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Original Research Article

High velocity mandible fracture and treatment outcomes- our experience

Richa Garg[1], Achin Pant[2], Shahzad Ahmad[3], Bhavini Jain[4].

[1]Senior Resident, Dept. of ENT- Head and Neck surgery, AIIMS Gorakhpur, Uttar Pradesh, India

[2]Assistant professor, Dept. of ENT-Head and Neck surgery, GMC Haldwani, Uttarakhand, India

[3]Associate professor, Dept. of ENT-Head and Neck surgery, GMC Haldwani, Uttarakhand, India

[4]Junior Resident, Dept. of ENT-Head and Neck surgery, GMC Haldwani, Uttarakhand, India.

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Corresponding author: Richa Garg
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Abstract:

Aims: This study was carried out to estimate the pattern of mandible fracture following high velocity injury to the face and the treatment with their associated complications.

Material and Methods: The present prospective cohort study included 58 total no. of patients with 74 no. of fractures among individuals 20-40years with high velocity injury. Methods of management included detailed clinical assessment with radiographic scans including orthopantomographs and computed tomographs along with combination of soft diet, maxilla-mandibular fixation, open reduction and internal fixation.

Results: This prospective cohort study includes 58 individuals with 74 mandible fracture sites, following high frequency injury to jaw. Most frequent fractures found in our study individuals were fracture body parasymphysis of mandible 26(35%), followed by fracture condyle 22(30%), angle of mandible fractures 14(19%), mandibular symphysis 10(13%), ramus of mandible 2(3%). Among surgically managed patients (45), malunion was observed in 6 (13%) and non-union in 1 (2%) while among patients managed non-surgically/conservatively (23), malunion was observed in 7 (30%), non-union in 2 (9%).

Conclusion: We compared the pattern of mandibular fracture following high velocity facial injuries with maximum incidence of parasymphysial fracture. Higher incidence of right sided fractures was observed.

Our study also shows associated complicatios both pre and post definitive treatment, need for surgical and nonsurgical treatment in different types of mandible fractures.

Keywords: Mandible fractures, Mandible body, Condyle, High velocity injury, Road Traffic Accidents.

Introduction

Mandible is a parabolic bone with a complex articulation. Mandibular fractures are the third most common type of facial fractures, after fractures of the nose and cheekbone. Maxillofacial fracture patterns vary in different geographical areas based on their social conditions, laws and individual behaviour limiting researchers to

international comparisons. Fractures frequently occur at potentially week points of the bone where the bone is relatively thin. The angles of mandible may be weakened by un-erupted wisdom teeth, parasymphysis by the long root of the canine teeth and the condyle due to its slender anatomy. It is also common for mandible to fracture at multiple sites.

If not treated in a timely manner, these fractures can lead to serious, sometimes life-threatening outcomes including: Airway blockage, Bleeding, aspiration, Difficulty eating, Difficulty talking, Infection of the jaw or face, TMJ pain and other problems, Numbness of part of the jaw, Problems aligning the teeth.

Aim of treatment in mandibular fractures is to restore masticatory function by maintaining denture occlusion and acceptable cosmesis. Conservative and surgical management are considered based on site, type of injury and patient preferences. On one hand the surgical treatment has inherent anatomical complication hazards and economically costlier, non-surgical treatment has less morbidity, but may be associated with poor long term functions of malocclusion, decreased mouth opening and poor achievement of dental occlusion [1]

Epidemiological studies are important to know the trauma burden, which will help in knowing trauma load, help healthcare providers for a better approach in making treatment algorithm. This study aims to identify changing trends of epidemiology following high velocity injuries, results for surgical treatment with open reduction and internal fixation of mandibular fractures and outcomes of surgical and non-surgical treatment.

Material and Methods

Study design and sample:

The present prospective cohort study included 58 total no. of patients with 74 no. of fractures among individuals 20-40years with high velocity injury, presenting to out-patient department of Oto-rhino-laryngology and department of dentistry between May 2022 to April 2024. The research protocol was approved by the Institutional Ethics Committee governing the use of human participants in clinical experimentation.

