Section A-Research paper

Possible Role of Tension band Wiring on Fracture Mandible Reduction and Fixation

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Abstract

There are numerous classification methods that have been given in the literature on maxillofacial trauma, but no one system that all practitioners agree upon can be used to standardise communication. The most commonly referenced scheme is classification by anatomic region: condyle, body, angle,symphysis, ramus, and coronoid. The primary goals in management are to restore the mechanical strength of the fracture area to that of its premorbid occlusion and to promote the normal function of the masticatory muscles. Restoring the fractured fragments to their original anatomical positions is the first step in treatment. The fixing of the components in their natural anatomical positions is the second phase. Development in plating systems and technical knowledge regarding the osteosynthesis has made open reductions and rigid internal fixation as the most frequently used mode of treatment in facial skeleton fractures. Various modalities for fracture reduction/stabilization during fixation have been mentioned in literature, describing the use of custom made instruments or reduction forceps etc. Tension band wiring is quick, simple and effective way of achieving initial reduction and stabilization of bone prior to final rigid fixation. The added advantages are reduced operating time, reduced instrumentation and assistance which in turn provide clear and more accessible surgical.

Keywords: Tension band wiring, Fracture Mandible, Fixation

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The area between the roots of the central incisors, located between the alveolar process and the inferior border of the mandible in a vertical orientation, is known as the symphyseal region of the mandible **(1).**

The area between the lateral roots of the canines and the distal portion of the lateral incisors, spanning from the alveolar process to the inferior border of the jaw, is known as the para-symphysis region.Linear and oblique fracture orientations are characteristic in this region. The combined action of the digastric and suprahyoid muscles on a bilateral fracture can pull on the distal fragment inferiorly in an unfavorable fracture, placing the patient at risk of acute upper airway obstruction **(2)**.

The body region of the mandible is defined as the line coincident with the anterior border of the masseter muscle to the canine. The buccal and lingual cortices of this area are well-defined. Fractures typically follow a linear pattern, however, in the incidence of high-energy trauma, comminution can be seen. Fractures of the body of the mandible are usually seen in combination with fractures on the contralateral side of the mandible or with ipsilateral fractures of the condyle or ramus **(1).**

These anatomical units are frequently further divided into patterns that are favourable and unfavourable. The direction of a fracture line as seen on radiographs in the horizontal or vertical plane indicates favorability. The favorableness of mandibular fractures is influenced by the masticatory muscles' displacement forces Horizontally favorable fracture lines resist upward displacing forces. When seen in the vertical plane, a vertically favourable fracture line resists the medial pull of the medial pterygoid on the proximal fragment**.** Each subunit is described below by its anatomy, along with any favourable and unfavourable fracture patterns **(3).**

