

Scar Assessment - Extra Oral

Chart 4

Patient satisfaction

Grading

Very Satisfied  Satisfied  Not Satisfied

Intra Oral  Extra Oral
Observation and Results

Chart 5

Facial Nerve Paresis - Grading

- No Facial Nerve Paresis
- Temporary Facial Nerve Paresis
- Permanent Paresis

Chart 6

Mouth Opening Comparison – Line Diagram

- Intra Oral
- Extra Oral
Discussion

Fig. 21 - Exposure of the Infected Plate

Fig. 22 - OPG Showing Infected Plate
The mandibular angle fracture is one of the commonest fractures of the facial skeleton resulting in severe morbidity for the patients. There is still no universal consensus on the treatment of these fractures as the literature is replete with controversy. The other contributing factors include the complex biomechanics of the region, the sudden change in shape resulting in weak zone, presence of attachment of the masticatory muscles and the presence of 3rd molar which unfortunately weakens the bone.\textsuperscript{51}

All these controversies stem from the lack of understanding of the biomechanics in the angle region which also makes it a unique fracture. The present treatment options range from closed reduction\textsuperscript{62} to open reduction with non-rigid fixation by means of transosseous wires, circum-mandibular wires, or small positional bone Plates\textsuperscript{63}, to AO reconstruction Plates\textsuperscript{64}, dynamic compression Plates, mini/dynamic compression Plates\textsuperscript{64,65}, lag screws\textsuperscript{66}, and non-compression Plates\textsuperscript{67}. Still these various philosophies of treatment modalities out in the field have not come to a unanimous conclusion.

Since 1970s the paradigm shift has been observed in favour of open reduction and internal fixation of angle fractures. Two important school of thoughts exist advocating the same. First is the AO/ASIF fixation group which supported the use of ‘total rigidity without interfragmentary mobility’.\textsuperscript{68} This technique was later modified using a single non compression tension band plate and a compression plate at the inferior border. This move oscillated the move away from the concept of total rigidity. But there is a distinct disadvantage from the use of two plates as literature reveals that usage of two plates is associated
with the highest rate of complications. The use of 2 plates, according to in vitro studies prove that 2 plate fixation provides more stability in the fracture site in comparison to single plate at the superior border. 69 But this does not happen without complications. In 1994, Ellis and his co workers in their study proved that the use of two 2mm non compression miniplates is associated with a complication of 28%. 70 Danda and co workers insisted that there is no difference in wound dehiscence, malocclusion and infection between single plate and double plate fixation. 71 So it is opined that the need for the second plate fixation is not justified as it not only increases complication but also increases the surgeons operating time and difficulty.

The next school of thought which is universally accepted and which is regularly followed in this institution is the Champy’s model. This requires the use of a single monocortical non compression miniplate at the superior border of mandible over the external oblique ridge. According to his model, which was adapted from the work of Michlet et al, the superior border of mandible is subjected to tension and splaying while the inferior border undergoes compression. 72 So according to this concept there is no need for fixation of inferior border of mandible. But according to Rudderman et al, this model was found to be inconsistent with the geometrical conditions of mandible taking into account the complex biomechanics of the region. 73 He points out that tension and compression zones were found to reverse depending on loading position as suggested by Kroon et al. 74 He further adds that a facial force circuits that transmit the force through bone, soft tissue and muscle and fascia.
There has been a lot of debate over the use of intra oral or extra oral approach with pros and cons present for both the procedures. In this institution the intra oral approach is used routinely for the fixation of mandibular angle fractures. The approach itself is not technique sensitive for access of fracture but adaptability and fixation of the plate is quite cumbersome. Adding to this, the scenario changes in cases of displaced angle fractures as the access for even the reduction of the fracture is not adequate and takes more operative time providing poor visualization of the fracture.

Conventionally the placement of a larger, 2.3-mm plate or a reconstruction plate is used to provide more rigid fixation in the compression zone\(^9\). In contrast, in this study 2 mm mini plate with bi-cortical screws in the inferior border is used, in conjunct with a study by V. Singh et all, 2013\(^9\). It is believed that a single 4- hole non compression mini plate placed at the inferior border fixed with the bi cortical screws causes no distraction over the superior border and withstands the masticatory force.