Operative procedures were performed to the fractures of body, angle and symphysis of mandible according to their characteristics. Fracture condyle and subcondyle with undisplaced fractures were managed conservatively, displaced fractures with gross functional inability were referred to higher facilities. The post management parameters included healing prognosis, complication rates in terms of non-union vs malunion, nerve damage with paraesthesia or anaesthesia of dermatomal site and patient satisfaction post treatment. The follow-up was done for 6 weeks post definitive treatment.

Inclusion Criteria

1. Age 20-50years.
2. High velocity trauma in the form of road traffic accidents.
3. Individuals without major intracranial or multisystem complications.

Exclusion Criteria

1. Individuals with metabolic bone pathologies.
2. Insufficient dentition to restore normal occlusion.
3. Patient not willing to get treatment or not willing for follow up.
4. Individuals with a history of temporo-mandibular joint dysfunctions.

A written informed consent was signed by patients involved in the study and procedure and possible complications were explained to patients undergoing surgical procedures.

All trauma patients were first evaluated and managed according to Advanced Trauma Life Support protocols. Detailed clinical history, complete clinical examination was

done. Radiographic scans including orthopantomographs and computed tomographs were taken. Preoperative investigations were performed on surgical candidates. Preoperative and intra operative photographs were taken. Clinical and radiological parameters were evaluated during follow-up visits-

1. Site of injury
2. Width of mouth opening
3. Displacement of occlusion line.
4. Malunion or non-union if any.

All these parameters were observed pre-operatively, 3days post operatively and at 4-6weeks post definitive treatment.

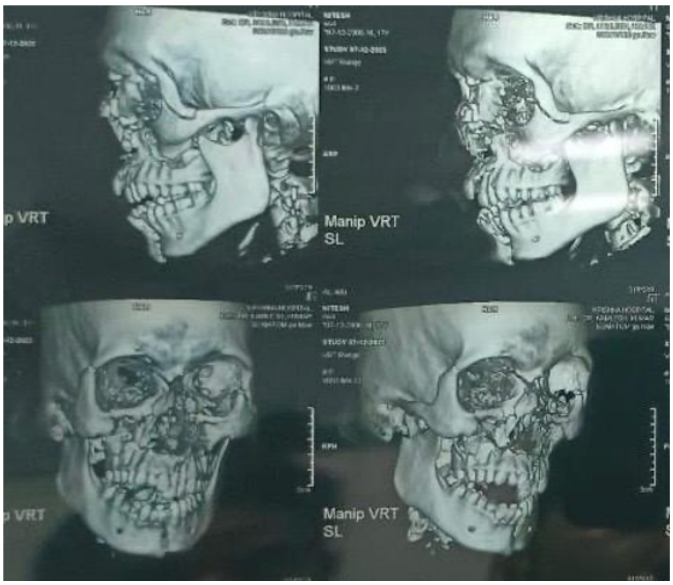

Photo:1: CT scan showing fracture symphysis of mandible

Procedures:

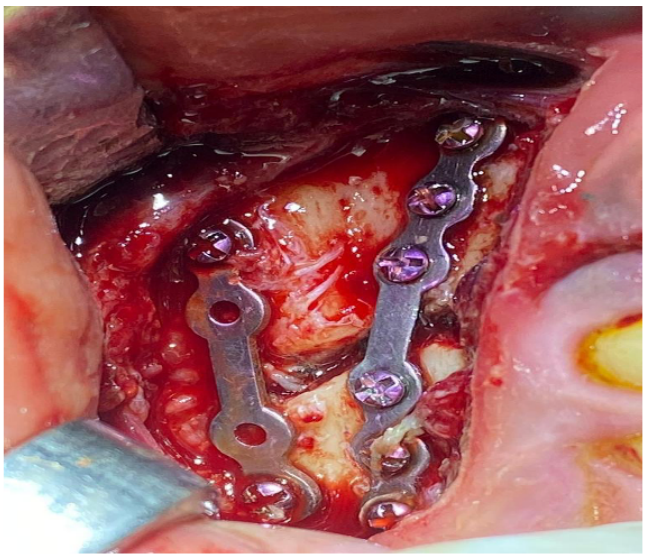

Photo:2: open reduction and internal fixation (ORIF) by titanium compression mini plates with bicortical locking screws