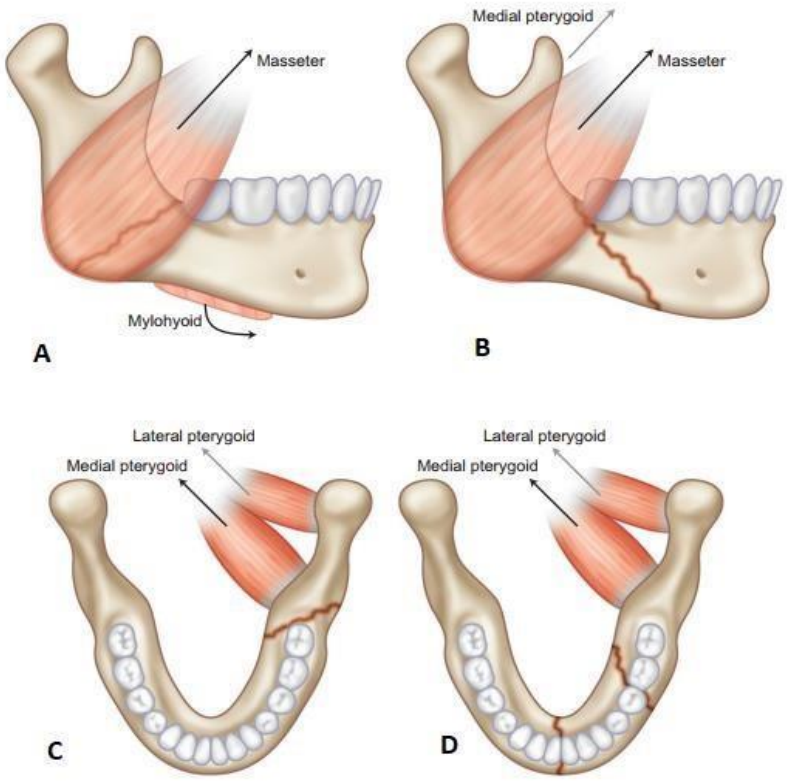

Figure (1): (A) Horizontally unfavorable fracture; (B) horizontally favorable fracture, (C) Vertically unfavorable fracture; (D) vertically favorable fracture **(3).**

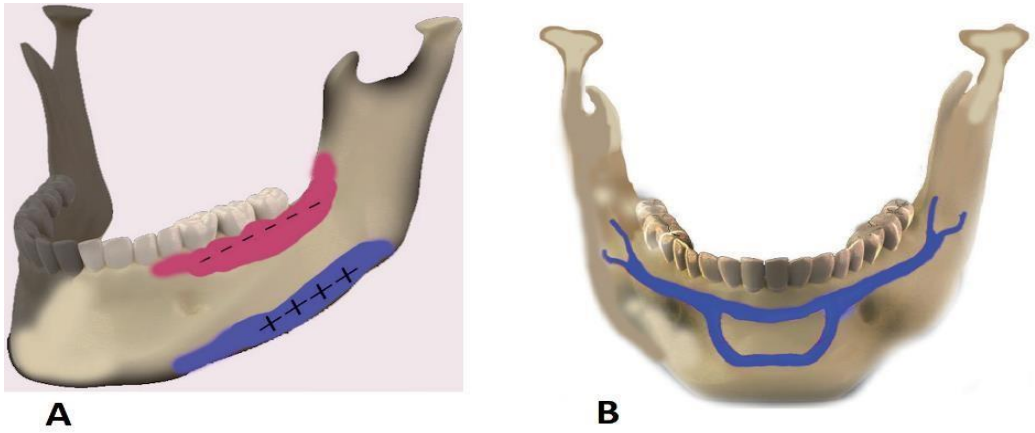

Figure (2): A. Tension zone (red color) (−) and compression zones (blue color) (+) (4).

Table (1): Kruger Classification of Mandibular fractures (4)

Relation to External Environment	Types of Fractures	Dentition of the Jaw with Reference to the Use of Splints	Localization
• **Simple or Closed** • **Compound or Open**	• Incomplete • Complete • Green stick • Comminuted	• Sufficiently dentulous jaw • Edentulous or insufficiently dentulous jaw • Primary and mixed dentition	• Fractures of the symphysis region between the canines Fractures of the canine region • Fractures of the body of the mandible between the canine and angle of the mandible • Fractures of the angle of the mandible in the third molar region • Fractures of the mandible ramus between the angle of the mandible and the sigmoid notch • Fractures of the coronoid process • Fractures of the condylar process

Biomechanics of fractures

Under load, the mandibular bone experiences a variety of linear and angular forces, including compressions and tensions, shears and torsions, and bending. It has been shown that the mandibular bone can deform plastically and elastically in response to external stresses. Muscles, on the other hand, exert specific vertical and horizontal stresses on fragments. These forces might be associated with displacement of fragments **(5)**

1. Muscle forces

Muscles are associated with pull direction which might induce a compression on fragments with a subsequent prevention of displacement. Fractures which are developed by the effects of such forms of muscles pull vector are termed favorable fractures. In contrast, certain muscles could pull which induce displacements of fragments. Fractures at such forms of drawbacks conditions are termed unfavorable fractures **(6)**

