IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 10 Ser.9 (October. 2023), PP 09-21
www.iosrjournals.org

An Observational Evaluation Of Patterns Of Mandibular Fractures And Their Management

Nikhil Prasad[1] ,Umesh Kumar[2] ,Sumanbabu Gottam3,Sudipta Bera[4]
1 Senior Resident, Department of Plastic Surgery, Institute of Medical Sciences, Banaras Hindu University , Varanasi
2 Associate Professor and Head, Department of Plastic Surgery, Institute of Medical Sciences, Banaras Hindu University , Varanasi
3 Senior Resident, Department of Plastic Surgery, Institute of Medical Sciences, Banaras Hindu University , Varanasi
4 Assistant Professor , Department of Plastic Surgery, Institute of Medical Sciences, Banaras Hindu University , Varanasi

ABSTRACT
OBJECTIVE: To investigate the patterns of fractures involving the vertical parts of mandible and assess strategies employed in the treatment to improve clinical outcomes.
MATERIALS AND METHODS: Ninety consecutive patients involving fracture in the vertical part of mandible were managed as per a devised protocol. The etiological factors, anatomical location, fracture patterns, associated injuries and management, including surgical incisions, complications and follow up data were recorded.
RESULTS: In our study, males were predominantly involved (91.1%), and road traffic accidents (52%) and assault (18.8%) amounted to the most common etiologies. Multiple fracture segments were associated with more displacement of segments (54.8%), frequently involved the nasal bone (57.8%) or the palate (65.6%). Condyle was most commonly fractured site (25.4%) followed by parasymphysis (24.8%). Majority of the fractures of the vertical part of the mandible were of the simple or closed type (81.1%). Complications such as malocclusion (11.1%), surgical site infection (12.2%), and facial or marginal mandibular nerve injury/palsy (5.5%), TMJ arthrosis (11.1%) were managed and their incidence correlated with specific fracture pattern and management.
DISCUSSION: Each pattern has distinct characteristics and is associated with varied outcomes. Maxillomandibular fixation (MMF) was used to treat undisplaced condylar, coronoid and subcondylar fractures with good functional results. In displaced fractures the retromandibular incision gave better access in majority cases. In cases with overlap segments, better reduction was achieved due to a traction provided.
CONCLUSION: Understanding the patterns of mandibular fractures is crucial for accurate diagnosis and treatment planning.

Keywords: *Management Protocol, Ramus Fractures, Verticle Mandibular Fractures, Retromandibula Incision.*

Date of Submission: 21-10-2023 Date of Acceptance: 31-10-2023

I. INTRODUCTION

Mandibular fracture is the most common type of fracture in the facial skeleton.[1] Amongst mandibular fractures, condylar fractures have highest incidence[2]. Physical trauma, as well as road traffic accidents, interpersonal violence, workplace hazards, sports, falls and gunshot wounds, are most frequent external causal factors.

Mandibular fractures can occur in the condyle, body, symphysis, and angle areas, among other anatomical locations. Every fracture pattern has unique traits that needs to be addressed. Concurrent injuries to surrounding structures, such as teeth, soft tissues, and facial bones, may render the management of mandibular fractures more challenging. The choices made about treatment, functional outcomes, and cosmetic outcomes may be significantly impacted by these injuries. In order to manage mandibular fractures holistically, a thorough assessment of the fracture site, multiplicity of fractures within the mandible, and related injuries is necessary. Accurate diagnosis, adequate reduction and fixation, as well as the avoidance of comorbidities, are necessary for this.[3,4]

This study aims to comprehend mandibular fracture management by examining the patterns of mandibular fractures, identifying associated injuries, and analyzing therapy options. In particular, we emphasize the different types of fractures of vertical part of mandible, as these are significantly peculiar in terms of occurrence, management, complications and follow-up.

II. MATERIALS AND METHODS

We conducted a Prospective observational study with 90 patients consecutively enrolled. The patients were selected from the Emergency and Triage department from January 2021 to December 2022. Informed written consent was obtained from the patients after explaining to them the purpose of the study. Permission for conducting the study was taken from the Institutional Ethics Committee. A detailed history, clinical examination and relevant radiological investigations were documented for every patient on a pre-prepared proforma. All data collected was tabulated and analyzed using proper statistical tools. Patients having various types of fractures of the vertical limb of the mandible namely, condylar neck, sub condyle, ramus of mandible and the angle of mandible, as a component of their trauma were selected for this study and their fractures classified as per Lindahl[4] and Krenkel[5] classification systems and a plan drafted for management. Patients with Cervical spine injury and those with Life threatening injuries were excluded from the study.