All the fractures of body, symphysis of mandible and displaced fractures of angle of mandible were treated surgically as open reduction and internal fixation (ORIF) by titanium compression mini plates with bicortical locking screws. ORIF was

performed post injury 5-10days after the post injury edema had subsided.

Undisplaced fractures of mandible condyle and subcondyle were managed with maxilla-mandibular fixation with elastic bandage around head and lower jaw, fixing moveable lower jaw to upper jaw for 2 weeks. While the displaced fracture individuals with or without temporomandibular joint dysfunction were referred to higher facilities.

Statistical analysis used

Descriptive and analytical statistics were calculated using Statistical Package for Social Sciences (SPSS) version 19). The Mann–Whitney U-test was used to assess the significance of the difference between the groups, whereas the Wilcoxon signed-rank test was used to assess the significance of the difference between the paired observations in each group.

Results

Table: 1: mandible fracture pattern

Site	No. of fractures	20-30 yrs	30-40 yrs	Frequency %	Right:left jaw	Closed:open fractures	Displaced: undisplaced fractures
Body/ parasymphysis	26	14	12	35%	17:9	10:16	21:5
Condyle	22	12	10	30%	14:8	22:0	6:16
Angle	14	7	7	19%	10:4	12:2	8:6
Symphysis	10	7	3	13%	-	4:6	8:2
Ramus	2	0	2	3%	1:1	2:0	0:2
Total	74	40	34	100%	42:22	50:24	43:31

"Chi-Square Test Results for Mandible Fracture Patterns"

Comparison	Chi-Square Value	Degrees of Freedom	p-value	Significant (α=0.05)
Age Group vs. Fracture Site	2.68	4	0.612	No
Closed vs. Fracture Site	51.58	4	<0.001	Yes
Displaced vs. Fracture Site	29.13	4	<0.001	Yes

Table:2: Definitive treatment of mandibular fracture-

Site of injury	Period of commencement of treatment	surgical vs non surgical treatment
Body/parasymphysis	7-10days	23:3
Condyle	0-4days	0:16
Angle	7-10days	10:4
Symphysis	7-10days	10:0
Ramus	7-10days	2:0
Total		45:23

Chi-Square Test Results for Mandibular Fracture Treatment				
Comparison	**Chi-Square Value**	**Degrees of Freedom**	**p-value**	**Significant (α=0.05)**
Treatment Type (Surgical vs. Non-Surgical) vs. Site of Injury	43.38	4	<0.001	Yes

Table:3: complication rates post definitive treatment

		Surgically managed	**Non surgically managed**	**Total**
Abnormal healing	Malunion	6 (13%)	7 (30%)	13
	Non union	1 (2%)	2 (9%)	3
Nerve damage	Temporary	9 (20%)	7 (30%)	16
	permanent	2 (4%)	2 (9%)	4
Inflammatory complications		0	0	

Chi-Square Test Results for Complication Rates Post Definitive Treatment				
Comparison	**Chi-Square Value**	**Degrees of Freedom**	**p-value**	**Significant (α=0.05)**
Complication Rates (Surgical vs. Non-Surgical) vs. Management Type	0.66	3	0.883	No