2. Tension

Areas of compression and tension are created across the jaw by the pulling force produced by the muscles of the oral and maxillofacial region. The compression zone is located distally, whereas the tension area is located in the upper mandibular region. Champy's principle is according to such tension and compressions zones that was established to be as a guideline to confirm efficient management for open reduction of mandibular factures **(7).**

Physical Examination for Mandibular Fractures

The physical examination should consist of inspection and palpation. Pain, swelling, redness, and localised heat are the four well-known symptoms of inflammation and are strong indicators of a fractured jaw. Common intraoral findings linked to mandible fractures include fractured dentition, gingival bruises, lacerations, movement of teeth, decreased incisal openness, and malocclusion **(8).**

Alteration of sensation to the lower lip and chin is pathognomonic of a fracture of the mandible posterior to the mental foramen. Nevertheless, numbness in the inferior alveolar nerve's distribution is a rare complication of nondisplaced fractures of the parasymphysis, or body. Examine the gingival tissue for any bruises or abrasions. Injury to the underlying mandible may be indicated by trauma that results in bleeding, a hematoma, and discontinuity of skin or mucosa **(9).**

For instance, a wound beneath the chin is a common location of laceration typically indicating symphyseal, para-symphysis, and/or sub-condylar fractures. The skin on the affected area of the face should be examined for lacerations, hematoma, and swelling. A mandible fracture may be present in a patient with asymmetries of the face, and aberrant mandibular facial shapes should be examined. A retruded chin can result from a fractured para-symphysis on both side. The anterior mandible may be forced downward by bilateral body and subcondylar fractures, resulting in an opened mouth. The lateral face may seem flattened as a result of a fracture along the mandible's body or ramus**.** one must constantly be on the lookout for C-spine injuries from neck hyperextension and related mandibular fractures. **(9).**

Radiological Examination

Helical CT with the addition of 3D reformatting has largely supplanted plain-film radiography as the diagnostic gold standard in the acute setting. CT of the craniofacial skeleton provides detailed resolution, and the ability to rapidly and accurately assess the fracture location, vector, and degree of displacement, panorama has great importance on radiological examination. **(10).**

Principles of mandibular fractures management

First, airway maintenance needs to be provided for the traumatised patients. Foreign bodies made up of tooth fragments and intraoral haemorrhage may present an airway closure risk in patients who are resting supine. Even if a case with a disrupted awareness level may initially ingest blood, it might be associated with emesis by the effect of time. Mandibular pulling forward with a properly positioned cervical collar could provide breathing **(6)**

It must be taken into account that in cases of complicated fractures, placing the lower jaw with the help of a cervical collar may be quite difficult. In particular, open fractures and delayed healing are treated well with antibiotics. Anti-inflammatory drugs must be administered to the patient, and if there are no sterile wounds, the requirement of tetanus vaccine has to be taken into consideration **(11).**

Aim of fracture management

The primary goals are to restore the mechanical strength of the fracture area to that of its premorbid occlusion and to promote the normal function of the masticatory muscles. Restoring the fractured fragments to their original anatomical positions is the first step in treatment. The fixing of the components in their natural anatomical positions is the second phase. **(12).**

Greenstick fractures or incomplete fractures without pain, functional disruption, malocclusion, or disease may be treated non-operatively with monitoring alone and mechanical soft food modification. lists the indications for surgical management of mandibular fractures **(6)**

Table (2): Indications for Surgical Management of Mandibular fracture (6)

Closed reduction	Open reduction
Non-displaced favorable fractures	1) Displaced unfavorable fractures of the angle/body/ para-symphysis
2) Grossly comminuted fractures	2) Associated fractures of the craniofacial skeleton
3) Fractures with marked soft tissue damage	3) Malunion
4) Edentulous Mandibular fractures	4) Non-union
5) Mandibular fractures in children	5) Contraindications to MMF
6) Condylar fractures	6) Displaced condylar fracture with midface fractures in both sides
	7) Edentulous maxilla opposed a mandibular fracture