All cases were managed as per devised treatment protocol attached (FIGURE.1 AND 2). Mandibular fractures were initially immobilized using arch bar, in order to, achieve a better airway, decrease bleeding from fracture, and also reduce pain, thus comparison of duration of surgery only includes the time required for Open Reduction and Internal Fixation (ORIF). All cases were operated under general anesthesia with appropriate nasal/submental intubation and surgical access namely pre-auricular incision for condylar fractures or a submandibular/ retromandibular approach for fractures of sub condyle/ramus of mandible were used. Open Reduction and Internal Fixation was done using standard aseptic techniques and titanium mini plates and a self-tapping screw system was used to achieve stable and sturdy reduction and fixation of fracture segments. Postoperatively, patients were given pain medication and started on chlorhexidine mouth wash. A liquid or no-chew diet was implemented for up to 6 weeks. X-ray lateral oblique views were done on all patients postoperatively. In accordance, the patients were followed up fortnightly for the first 2 months and monthly in the 3rd month and their post-operative complaints, scars, dental occlusion, lateral excursion and mouth opening in terms of interincisor distance was documented.

The data thus collected was analyzed using SPSS v23. The data were expressed as frequency and percentage for categorical variables. The quantitative data showing Gaussian distribution were expressed as mean ± SD. Student's paired t-test was applied for comparison of data of two groups showing Gaussian and non-Gaussian distribution, respectively. A p-value of <0.05 was considered as significant.

Fig.1 : Protocol devised for management of various patterns of condylar and ramus of mandible fractures

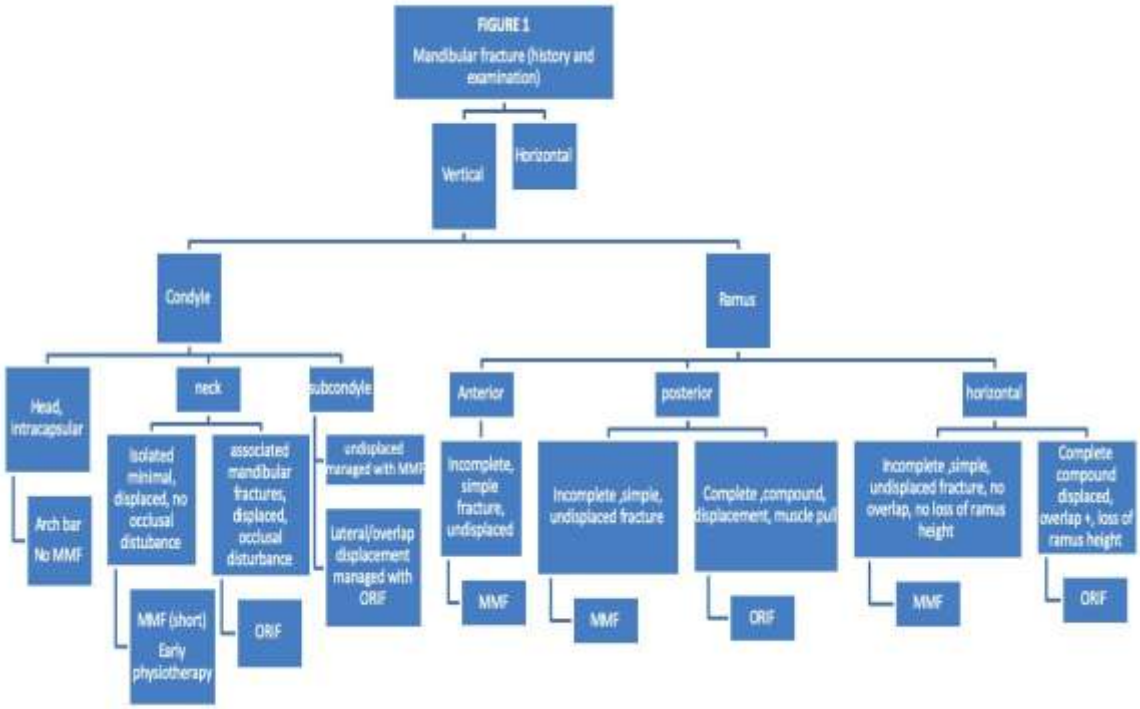
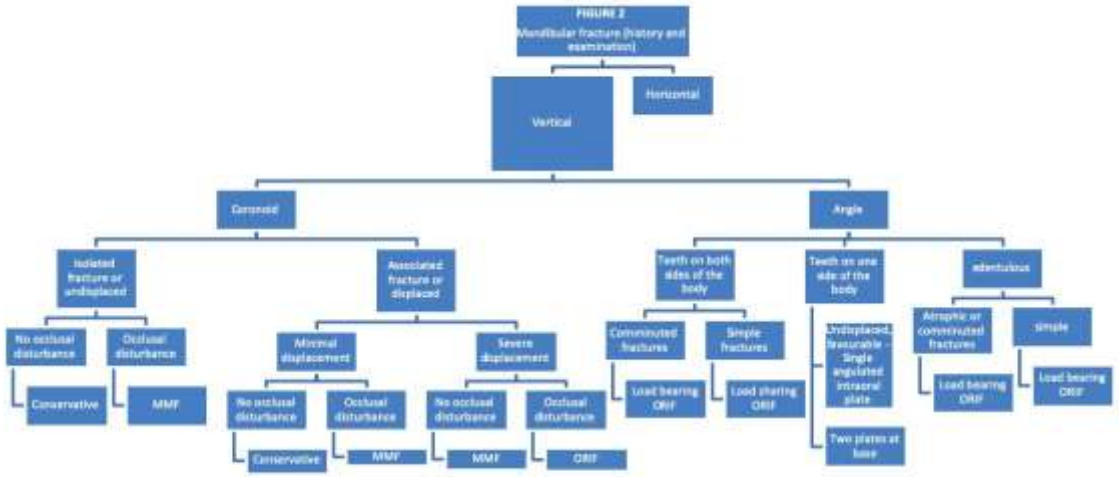