Table:4: Post definitive treatment status of mandibular fracture

Site	**Total no. of fractures**	**Malunion**	**Non union**	**Temporary Nerve damage**	**Permanent Nerve damage**	**Mouth opening Pre treatment (mm)**	**Mouth opening Post treatment (mm)**	**Chi-square value**	**P value**
Body	26	4	2	12	4	8	36	5.991	0.05
Condyle	22	4	0	2	0	4	30	9.488	0.01
Angle	14	2	1	2	0	5	36	7.815	0.03
Symphysis	10	2	0	0	0	10	40	4.605	0.02
Ramus	2	1	0	0	0	24	38	3.841	0.04

Duration of commencement of definitive treatment was 7-10days post injury in cases of surgical management due to encountered facial edema post injury. Undisplaced condylar fractures were managed conservatively by maxillo-mandibular fixation using elastic bandage for a duration of minimum 2 weeks.

Mandible fracture sites were body/ parasymphysis of mandible 26(35%), condyle 22(30%), angle of mandible fractures 14(19%), mandibular symphysis 10(13%) and fracture ramus of mandible 2(3%). Individuals among age group 20-30yrs encountered more no. of mandibular fractures compared to individuals among 30-40yrs of age group which had a Chi-square value of 2.68 which was not significant (p-value=0.612). Right jaw fractures were comparatively more than left jaw fractures with a ratio of 42:22. Closed fractures were more frequently encountered compared to open type of fractures with a ratio of 50:24. Closed fractures were common on angle and condyle of mandible compared to other sites with Chi-Square value of 51.58 for all mandibular fracture sites which was a significant (p-value < 0.001). Displaced to undisplaced fractures ratio was 43:31 and displaced fractures were more common on symphysis and parasymphysis with Chi-square value of 29.13 for different mandible fracture sites which is significant (p-value <0.001). Condyle fractures were mostly undisplaced with a ratio of displaced to undisplaced fractures was 6:16. [Table 1& 2]

Parasymphysial fractures were treated by surgical approach with surgical to non-surgical ratio of 23:3 while angle of mandible fracture surgical to non-surgical treatment ratio was 10:4. All symphysial fractures needed surgical treatment along with all the ramus of mandible fractures. For the treatment type and site of injury the Chi-Square ratio was 43.38 with p-value <0.001 which was significant.

Abnormal bone healing after fracture definitive management in 68 fractures was observed in 16 patients with malunion in 13 and non-union in 3 patients. Among surgically managed patients (45), malunion was observed in 6 (13%) and non-union in 1 (2%) while among patients managed non-surgically/conservatively (23), malunion was observed in 7 (30%), non-union in 2 (9%). Complications were more frequently encountered in non-surgically treated individuals, the Chi- Square values were 0.66 with p-values 0.883 which was not significant. [Table 3]

Out of 26 parasymphysial fractures 5 presented with malunion 6 weeks following treatment while non-union was observed in 2. Among condylar fractures 4 had malunion and none were observed to have non-union. Among Angle of mandible fractures, 2 had malunion and 1 had non-union. Only 2 individuals with symphysial fracture presented with malunion while 1 ramus fracture had malunion. Temporary nerve damage was observed among 12 individuals with fracture body of mandible, 2 individuals with fracture condyle and 2 individuals with angle of mandible fracture. While permanent nerve damage was observed among 4 individuals with fracture body of mandible. [Table 4]

Discussion

In our study we studied individuals with high velocity injury with mandibular fractures with or without associated facial fractures. We emphasized on the extent of mandible fracture and their frequency in different age groups following high velocity injuries.

Operative evaluation is typically preferred for mandibular body fractures given unfavorable pull of the fracture line from masticatory muscles making these fractures more unstable and easily displaced at the time of presentation [2]. This was found comparable in our study as well.

Gaelen Stanford et al in their study on mandible angle fracture reported that uncomplicated fracture angle of mandible can be managed by single monocortical miniplates, however complicated and comminuted fractures require more rigid fixation. In our study we have also observed that uncomplicated fractures of mandible without displacement or minimal displacement could be managed either conservatively or by single monocortical miniplate while displaced fractures with tooth loss and unstable fractures require thick plates and more

than 1 miniplate for fixation and to avoid complications [3].