Whole fractures involving the mandible must be treated early, similarly to the other anatomical areas. On the other side, quick interference is rarely used. Although the risk of infection increases over time in individuals with open fractures, management in cases without airway problems or painful fractures may be postponed until the following day **(13).**

Closed versus open treatment

Closed reduction

Inter maxillary fixation (IMF) is the term for an anatomical restoration of the fragments without direct visualisation of the fracture line, which is known as closed reduction. Inter maxillary fixation involves stabilising the fracture with teeth-borne and bony-borne stabilisation in order to acquire the proper maxilla-mandibular relations **(14).**

IMF is often the basis of closed methods. IMF is the fixation of the mandible and maxilla following occlusion of the teeth, preventing the injured patient from opening their mouth for a predetermined amount of time to allow for subsequent healing. Analgesic medications must be prescribed in this scenario. It should be noted that if there is an open fracture, seven days of antibiotic use are required **(15).**

The treatment approach must be maintained until the firm callus forms (5 Weeks). However, in situations with complex fractures, longer care periods may be required for healing. Optimum bone union might be proven in 5 weeks. Due to the advantages of elastic tractions, which provide efficient repositioning of the fragments, and its low costs, the closed approach has remained popular in recent years. **(15).**

The continuation of IMF for 4 Weeks is the major drawback of closed therapy. This has been shown to be connected to the case's malnutrition and weight loss. Also, due to the difficulty of cleaning the teeth with the help of IMF, the situation needs to be explained in the context of oral hygiene. In general, closed reduction may be required in cases of large comminuted fracture with missing soft tissue. Mandibular edentulous fracture is a contentious condition that frequently requires periosteal vascularity **(15).**

Open reduction

In situations where a closed strategy has failed or is inappropriate, this technique is preferred. In an open reduction, the fractures are operated on and the fracture fragments are moved to their proper anatomical locations. This stage is known as reduction. The stage of fixation then follows. In an open reduction, fixation may be rigid or semi-rigid. Furthermore, rigid fixations use compression plates and bi-cortical screws. Although this is a valid strategy that allows the case to rapidly return to routine activities, it has several disadvantages **(16).**

Mini-plates are utilised for semi-rigid fixation. These little plates are placed on the stress areas near the fracture. Micro movements brought on by a semi-rigid fixation are thought to positively affect callus formation. Anatomical structures are preserved by the use of mono-cortical screws. It might be possible to do the intraoral operation while under local anaesthetic. In general, IMF and elasticity could be used to obtain occlusion. A soft diet is administered to the case during semi-rigid fixation. After healing, excising the plates is not required **(17).**

Fracture Fixation Principles

The majority of data have been concluded from previously carried out scientific work. Internal fixation in the context of mandibular fracture could be subdivided into 2 classes: load-bearing as well as load- sharing **(18)**.

Load-bearing fixation (LBF) indicates a hypothesis that is able to bear the entire load formed by mandibular functions in which the host bone at the fracture place shares none of the functional load. Classically, this needs the application of a major reconstructive plate to the lower mandibular margin. This has to be performed in cases when there is inadequate bone at the fracture place to tolerate all loads. Instances of LBF involve defect and comminuted fractures, as well as fractures in extensively atrophic mandibles **(18)**.

On the other hand, Load-sharing fixation (LSF) defines a fixation scheme while the functional load is shared among the fixation hardware as well as the bone besides the fracture site **(18)**.LSF could be subdivided into rigid and non-rigid fixation. The main change among rigid and non-rigid fixation centers on interfragmentary mobility **(18)**.