Fig.2 : Protocol devised for management of various patterns of coronoid and angle of mandible fractures



**MMF duration was decided on case to case basis as per the fracture pattern noted and Displacement was defined as per contact of segments and cortical margins of bone matching

III. RESULTS

In this study, we observed that the male had a higher incidence of mandibular fractures (91.1%). Vertical fractures of the mandible were not seen to be associated with an increased incidence of ENT bleed. Multiple fractures of the mandible were more commonly seen in patients of younger age group (0-40). Majority of patients who had a palatal fracture also had multiple fracture sites within the mandible (75%). Majority of patients who had a nasal fracture also had multiple fracture sites within the mandible (62.5%). Assault was more commonly seen as a cause of injury in patients of 21-50 years of age (82.3%). Additionally, more than half of the patients with fractures due to a history of fall were of the age group pediatric and adolescent age groups (58%).

Pre-operative reduced mouth opening is a clinical feature common to mandibular fractures, but it was twice as common in patients having multiple fracture sites in the mandible (66.2%) vs single fracture (33.8%). Patients having multiple fractures within mandible had more displacement of segment than singular fractures (54.8%). In our study regarding vertical pattern fractures of mandible, patients having an unfavorable segment of bone were more likely to have multiple fractures within the mandible. (FIG.3) These fractures can be managed with the above-mentioned surgical protocol.

Out of 90 patients, 29 (32.2%) underwent conservative treatment either with eyelets, short segment arch bars, inter-dental wiring, or a full Maxillomandibular fixation (MMF) using arch bar and rubber bands. Rest of the patients were managed with MMF followed by ORIF.

Majority of our cases were approached intra-orally for ORIF (43.3%) while approximately one-third patients required an incision to be committed (32.3%). Retromandibular incision (58.62%) was the most preferred access by the operating team to manage cases in the study group (Fractures of the vertical part of mandible).

Condyle was the most commonly fractured site in our study (25.43%) followed by the parasymphyseal region (24.85%). (TABLE 1) The lateral excursion was seen postoperatively in 21 cases, all cases had fracture sites in the vertical part of the mandible, but the overall lateral excursion was seen only in 23.3% of cases. There was no statistically significant correlation between Mandibular protrusion/retrusion and Vertical part of mandible fractures suggesting fractures of this part behave similar to fractures of horizontal part of mandible. (TABLE 2)

The majority of the fractures of the vertical part of the mandible were of the simple or closed type (81.1%) and only 17(18.9%) cases were either compound or open in nature. The complications were significantly higher with compound fractures of the vertical part. (TABLE 3)

Pseudo arthrosis and pain at TMJ was observed in only 11.1% cases with Vertical part of mandible fractures. In patients having both DM and another co-morbidity, there was a direct correlation in occurrence of

post op infection. However, when a single co-morbidity was present, there was no significant increase in infections.

Fig. 3: Multiplicity of mandibular fracture sites correlation with Vertical part of mandible fractures