In this study, the mean duration of surgery in group A (intraoral) was 54 min(SD 7.53) while in group B (extraoral), the mean of duration was 43.86 min(SD 4.14). The difference in the time span was because of the ease of fracture reduction and fixation by extra oral method. Even though the soft tissue dissection for the exposure of fracture segment in the extra oral submandibular approach is quite time consuming in comparison to the simple, paragingival incision of intra oral approach, the time taken for reduction and fixation was found to be very minimal.
The difficulty of the surgery was assessed by a senior resident assisting the case who has proper experience in both the approaches and was blinded from the study to eliminate the bias. For group A (intra oral) only 14.28% were assessed as ‘simple’ while 42.85% rated it as ‘mild difficulty’ and the same percentage going for ‘very difficult’. In group B (extra oral) 71.4% rated the surgery as ‘simple’, while 28.5% assessed it as ‘mild difficult’ and none of the surgeons assessed it as ‘very difficult’. This difference in favour of extra oral procedure is probably due to the ease of reduction of displaced fracture fragments and adaptation of plate without much bending and distortion of plate which might result in fracture of plate later.

The scars of the patients in the group B (extra oral) were assessed in terms of cosmetics. This assessment was carried out by a senior resident at the end of 3 months post operative period and was blinded from the study. 57.4% of patients’ scars were rated as ‘unnoticeable’ and 42.8% were noted as barely noticeable while none of the patients were categorized as ‘noticeable’. The mark of the incision was obviously there at the end of 3 months but it was within the sub mandibular shadow masking it. This is in direct contrast to a study by Zaib un Nisa (2014) Facial Cosmetic dissatisfaction (60%) were much higher in patients where extra oral approach was used.\textsuperscript{75} In this study there was no keloid or hyperpigmentation formation in the scar. We postulate that if natural skin creases are used for incision and proper principle being followed the chance of cosmetic deformity is miniscule.
The patients were followed up and assessed for pain and their overall satisfaction after surgery till 3 months. For group A patients (intra oral) 42.8% were ‘satisfied’ post operatively and 28.5% in both the groups of ‘very satisfactory’ and ‘not satisfactory’. For group B patients (extra oral) 71.4% were in the class of ‘very satisfactory’ while 14.2% were in the group ‘satisfactory’ and ‘not satisfactory’. The satisfaction level of the patients belonging to intra oral group was not high, probably due to decrease in mouth opening and probably the need for frequent mouth rinse and proper oral hygiene to prevent infection.

At the end of 3 months follow up, mouth opening was greater in group B (36.57±3.21) when compared to group A (28.86± 2.54). There is no standard definition of trismus and there is lack of specific groupings making it difficult to calculate the degree of mouth opening required for normal oral function. In a study done by Reiadh K. Al-Kamali, he postulated that the restriction in mouth opening after sub mandibular approach can be minimised by minimal stripping of the masseter muscle in the region which was followed in our surgeries. The patients in both the groups were advised vigorous mouth opening exercises. It may be due to the non compliance of the patients in the intra oral group in following the regimen and this may have lead to this difference, as initial pain and swelling intra orally restricted their mouth opening. But the values improved gradually at the end of 3 months period and it is believed that the mouth opening will probably increase in the following months.

After surgery at the end of 3 months in both the groups, the presence of any occlusal discrepancy was nil. Though 80% of the patients had occlusal discrepancy at the time of presentation to the institution, it was remarkable that
Discussion

occlusion was returned to normal norms in both the groups. For initial stability and fixation, both the groups were kept in IMF for one week post operatively which would have possibly helped in stabilization of the occlusion that was achieved by means of surgery.

The IMF period used in our study was for one week in both the groups. It is believed that increased IMF causes dissatisfaction to the patient primarily as none will be willing to take liquid diet and be willing to be mute for longer period of time. One week of IMF helps in stabilization of soft tissue and occlusion and is supplementary to fixation. This is in direct opposition to a study conducted by Rahul Gupta 2014 who postulated in favour of conservative management of mandibular fractures using IMF and found that the resultant mouth opening was good in 97% of the cases.  

In this study it was found that of the seven patients in group B (extra oral), 14.2% (n=1) patient had temporary facial nerve paresis which resolved later in four weeks period. This patient had abnormal sensation in the right mandible region and difficulty in swallowing his saliva initially. But this incidence is slightly better when compared to a study done by Zaib un Nisa(2014) who postulated that the 20 % of his patients had facial nerve injury. Reiadh K. Al-Kamali in his study pointed out that 47.36% of his patients had weakness in marginal mandibular branch of facial nerve and also has described the temporary nature of this nerve weakness. Dingman and Grabb (1962) in dissections of 100 marginal mandibular nerves found that the mandibular and buccal branches inosculate only in 5% cases in which if former is damaged, muscles supplied by it
may escape because of innervation from the other. So it is opined that even if there is weakness of facial nerve initially it is temporary due to re-innervation by the buccal branch of facial nerve.