LSF is classically proper for isolated simple fractures with proper bone-to-bone contact at the fracture line. Of note, entire the remaining fractures need rigid fixation. Of note, physicians occasionally referred to plates by the size of the external caliber of the screw utilized in the plate. Existing plating troubles are to some extent more complex. Gradually, such systems possess a lot of plate thicknesses which accommodate screws from 2mm to 2.7mm in caliber **(9).**

In specific, whole screws are fit to whole plates in the set. Classically, when one refers to rigid fixation in this context, it denotes that a thick plate and larger screws are utilized. Plate thicknesses differ in certain sets from one millimeter in profile to 2.8mm in profile. Obviously, a 2.8mm-profile plate by utilizing a 2.7mm screw would achieve rigid fixation if carried out in a proper manner. In contrast, a 1mm profile plate with a 2mm screw could achieve non-rigid fixation. Everything in among is a shade of gray based on the numbers and site of plates utilized **(9).**

Understanding the success of the procedure and the expense of the approach is vital in order to choose the best course of action. Decision-making also involves familiarity with a procedure, understanding of subsequent masticatory functions, and complication rates **(9).**

Surgical Treatment by Fracture Site

1. **Body and angle**

Approach

Angle and body fractures may be managed via an intraoral approach or with a transbuccal trochar system.visualization and angling of instrumentation can be difficult when attempting to access fractures via an intraoral approach ,resulting in inadequate visualization of complete fracture anatomy and subsequent inappropriate fixation . In these situations,a percutaneous transbuccal trochar affords a conduit by which to allow the perpendicular introduction of drills and screws during surgical fixation .

When the intraoral and transbuccal approachs do not allow for sufficient visualization and reduction of fractures of the angle and body ,the Risdon aaproach can be utilized.

Technique

Body and angle fractures of the mandible are often difficult to manage due to adjacent structures.for open treatement ,both rigid and non rigid fixation stratagems are utilized.if rigid fixation is chosen, plate and screw fixaton with a 2 plate technique is most commonly employed.one miniplate with monocortical screws at the superior border and one miniplate with bicortical screws at the inferior border of the mandible are placed.Non rigid fixation via champy technique is most commonly employed in fractures of the angle. This approach allows for micromotion between segments and promotes secondary bone healing through an intermediate phase of callus formation prior to ossification .due to the conservative dissection with less tissue stretching and periosteal stripping , the use of champy plates has shown a decrease in operative time and less postoperative discomfort while resulting in equivalent rates of bony union.

a) Rt body mandibular fracture

b) Tension band wiring in situ with reduced fracture

c) Lower border plating of reduced fracture with tension band in situ

d) Completed plating with anatomic fracture reduction

Figure (2) fracture lt body of mandible A. before fixation B. after fixation

2. Symphysis/Parasymphysis :Plating of Anterior Mandibular Fractures (AMFs):

AMFs can be categorised as either fractures between the lateral incisors (symphyseal region) or fractures between the lateral incisors and the second premolar (para-symphyseal region) **(18).**

In most cases, fractures of the anterior mandible are easily accessible via intraoral incisions.

TECHNIQUE

Symphseal and parasymphseal fractures can be managed in three ways . for simple nondisplaced fractures, closed reduction with arch bars with maxillomandibuar fixation alone can be utilized to reestablish and maintain premorbid occlusion . fractures can be opened ,reduced ,and fixated with one of two techniques:(1)plate and screw fixation or (2) lag screws .Two miniplates can be used across the champy lines of tension or a single bone plate at the inferior border of the mandible with an arch bar serving as the tension band .

2 miniplates are sufficient in almost all circumstances and may result in equivalent results, but they may also cause more postoperative adverse events than have previously been reported **(18)**.

It has been reported that the two miniplate method can be replaced with a single, larger plate. **(19).**

In order to limit the danger of postsurgical displacement of the fractured segments and to enable an early return to normal function for AMFs, various types of plating systems have been developed throughout the years **(20).**

The 2.0mm fixing method is one of the more useful ones for AMFs.

Miniature plate system. Michelet introduced it for the first time**,** and since then Champy et al. have made considerable advancements.It was developed in 1976 and is now the accepted surgical procedure for treating mandibular fractures **(7).**

Champy et al. recommended using double miniplates in the anterior part of the jaw in 1978. They had recommended placing one mini-plate at the symphysis' inferior border and another plate five millimetres above it. This is done to counteract the torsional pressures that the static bite and chewing had on the anterior mandible **(7).**

Farmand and Dupoirieux developed the three-dimensional (3D) titanium plating systems for the treatment of maxillofacial fractures**.** The use of 3D plates has been considered one of the fixation methods that challenge Champy's technique for mandibular fractures fixations **(2)**.