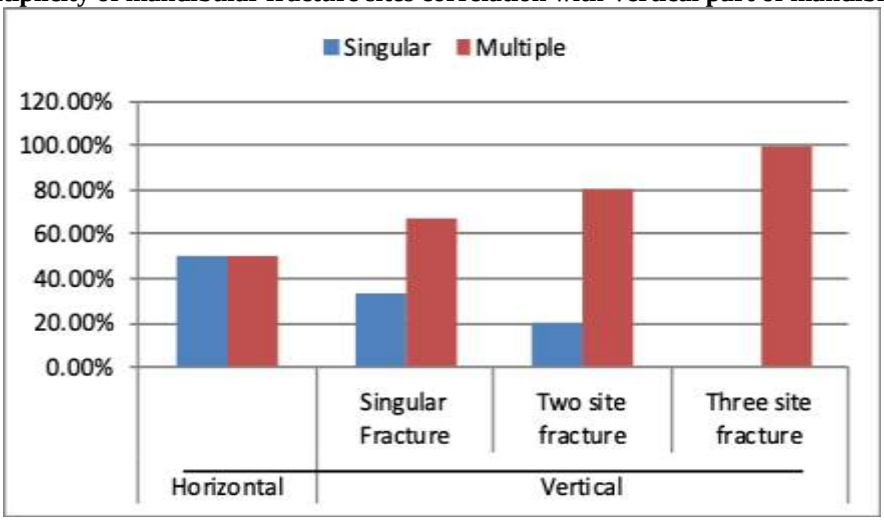


Table 1 :- Site of fracture

		Frequency	Percentage
Condyle	Head	24	13.87
	Neck	8	4.62
	Subcondyle	12	6.94
		44	25.43
Coronoid	Isolated/undisplaced	2	1.16
	Associated	9	5.19
		11	6.35
Ramus	Anterior border	10	5.78
	Posterior border	3	1.73
	Horizontal	7	4.05
		20	11.56
Angle	Teeth on both side	16	9.25
	Teeth on one side	9	5.20
	Edentulous	5	2.89
		30	17.34
Body		7	4.04
Parasymphysis		43	24.85
Symphysis		18	10.40

Table 2: Postop lateral excursion correlated with Vertical part of mandible fractures

Postoperative lateral excursion		Horizontal	Vertical			Total
			Singular Fracture	Two site fracture	Three site fracture	
No lateral excursion	Frequency	4	50	13	2	69
	%	4.4%	55.6%	14.4%	2.2%	76.7%
Lateral excursion	Frequency	0	19	2	0	21
	%	.0%	21.1%	2.2%	.0%	23.3%
Total	Frequency	4	69	15	2	90
	%	4.4%	76.7%	16.7%	2.2%	100.0%

Table 3: Complications correlated with compound fractures of the vertical part of mandible

Complication	**Compound**
Postop Mal-occlusion	3 (3.3%)
Postop Mouth opening	17 (18.9%)
Postop-infection	4 (4.4%)

IV. DISCUSSION

Understanding the patterns of mandibular fractures is crucial for accurate diagnosis and treatment planning. Mandibular fractures can occur at different anatomical sites, including the condyle, body, symphysis, and angle regions. Each fracture pattern has distinct characteristics and may be associated with specific complications.

The condyle (25.43%) and parasymphyseal (24.85%) regions were the most fractured in our investigation, similar to Widmark et al [5], Chrcanovic BR et al [6] and Bormann KH et al [7]. The high incidence of mandibular condyle fracture is attributable to the binding of the mandibular ramus (high stiffness) to the mandibular condyle (low stiffness).[2] Fractures are generally caused by indirect force that is delivered to the mandibular condyle head. The condylar fragment may be displaced (most often laterally) based on the angulation of the fracture and predominant muscle pull.[3] The most common external causative factor is physical trauma, and motor vehicle accident, inter-personal violence, industrial hazards, fall, sports, and gunshot wounds. Condylar process fractures require skillful care to restore the joint's function and anatomy.

Road traffic accidents caused 52.2% (47/90) of maxillofacial fractures. Zachariades et al [8] and Van Beek et al [9] found that road traffic accidents caused over half of maxillofacial fractures. Motor vehicle accidents are more common due to their ease of use and lax traffic laws, which increase maxillofacial trauma and fractures.

Our male predominance (91.1%) is similar to that gender distribution found in literature.[10-12] Travelling, sports, socializing, and alcohol intake make males more likely to have facial injuries. Maxillofacial trauma involved mostly 21-30-year-old patients, which is consistent with earlier studies.[13-17] 60% of maxillofacial fracture patients were in their third and fourth decades, with the highest incidence in the third. Our study found the highest prevalence in 21-30 years of age 33 (36.6%) and 31-40 years of age 19 (21%). Natu SS et al [13], Chandra Shekar BR.[17] agree.

Alcohol intoxication was 41% in Chandra Shekar BR et al [17] and 13% in Zix JA et al [18]. Al Ahmed et al [19] found no alcohol consumption in Sharjah, UAE, maxillofacial injury patients. The tight alcohol sales and use laws avoid alcohol-related injuries. In our study 38.8% were under influence when injured.

Kontio et al [20] reported 67.02% loss of consciousness in their study due to violence causing maxillofacial injuries. In our study it was seen to be 21.1%. Our investigation found 31.1% single and 68.9% multiple mandibular fractures. This resembled Sirimaharaj et al. and Ajmal et al [21]. 68.9% of patients had multiple mandible fractures, similar to Ogundare et al.14 (52.25%). One-third of cases had parasymphysis with condylar fracture. A horizontal direct hit to parasymphysis sent a force to mandibular condyle, causing significant tensile strength and fracture. Contrary to Dongas and Hall et al. [22], who saw parasymphysis with angle, Ogundare et al.[15] reported body with angle as the most common pairings.