In this study there was one patient in intra oral group who had exposure of plate in 2 weeks time. This value is lower when compared to a study done by Levi et al (1991) who pointed out that when mandibular angle fracture is treated by a single miniplate intraorally, the complication rate is 26.3%. In another study done by Kenneth wann (2012), it has been found that the complication rate of transoral fixation is 16% which is comparable to this study. In experience it is opined that the reason for this complication is primarily due to the anatomic position of the intra oral plate being over the external oblique ridge. This makes the soft tissue cover of the plate being thin when compared to the extra oral fixation where adequate soft tissue cover is possible. Also there is a greater chance of pathogens from the periodontal regions to enter the surgical site as the distance from the teeth to the surgical site is less in comparison to extra oral technique. Also the amount of plate bending done to adapt the plate intra orally makes it formidable to fracture of the plate itself. These reasons make the complication rate of the intra oral fixation a notch higher. Choi et al observed that the inferior border splaying after the intra oral fixation of the plate causes movement of fracture and this is responsible for wound complications in those cases.

According to a study by Uma Shanker Pal, 2013 who insists that the installation of a single mini plate by transbuccal fixation or along the external oblique ridge as done by champy’s was sufficient to withstand the normal
masticatory forces, but this type of fixation did not account for the buccolingual splaying or the opening of the inferior border due to bending of the plate. Since this is not neutralized, even the masticatory forces over the second molar region allows fracture segments to open up in the inferior border which might result in failure of osteosynthesis especially in case of displaced mandibular angle fractures. Fracture reduced by Champy’s plate was vulnerable to torsional and bending movements along the long axis of the mandible, particularly when loaded close to the fracture site. These torsional forces theoretically may lead to a loss of friction lock and result in reduced primary stability. The friction between the screw head and plate is the main weak point of the entire fixation. Another factor is inaccurate adaptation of the plate which might even cause bone loss in the surgical site. Occlusal load applied near the fracture (second molar) and to the contralateral second molar produced a rotational separation of segments, whereas a bicortical system resisted displacing forces better when the load is applied.

The fate of tooth in line of fracture is another topic of debate. There is no consensus regarding this as literature is filled with views of far and against the removal of 3rd molar in relation to fracture. Gerbino 1997 has pointed out that each case has to be dealt independently and it has to be case specific. In this institution this is followed and the tooth is removed when it interferes with fracture reduction or in a case of compound fracture. In the fourth case of extra oral group there was fracture of 3rd molar in line of angle fracture. The extraction of tooth was planned as it impeded fracture. But only the distal root could be removed as mesial root was deep into the fracture segment. So the mesial root was left in situ and plate was fixed after adequate reduction. The mesial root was
removed after six weeks completion of osteosynthesis. In another case of extra oral group, the 3rd molar was removed 3 weeks after fracture reduction and fixation extra orally. The tooth was not removed before or during surgery as it would have made it a compound fracture prone to infection. So a compromise was made in ideal occlusion initially and at the end of three weeks the tooth was removed by closed method of extraction. The desired occlusion was thereby achieved for the patient in the end which is a favourable result.
Summary and Conclusion

The use of extra oral method of fixation has been used rarely for the fixation of mandibular angle fracture citing various reasons. It is to be emphasized that in order to adequately reduce and fix the fracture segment especially in cases of displaced fractures this technique is indispensable. In this study, 2mm miniplate was used for the fixation in inferior border which is the same thickness plate used in superior border fixation. It is believed that this thickness is adequate to resist the displaced forces in angle fracture in contrast to the 2.4 mm reconstruction plate usually used in this region.

There were no significant differences in terms of complications between the two groups although the functional outcomes like patient satisfaction, mouth opening at the end of 3 months follow up, had significant difference. Also the incidence of usual demerits associated with the extra oral approach such as facial nerve paresis and scarring were quite less compared to the reports mentioned in the literature around the world. The duration of intra operative time was comparatively less in extra oral group and the ease of surgery was found to be better in the extra oral group. The clinical union of fracture and radiographic assessment of fracture after surgery, occlusal harmony between the two groups revealed no significance.

The other parameters including surgeon’s assessment of ease, duration of surgery, scar assessment were rated by a different senior resident who was blinded from the study which ruled out the observer bias. Also the patients were randomly assigned into two groups to eliminate selection bias. This study has its pitfalls too. The sample size in this study is quite small. In addition we could have classified
the fractures as vertical/horizontal, unfavourable/favourable which could have opened up new doors of information. Also the study group did not have exclusively isolated angle fractures as some of these patients had combined fractures which warranted usual mode of fixation. The follow up period for this study is three months which is sufficient to fulfil the parameters that had been formulated. To conclude, even though champy’s miniplate fixation through intra oral approach is followed worldwide for fixation of angle fracture, the displaced angle fractures are better reduced and fixed with inferior border plating which provides easy access, adaptation of plates, short surgical time with minimal complications.