Role of Tension Band Wiring as a Preliminary Step in Reduction and Fixation of Fracture Mandible

Development in plating systems and technical knowledge regarding the osteosynthesis has made open reductions and rigid internal fixation as the most frequently used mode of treatment in facial skeleton fractures. Various modalities for fracture reduction/stabilization during fixation have been mentioned in

literature, describing the use of custom made instruments or reduction forceps etc.This method is quick, simple and effective way of achieving initial reduction and stabilization of bone prior to final rigid fixation. The added advantages are reduced operating time,reduced instrumentation and assistance which in turn provide clear and more accessible surgical field**. (24)**

a)t parasymphseal fracture

b) Tension band wiring in situ with reduced fracture

c) Lower border plating of reduced fracture with tension band in situ

d) Completed plating with anatomic fracture reduction

Figure (3):Role of tension band wiring on fracture mandible reduction and fixation

Arch bars [Erich's] are placed in both upper and lower i.e. maxillary and mandibular arch or interdental wiring was done. Arch bars in mandibular arch are left slightly loosened to allow for upper border manipulation while doing fracture reduction . Fracture site is exposed via intraoral vestibular degloving incision after infiltration of xylocaine with adrenaline [1:100,000] in area of fracture. Subperiosteal exposure of fracture is done and one hole on each side of fracture is drilled by 1.5 mm^2 drill bit. Holes are drilled approximately at a distance of 1–2 cm from line of fracture and perpendicular to fracture line,2 mm^2 self tapping stainless steel/titanium screws are tightened into the holes on each side, so that approximately 2 mm of screw length remains above the bone to engage wire loop. A 24 gauge wire loop is placed around the screws and tightened while exerting the pull perpendicular to screws. Wire is tightened in a way so that finally the wire loop exerting tension force lies in contact with fracture line, thereby minimizing the moment arm of torque and hence the lingual separation of the fracture segment. After accurate fracture reduction, mandibular arch bars are tightened and IMF is done to stabilize occlusion. Rigid fixation is carried out by fixing four holed plate at lower border below the tension band wiring.After fixation of this plate tension band wiring is removed and another four holed plate is adapted in place of tension band wiring and fixed. Same holes drilled earlier can be used for the second plate fixation. Wounds Are Closed By Using Resorbable Suture Material.
Follow up of the patients to record early complications in hospital admission and late after discharge.
This method is quick, simple and effective way of achieving initial reduction and stabilization of bone prior to final rigid fixation. The added advantages are reduced operating time, reduced instrumentation and assistance which in turn provide clear and more accessible surgical field.

Postsurgical Care

In the context of prolonged success of all treatment of mandibular fractures, the postsurgical management is crucial. In addition, Close monitoring of appointments are of great importance to strengthen appropriate diet, as well as progression of functions. Whole approaches of internal fixation possess an objective of initial restoration of maximal functions, comprising dietary intake and speech as well as airway **(25)**.

Patients are put on a soft diet to reduce bite force and fracture motion. After surgery, a soft diet is advised for about 4 weeks. During this moment, it's crucial to avoid using your entire masticatory system. Patients who will be in MMF for a prolonged amount of time need to receive additional liquid nutrition **(26).**

Postsurgical IMF:

Mandibular-maxillary fixation promotes stability, aids in reduction, and acts to reestablish premorbid occlusion. especially in cases with multiple fractures. Reduction in movements during callous development and occlusal stability **(27).**

Furthermore, maintaining mandibular-maxillary fixation for a little time after surgery—between one and two weeks—serves as a reinforced tension band. Cases could switch from mandibular-maxillary fixation to elastic guidance when released. If there are discrepancies in occlusion, guiding elastics may be utilised to help a patient get functionally trained into an appropriate occlusion. **(28).**