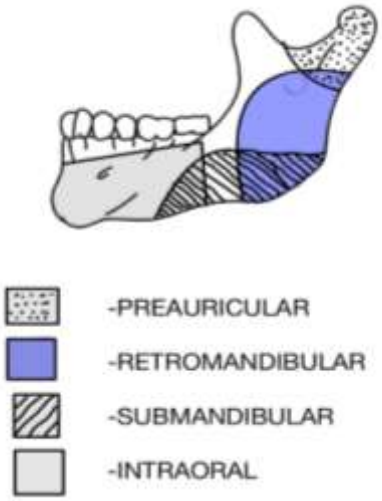
Pre-operatively,patients had deranged occlusion and bony deformities. Laurentjoye M et al.[23] concurred. The parasymphysis, symphysis, and body fractures were treated intraorally. Angle fractures that undisplaced and favorable instances (5 patients) were treated intraorally. During intraoral parasymphyseal fracture reduction and fixation, the mental nerve was preserved. Maxillomandibular fixation (MMF) was used to treat undisplaced condylar, coronoid and subcondylar fractures with good functional results, similar to the results of Ghodke et al.[24]

Only 4 patients had reduced mouth opening post-op. TMJ damage likely caused this. Arch bar was retained for 4 weeks. MMF withdrawal at 2 weeks and early mobilization resulted in near-normal mouth opening. At the first review, 10 patients (11.1%) exhibited malocclusion, comparable to Benjamin et al [25-27]. Occlusion is crucial to treating subcondylar fractures. Post-ORIF malocclusion rates differ in literature, due to the patient's dental history, additional maxillofacial fractures, bilateral condylar fractures, and poor fracture reduction, Ellis, 1998 [28]; Meyer, Zink et al. 2008[29] and at 3 months follow-up, Ellis et al. 2000 found no occlusal abnormalities.[30]

A common finding in our study was in respect to incisions. Surgical accessibility was determined by operation length, fracture reduction, plate and screw implantation, and nerve preservation. Practically the preauricular incision was useful in cases requiring ORIF of the condylar head, neck and subcondylar region while the submandibular approach provided access for reduction of fractures of the body, angle and lower ramus

of mandible only. The retromandibular approach provided access for ORIF of majority of the fractures involving vertical part of mandible i.e. the subcondyle, ramus and angle of mandible fractures. The posterior border of the mandible could be visualized all through the incision. This incision was also seen to be the least morbid, cosmetically acceptable and offered a faster learning curve. (FIGURE 4)

FIG 4: Accessibility through various incisions



In displaced fractures of the vertical part of mandible, the retromandibular incision gave better access for open reduction due to traction offered by a skilled assistant. The retromandibular incision not only offered clear view of the fractured segments but also allowed to visualize the sturdy angle of mandible hence enabling a tractional pull by the assistant by a bone holding forceps or by using a stainless-steel wire loop passed through a hole drilled there. Such practical problems and solutions were very helpful in reducing frequently observed over riding / over lapped fractured mandibular segments. Hinds et al[27] also found retromandibular technique better for subcondylar fractures. This incision should be made in a skin fold, 1 cm below the ear lobe, and 1 cm posterior to the mandibular ramus. The parotid gland is retracted anteriorly and the masseter muscle is divided to approach fracture gap. In our study, the operating team favored retromandibular incision (58.62%) to treat vertical mandible fractures. This was particularly also found to be useful in cases having post traumatic lateral displacement of the fractured segments.

Five patients in the operative group (12.2%) were treated with antibiotics based on wound swab culture and sensitivity data. The implant was kept until clinical fracture union was confirmed. Four individuals had implants removed after fracture union. The infection rate was observed to be higher than the 8.1% rate noted by Ugboko et al.[26] Four patients in the operated group (5.5%) suffered nerve damage, like the study by Benjamin et al.[25] (7.1%) and Cawood [28] (8%) which improved in 8-12 weeks. Similar to Meyer et al. 2008, radiographs showed no plate bending, screw loosening, or plate fracture during the 3-month follow-up. [29]

Four (4.4%) of 90 patients received conservative treatment with eyelets, short segment arch bars, or inter-dental wiring, while 25 (27.8%) received maxillomandibular fixation (MMF) because they were unfit for anesthesia. Benjamin et al.[25] used arch bars and eyelets with similar results. Fractured mandible immobilization is usually 4-6 weeks.[14,15] while in condylar fractures for lesser duration.[4] Although empirical, it is frequently influenced by various factors, including patient age, type, quantity, and severity of fracture, presence or absence of retained teeth in fracture line, and infection.

Lateral mandible movements are better indicators of TMJ function than mouth opening they assess translational condyle movements, which are more affected by fractures as described by Buschang, Throckmorton et al. 2000 [31]. In our study group, patients with vertical mandible fracture sites had higher rates of post-operative lateral excursion (23.3%). Adult lateral excursion averages 9–11 mm and ranges from 6–22 mm.