60. Edward Ellis-Surgical Approaches To Facial Skeleton.


CASE REPORT FORM

COMPARISON OF SUPERIOR BORDER AND INFERIOR BORDER FIXATION FOR DISPLACED MANDIBULAR ANGLE FRACTURES

Patient’s Name : ________________________________

Age/ Sex : ________________________________

Patient’s Identification No : ________________________________

Contact Address : ________________________________

Contact No : ________________________________

Institution : 1. TN Govt. Dental College & Hospital,
Chennai - 600 003.

2. Rajiv Gandhi Govt. General Hospital,
Chennai 600003

Centre : 1. Dept. of Oral & Maxillofacial Surgery,
TN. Govt. Dental College and Hospital,
Chennai - 600 003.

2. Rajiv Gandhi Govt. General Hospital,
Chennai 600003

Patient’s Identification/ OP No: ________________ Date: _____________
DETAILS OF SURGERY

Procedure followed : Open reduction and internal fixation

Any other information :

Details of Drug therapy :

POST-OPERATIVE ASSESSMENT:

Parameters assessed:

1. Surgical ease and exposure.
2. Intraoperative time
3. Patient satisfaction
4. Mouth opening
5. Occlusion
6. Wound infection & dehiscence
7. Facial nerve paresis
8. Clinical union
10. Fracture reduction after 3 months with radiographs

Name of the Investigator :

Signature of Investigator :
**CASE SHEET PERFORMA**

Name :  
Age / sex :  

Chief complaint:

Duration of presenting illness:

Past medical / surgical history:

Local examination:

Extra Oral:

- Step deformity
- Condylar movements
- Mouth opening
- Tenderness on palpation

Intra oral:

- Occlusion
- Compound fracture
- Teeth in line of fracture

Investigations:

Routine blood investigation, ICTC, Chest X ray, ECG, RFT, LFT, Blood group, Digital OPG

Diagnosis:

Treatment Group:

Treatment done:

Complications if any:
INFORMED CONSENT

COMPARISON OF SUPERIOR BORDER VS INFERIOR BORDER FIXATION FOR
DISPLACED ANGLE FRACTURES OF MANDIBLE

Patient’s Identification No: ___________ Patient’s Name: ___________

Patient’s DOB: ________ _______ _______ _______

I confirm that I have read and understood the given Information Sheet for the above
study. I have had the opportunity to ask questions and all my questions and doubts
have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to
withdraw at any time, without giving any reason, without my legal rights being
affected.

I understand that the Clinical study personnel, the Ethics Committee and the
Regulatory Authorities will not need my permission to look at my health records both
in respect of the current study and any further research that may be conducted in
relation to it, even if I withdraw from the study. I understand that my identity will
not be revealed in any information released to the third parties or published, unless
as required under the law. I agree not to restrict the use of any data or results that
arise from this study.

I agree not to withhold any information about my health from the investigator and
will convey the same truthfully.

I agree to take part in the above study and to comply with the instructions given
during the study and to faithfully co-operate with the study team and to immediately
inform the study staff if I suffer from any deterioration in my health or wellbeing or
any unexpected or unusual symptoms.

I am aware that my jaw fracture can be treated by small incision inside mouth or by
a small incision in the side of the jaw outside thereby exposing the fracture site,
reduced and fixed with 4 hole titanium plate with screws and closed with 3-0 vicryl
suture, temporarily immobilizing the jaws for 1 week with wires. I was explained
about the surgical methods (under local or general anesthesia) of treating the
jaw fracture using plates and screws and chose the surgical option on my own wish. I
was also informed about the side effects of local anaesthesia (or) general
anaesthesia and surgical procedure. I hereby consent to participate in this study.

I consent to give my medical history, radiographs undergo complete physical
examination and diagnostic tests including hematological, biochemical and urine
examination etc.

Signature/Thumb Impression: ____________________________ Place: __________ Date: __________

Patient’s Name & Address: ___________________________

Signature of the Investigator: ____________________________ Place: __________ Date: __________
Study Investigator’s Name: ____________________________

Institution: ____________________________

Signature of the Witness: ____________________________ Place: __________ Date: __________
Name & Address of the Witness: ____________________________

* Mandatory for uneducated Patient (Where thumb impression has been provided above)
சமூக விவகாரச் சட்டமியல்

சமூக விவகாரச் சட்டமியல் மற்றும் நூற்றாண்டு காலத்திற்கு முன் வளர்ச்சி காரணி முன்னுப்பகுதி விளக்கும் மற்றும் செயல்பாடுகள் மற்றும் பாதுகாப்பு விளக்கும் கொண்டாட்டம்

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