Adverse events of Mandibular Surgeries

One major research has evaluated the frequency of adverse events in 363 cases with mandibular fractures managed at a tertiary care center. They have demonstrated that hardware failure was the commonest adverse event (15.4percent) then infections (15.1 percent). Smokers and patients with systemic illnesses could be identified as having higher adverse event frequencies. **(30).**

Pain and swelling at the same surgery site are usually the earliest symptoms. One must consider replacing the hardware when it fails, occasionally with a rigid construct. Such concept is true even in the face of major infections. Malocclusion is the most serious side effect following surgery**(32).**

Conclusion:

Various modalities for fracture reduction/stabilization during fixation have been mentioned in literature, describing the use of custom made instruments or reduction forceps etc. This method is quick, simple and effective way of achieving initial reduction and stabilization of bone prior to final rigid fixation. The added advantages are reduced operating time, reduced instrumentation and assistance which in turn provide clear and more accessible surgical.

References

1. Goodday, R. H. (2013). Management of fractures of the mandibular body and symphysis. Oral and Maxillofacial Surgery Clinics, 25(4), 601-616.
2. Al-Moraissi, E. A., and Ellis, E. (2014). Surgical management of anterior mandibular fractures: a systematic review and meta-analysis. Journal of oral and maxillofacial surgery, 72(12), 2507.
3. Zhou, H., Lv, K., Yang, R., et al. (2016). Mechanics in the Production of Mandibular Fractures: A Clinical, Retrospective Case-Control Study. PLoS One, 11(2), e0149553-e0149553.
4. Kruger, G. O. (1974). Textbook of oral surgery: Mosby.
5. Draper, E. R., and Goodship, A. E. (2003). A novel technique for four- point bending of small bone samples with semi-automatic analysis. Journal of biomechanics, 36(10), 1497-1502.
6. Dergin, G., Emes, Y., and Aybar, B. (2019). Evaluation and Management of Mandibular Fracture Trauma in Dentistry: IntechOpen.
7. Champy, M., Lodde, J., Schmitt, R., et al. (1978). Mandibular osteosynthesis by miniature screwed plates via a buccal approach. Journal of maxillofacial surgery, 6, 14-21.
8. Wolfswinkel, E. M., Weathers, W. M., Wirthlin, J. O., et al. (2013). Management of pediatric mandible fractures. Otolaryngologic Clinics of North America, 46(5), 791-806.
9. Pickrell, B. B., and Hollier Jr, L. H. (2017). Evidence-based medicine: mandible fractures. Plastic and reconstructive surgery, 140(1), 192e-200e.
10. Kaeppler, G., Cornelius, C.-P., Ehrenfeld, M., et al. (2013). Diagnostic efficacy of cone-beam computed tomography for mandibular fractures. Oral surgery, oral medicine, oral pathology and oral radiology, 116(1), 98-104.
11. Bohluli, B., Mohammadi, E., zoljanah Oskui, I., et al. (2019). Treatment of mandibular angle fracture: Revision of the basic principles. Chinese Journal of Traumatology, 22(2), 117-119.
12. Brandt, M. T., and Haug, R. H. (2003). Open versus closed reduction of adult mandibular condyle fractures: a review of the literature regarding the evolution of current thoughts on management. J Oral Maxillofac Surg, 61(11), 1324-1332.
13. Khelemsky, R., Moubayed, S. P., and Buchbinder, D. (2016). What is the evidence for open versus closed treatment of mandibular condylar fractures in adults? The Laryngoscope, 126(11), 2423-2425.
14. Rozeboom, A., Dubois, L., Bos, R., et al. (2017). Closed treatment of unilateral mandibular condyle fractures in adults: a systematic review. International journal of oral and maxillofacial surgery, 46(4), 456-464.
15. Sahoo, N., and Mohan, R. (2010). IMF screw: An ideal intermaxillary fixation device during open reduction of mandibular fracture. Journal of maxillofacial and oral surgery, 9(2), 170-172.