As there is no existing protocol to manage vertical mandibular fractures, this study established an evidence-based flowchart for the same. Our emphasis was on the management of different types of fractures based on part of mandible involvement, the extent of displacement, and associated complications. By creating a sound protocol, the management of vertical mandibular fractures can be standardized universally.

V. CONCLUSION

In this study, several conclusions may be drawn-

The condyle was the most commonly fractured site, majority of the fractures of the vertical part of the mandible were of the simple or closed type, while compound fractures were predominantly involving the horizontal part of mandible. The retromandibular incision was used most as it allowed open reduction of the fractured segments using a swift pull by a skilled assistant.

Understanding the patterns of mandibular fractures is crucial for accurate diagnosis and treatment planning. By creating an evidence-based protocol, an attempt can be made to standardize the management of vertical mandibular fractures.

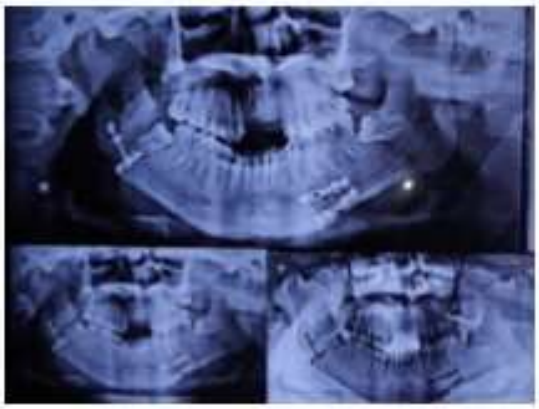
FIGURE 5: Right sided angle of mandible fracture and left sided body of mandible fracture

(a) Preoperative 3D reconstructed CT scan

(b) Post-operative X-ray

(c) Incision

(a)



(b)

(c)

FIGURE 6: Left sided angle of mandible fracture and right sided body of mandible fracture with associated frontal bone fracture

(a) Pre-operative clinical picture

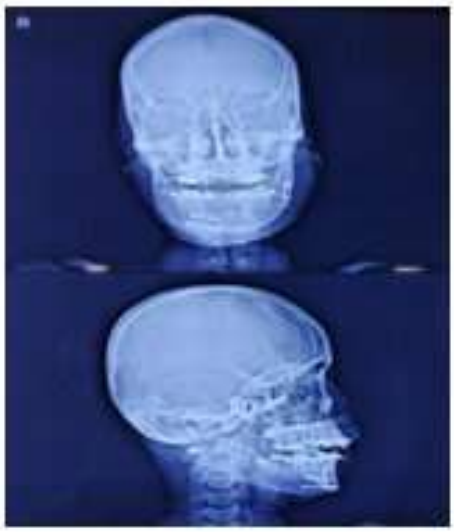
(b) Preoperative 3D reconstructed CT scan

(c) Post-operative X-ray

(d) Follow up clinical picture

(a)

(b)



(c)

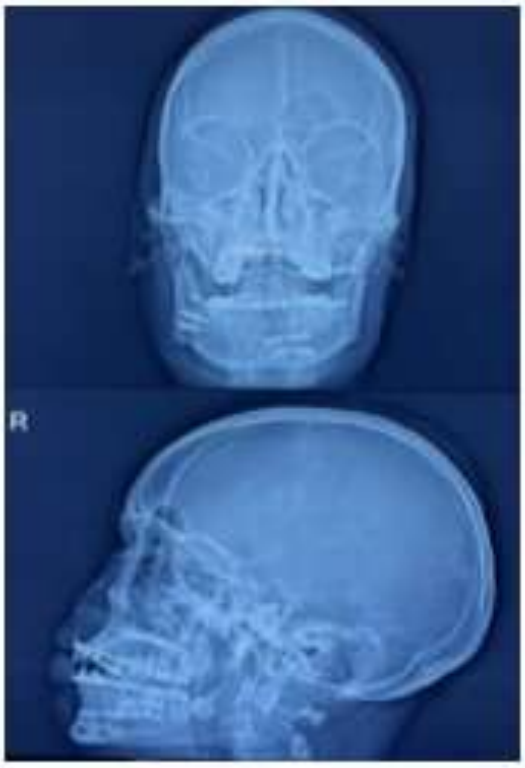
(d)

FIGURE 7: Right sided angle of mandible fracture and left sided parasymphysis of mandible fracture with a displaced segment

(a) Preoperative 3D reconstructed CT scan
(b) Pre-operative clinical picture
(c) Post-operative X-ray

(a)