Elie M et al in their study on mandibular fractures stated that treatment of the fractures jaw depends on location of injury and severity of injury. Minor fractures can be managed by conservative management; surgical treatment is required for moderate to severe fractures. Lower jaw may be needed to fix with upper jaw for 4-6 weeks to immobilize fracture sites. We have also followed similar management strategy and observed good results with jaw fixation in cases of undisplaced and uncomplicated fractures for 3-4 weeks while complicated/ displaced fractures of mandible, were treated by surgical fixation with bicortical miniplates with locking screws [4].

Cameron C et al in their study to observe inflammatory complications among mandibular fractures managed outpatient had observed some inflammatory complications both in electively planned surgery for mandible fracture and emergency management with non-significant increase in inflammation among emergency management individuals. Post surgical inflammation was not observed in any of the study individuals in our study. However, we have only performed elective surgical procedure after 7-10days post injury. This gives advantage of treating open injury site contamination as well improving general health before operative procedure and edema subsides[5].

Zimmermann et al in their paper on review of mandible fracture in cattle stated that surgical management of selected mandibular fractures had a favourable prognosis. This inference is also true in our paper where complication rates are less in surgically operated patients [6].

Hamad ebrahim et al in their study on pattern of maxillofacial fractures among 20-29years individuals observed maximum mandibular fractures in condyle (23%), followed by angle of mandible (20%). However, in our study of high velocity injury among 20-50 years individuals, maximum mandibular fractures occurred in body/ parasymphysis (35%), followed by fracture condyle (30%), followed by angle of mandible fractures (19%), with symphysial fractures in (13%) and ramus fractures in (3%). This difference in epidemiology of fracture may be due to velocity of trauma, status of mandible, ethnicity and traffic rules [7].

Chris Singleton et al in their retrospective study on mandibular fractures observed most mandibular fractures on left side compared to right. While in our study most of the mandibular fractures were observed on right side with a ratio of 42:22. This difference may be due to difference in traffic rules and road laws in case of fractures following road traffic injuries [8].

There were no definite changes observed with seasonal variations in facial injuries following road traffic accidents. However more injuries were observed on Saturdays and Sundays, probably due to increased public activities during holidays with more incidence of accidents.

Geographical and mode of injury related variations exist in mandible fracture. A great no. of angle of mandible fractures occur in interpersonal violence [7].

However condylar fractures were observed more in children following injuries after falls due to collision to the chin point [9].

While road traffic accidents were said to be more common cause of body/ anterior mandibular fractures.

This is comparable to our study where we have observed body/ parasymphysis fractures to be the more common mandibular injury following high velocity impact after road traffic accidents [10].

Nerve injury following mandibular fracture were commonly encountered with body of mandible fracture which was associated with inferior alveolar nerve, also the fracture parasymphysis were commonly

associated with mental foramina. It is due to comparatively weak bone on this site.

Conclusions and significance

Most common mandible fracture site following high velocity facial injury was observed to be mandible body/ parasymphysis, followed by condylar fracture, angle of mandible fractures, symphysial fractures with the least fracture site being the ramus. We observed Right sided mandible fractures more frequent compared to left side. This study also emphasizes that though the surgical management with open reduction and internal fixation provides early and better rehabilitation for mandible fractures with less bone reunion problems, non-surgical management with partial/temporary immobilization can be tried in uncomplicated and undisplaced mandibular fractures with slightly more incidence of bone reunion problems.

Further detailed studies are needed with more sample size, comparison between different cause of mandible fractures to the pattern of fracture and associated complications.

This study included young individuals among 20-40yrs of age group with non-diseased mandible/ bones on clinical and radiological examination and who underwent high velocity facial injury, making the study group more comparable in terms of age group and selected cause of fracture for better understanding.

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