16. Alpert, B., Tiwana, P. S., and Kushner, G. M. (2009). Management of comminuted fractures of the mandible. Oral and maxillofacial surgery clinics of North America, 21(2), 185-192
17. Chrcanovic, B. R. (2013). Open versus closed reduction: comminuted mandibular fractures. Oral and maxillofacial surgery, 17(2), 95-104.
18. Ellis III, E., and Miles, B. A. (2007). Fractures of the mandible: a technical perspective. Plastic and reconstructive surgery, 120(7),76S-89S.
19. Agnihotri, A., Prabhu, S., and Thomas, S. (2014). A comparative analysis of the efficacy of cortical screws as lag screws and miniplates for internal fixation of mandibular symphyseal region fractures: a randomized prospective study. International journal of oral and maxillofacial surgery, 43(1), 22-28.
20. Sehgal, S., Ramanujam, L., Prasad, K., et al. (2014). Three- dimensional v/s standard titanium miniplate fixation in the management of mandibular fractures–A randomized clinical study. Journal of cranio-maxillofacial surgery, 42(7), 1292-1299.
21. Vineeth, K., Lalitha, R., Prasad, K., et al. (2013). "A comparative evaluation between single noncompression titanium miniplate and three dimensional titanium miniplate in treatment of mandibular angle fracture"–a randomized prospective study. Journal of cranio- maxillofacial surgery, 41(2), 103-109.
22. Farmand, M., and Dupoirieux, L. (1992a). Intérêt des plaques tridimensionnelles en chirurgie maxillo-faciale. Revue de Stomatologie et de Chirurgie Maxillo-faciale, 93(6), 353-357.
23. Yadav, D., Mishra, R., and Shashank, T. (2019). 3-Dimensional versus Conventional Titanium Miniplate osteosynthesis in mandibular fracture–A Comparative study. Advanced Research in Dentistry and Oral Hygiene 1 (1): 1, 11.
24. Degala, S. and Gupta, N (2010): ''Tension Band Wiring'' A Simplified Approach for Fracture Reduction and Intermittent Stabilization. J. Maxillofac. Oral Surg. (Sept-Dec 2010) 9(4):382–384
25. Saman, M., Kadakia, S., and Ducic, Y. (2014). Postoperative maxillomandibular fixation after open reduction of mandible fractures. JAMA facial plastic surgery, 16(6), 410-413.
26. Manzie, T., David, M., and Bobinskas, A. (2021). Return to normal diet following mandibular fractures–how long is long enough? British journal of oral and maxillofacial surgery, 59(9), 1050–1055.
27. Swetha, K., Goudar, G., Bhayya, H., et al. (2018). Evaluation of efficacy of intermaxillary fixation screws in maxillofacial trauma: A clinical study. International Journal of Applied Dental Sciences, 4(1), 94-97.
28. Diaconu, S. C., McNichols, C. H., Liang, Y., et al. (2018). Utility of postoperative mandibulomaxillary fixation after rigid internal fixation of isolated mandibular fractures. Journal of Craniofacial Surgery, 29(4), 930-936.
29. Pattar, P., Shetty, S., and Degala, S. (2014). A prospective study on management of mandibular angle fracture. Journal of maxillofacial and oral surgery, 13(4), 592-598.
30. Gutta, R., Tracy, K., Johnson, C., et al. (2014). Outcomes of mandible fracture treatment at an academic tertiary hospital: a 5-year analysis. Journal of oral and maxillofacial surgery, 72(3), 550-558.
31. Odom, E. B., and Snyder-Warwick, A. K. (2016). Mandible fracture complications and infection: the influence of demographics and modifiable factors. Plastic and reconstructive surgery, 138(2), 282e-289e.
32. Kim, S.-Y., Choi, Y.-H., and Kim, Y.-K. (2018). Postoperative malocclusion after maxillofacial fracture management: a retrospective case study. Maxillofacial plastic and reconstructive surgery, 40(1), 27-27.