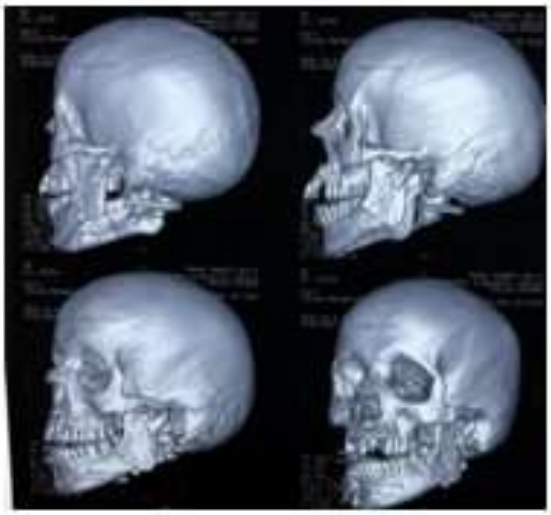
(b)



(c)

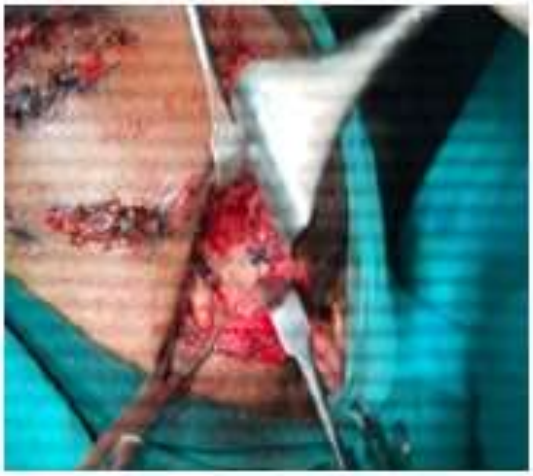
FIGURE 8: Left sided angle of mandible fracture and right sided parasymphysis fracture along with a displaced subcondylar fracture of the left side

(a) Preoperative 3D reconstructed CT scan
(b) Retromandibular approach used and the displaced condylar fracture segment was reduced using a swift pull by assistant using bone holding forceps
(c) Same incision was used for Open reduction and internal fixation of left angle and left subcondylar fracture segments



(a)

(b)

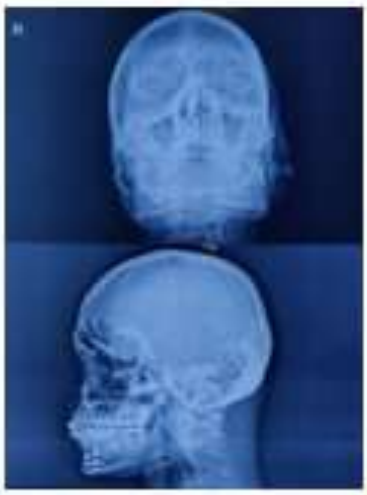


(c)

FIGURE 9: Left sided subcondylar fracture associated with a left sided incomplete fracture of the left parasymphysis

(a) Preoperative 3D reconstructed CT scan
(b) Post-operative X-ray
(c) Follow up clinical picture: lateral view showing a salivary fistula
(d) Follow up clinical picture: lateral oblique view

(a)



(b)

(c)

(d)

FIGURE 10: Intraoperative pictures

(a) Precise planning and marking of the incision

(b) Exploration and reduction of the fractured segments

(c) Open reduction and internal fixation of right condylar fracture using 2 hole with bar titanium miniplate and 2*6mm screws using a retromandibular incision

(a)

(b)

(c)

REFERENCES

[1]. Turvey TA. Midfacial fractures: a retrospective analysis of 593 cases. J Oral Surg. 1977;35:887-91.
[2]. Fridrich KL, Pena-Velasco G, Olson RA. Changing trends with mandibular fractures: a review of 1,067 cases. J Oral Maxillofac Surg. 1992;50:586-9.
[3]. Cienfuegos R, Cornelius CP, Ellis, Kushner G. CMF Mandible – Diagnosis - AO Surgery reference. 3rd ed. AO Foundation.
[4]. Moon H. Mechanical appliances for treatment of fracture of the jaws. Br J Dent Sci. 1874;17:303.
[5]. Widmark G. Facial symmetry after closed and open treatment of fractures of the mandibular condylar process. J Oral Maxillofac Surg. 2000;58:729.
[6]. Santler G. A comparative evaluation of osteosynthesis with lag screws, miniplates, or Kirschner wires for mandibular condylar process fractures. J Oral Maxillofac Surg. 2001;59:1169.
[7]. Chrcanovic BR, Abreu MHNG, Freire-Maia B, Souza LN. 1,454 mandibular fractures: a 3-year study in a hospital in Belo Horizonte Brazil. J Cranio-Maxillofac Surg. 2012;40:116–23.
[8]. Bormann KH, Wild S, Gellrich NC, Kokemüller H, Stühmer C, Schmelzeisen R, Schön R. Five-Year retrospective study of mandibular fractures in Freiburg, Germany: incidence, etiology, treatment, and complications. J Oral Maxillofac Surg. 2009;67:1251.
[9]. Zachariades NP. The pattern and aetiology of maxillofacial injuries in Greece. J Cranio-Maxillofacial Surg. 1990;18:251-254.
[10]. Van Beek M. Changes in the pattern of fractures of the maxillofacial skeleton. Int J Oral Maxillofac Surg. 1999;28:424-428
[11]. Gassner R, Tuli T, Hachl O, Rudisch A and Ulmer H. Cranio-maxillofacial trauma: a 10 year review of 9543 cases with 21067 injuries. J CranioMaxillofacial Surg. 2003; 31:51-61.
[12]. Greene D, Raven R, Carvalho G and Maas CS. Epidemiology of facial injury in blunt assault. Arch Otolaryngol Head Neck Surg. 1997;123:923-928.
[13]. Natu SS, Pradhan H, Gupta H, Alam S, Gupta S, Pradhan R, Mohammad S, Kohli M, Sinha VP, Shankar R, Agarwal A. An epidiomological study on pattern and incidence of mandibular fractures. Plast Surg Int. 2012;8343-64. doi: 10.1155/2012/834364.
[14]. Ogundare BO, Bonnick A, Bayley N. Pattern of mandibular fractures in an urban major trauma center. Journal of Oral and Maxillofacial Surgery, 2003;61(6):713–718.
[15]. Subhashraj K, Nandakumar N, Ravindran C. Review of maxillofacial injuries in Chennai, India: A study of 2748 cases. Br J Oral Maxillofac Surg. 2007;45:637-639.
[16]. Maliska MC, Lima Júnior SM, Gil JN. Analysis of 185 maxillofacial fractures in the state of Santa Catarina, Brazil. Braz Oral Res. 2009;23(3):268-74.
[17]. Chandra Shekar BR, Reddy C. A five year retrospective statistical analysis of maxillofacial injuries in patients admitted and treated at two hospitals of Mysore city. Indian J Dent Res. 2008;19(4):304-8.
[18]. Zix JA, Schaller B, Lieger O, Saulacic N, Thorén H, Iizuka T. Incidence, aetiology and pattern of mandibular fractures in central Switzerland. Swiss Med Wkly. 2011.
[19]. Hamad E Al Ahmed, Jaber MA, Fanas SHA and Karas M. The pattern of maxillofacial fractures in Sharjah, United Arab Emirates: A review of 230 cases. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 2004; 98(2):166-170.
[20]. Kontio R, Suuronen R, Ponkkonen H, Lindqvist C, Laine P. Have the causes of maxillofacial fractures changed over the last 16 years in Finland An epidemiological study of 725 fractures. Dental Traumatology. 2005;21:14-19.
[21]. Ajmal S, Khan MA, Jadoon H, Malik SA. Management protocol of mandibular fractures at Pakistan Institute of Medical Sciences, Islamabad, Pakistan. J Ayub Med Coll Abbottabad. 2007;19(3):51-55.
[22]. Dongas P, Hall GM. Mandibular fracture patterns in Tasmania, Australia. Australian Dental Journal, 2002;47(2): 131-137.
[23]. Laurentjoye M, Caix P, Lefebvre CM, Siberchicot F. Treatment of Mandibular Fractures With Michelet Technique: Manual Fracture Reduction Without Arch Bars. J Oral Maxillofac Surg. 2009;67:2374–2379.
[24]. Ghodke MH, Bhoyar SC, Shah SV. Prevalence of mandibular fractures reported at C.S.M.S.S Dental College, Aurangabad from February 2008 to September 2009. J Int Soc Prevent Communit Dent. 2013;3:51-8.
[25]. Benjamin A, Sara KE, Olushola AI. Analysis of complication of mandibular fracture. Afr J Trauma. 2014;3:24-9.
[26]. Oginni FO, Ugboko VI, Ogundipe O, Adegbehingbe O. Motorcycle- related maxillofacial injuries among Nigerian intracity road users. J Oral Maxillofac Surg. 2006;64:56- 62.
[27]. Hinds E.C. and W. J. Girotti. Vertical subcondylar osteotomy: a reappraisal. Oral Surg Oral Med Oral Pathol 1967; 24(2): 164-170.
[28]. Ellis E 3rd. Complications of mandibular condyle fractures. Int J Oral Maxillofac Surg. 1998;27(4):255-7. doi: 10.1016/s0901-5027(05)80506-5.
[29]. Meyer C, Zink S, et al. Clinical experience with osteosynthesis of subcondylar fractures of the mandible using TCP plates. J Craniomaxillofac Surg. 2008;36(5):260-268.
[30]. Ellis III E, Simon P, Throckmorton GS. Occusal Results after open or closed treatment of fractures of the mandibular condylar process. J Oral Maxillofac Surg. 2000;58:260–8.
[31]. Buschang, P. H., G. S. Throckmorton, et al. (2001)."Incisor and mandibular condylar movements of young adult females during maximum protrusion and lateral protrusion of the jaw." Arch Oral Biol 46(1): 39-48.