Type of Study: *Retrospective Study*

Comparison of Open Vs Closed Reduction of Mandibular Angle Fractures-A Retrospective Institutional based Study

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Abstract

Fractures of the mandible, particularly in the angle region have been found to have a high incidence. Clinical and radiographic examination along with the basis of displacement help to decide the treatment modality for these fractures. Open reduction is generally performed when there is significant deviation and closed reduction for simple fractures. The most common modality being Open Reduction with Internal Fixation(ORIF). The aim of the study is to compare Open Vs closed reduction in patients with fracture in the angle region of the mandible. This retrospective study involved a sample size of 18 patients with mandible fracture in the angle region. Case records were collected, tabulated and imported to SPSS for statistical analysis. Descriptive statistics and chi-square tests were adopted for association of various parameters. Angle fractures were most commonly seen in males(89%) than females. RTA and assault were the most common reason for trauma caused - 39% & 33% respectively. 89% of the treatment done was through open reduction with majority being treated by internal fixation(94%). Angle fracture management depends upon the severity of the displacement to decide the method of reduction and type of stabilisation. Open reduction with internal fixation was the most common treatment adopted in this study .

Keywords: *Open reduction, Closed reduction, Internal fixation, Angle fracture*

Introduction

There has been an increased trend of fractures of mandibles in the recent past. Among these, the most common site affected is the angle region of the mandible.[1] Mandible fractures occupy the second most frequent incidence in facial traumas with an incidence of 38%. [2]. Another study showed the incidence of 63.8% of the maxillofacial traumas affecting the mandible.[3] The etiology of fracture is very much related to the site of the mandible. The angle region of the mandible is a thinner cross sectional area bearing third molars and is considered to be the 'lever' area.[4,5] The reason behind these fractures is most frequently due to Road Traffic Accidents (RTA)[6], assault or interpersonal violence. Increased incidence of this happening in the urban region suggests that people do not tend to follow safety rules and regulations for their protection. This negligence and carefree attitude leads to accidents. The most prone are the youngsters who are often under the influence of alcoholism. [7]

Diagnosing the types of mandibular fractures in the correct site is very essential. Detailed history of the

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trauma occurrence, clinical examination,[8] radiographic examination guide for most effective treatment planning. The most useful for radiographic examination are the panoramic radiographs and tomography sometimes.[9] The management of these fractures are often influenced by several factors. They are associated with occlusal disharmony, pain, edema, laceration of soft tissue, hematoma, deviation of jaw, pain on mastication and while opening and closing of the mouth. [10,11]

Fracture management classified on the basis of method of reduction is dealt as open or closed reduction. Open reduction can further be subclassified as rigid or non-rigid fixation. Angle fractures are generally treated by an open reduction method. Open reduction is performed when there is significant deviation of the jaw, communitive fracture and instability. Closed reduction is preferred when it's a simple fracture with not much deviation and less severe [12]. Displacement of the jaw can influence the dimension of the airway at all levels[13]. Champy et al, while performing several investigations suggested that the most effective management of angle fractures is that plate location should be along the superior border of the mandible [14,15,16]

The most common modality used is the internal fixation. Open reduction and rigid internal fixation bring back the normal function, show easier maintenance and functional/ anatomical reduction with immobilization of the fracture.[17] However there arises complications which range from 7.5%-29% and is due to the use of compression and two points of fixation. Infection and malocclusion have shown to have high in the list of complications.[18] These can be reduced only when there are certain protocols developed. Extensive blood loss is also a complication in various surgical procedures which can be reduced with the help of pharmacological agents.[19] Post operative pain is reduced by prescribing NSAIDs like Ketorolac or Paracetamol which have been proven to be very effective.[20] Post operative care is also of importance for effective wound healing. BTX injections have been proved to assist wound healing of the facial laceration and also obtain good immobilization.[21] It has become difficult to determine the actual rate of complications of angle fractures because there are very few studies to this focus. Quality and quantity of post surgical care has to be similar in all regions of the world. [22] Previously, our team had conducted numerous clinical trials[23], in vitro & lab animal studies and reviews[24,25] over the past 5 years and now we are focussing on epidemiological surveys. The idea for this survey stemmed from the current interest in our community.

The aim of the study was to compare open and closed reduction in patients treated for mandibular fractures in the angle region. Method of fixation was also noted in order to acquire knowledge on the most effective one.

Materials and Methodology

Study Setting

This is a retrospective study of patients with Angular Mandible Fractures. It revolves around a university setting study having patients visiting Saveetha Dental College and Hospitals. The approval for this study was given by the Institutional Ethical Committee (Ethical Approval Number - SDC/SIHEC/2020/DIASDATA/0619-0320). The sample size for this study was 18 patients having mandible fracture pertaining to angle region. Sampling bias was minimized by verifying the photographs.

Data Collection and Tabulation

Retrospective data of 86,000 patients between June 2019 and March 2020 were retrieved and the patient records were reviewed and analysed for overall patients reported with maxillofacial trauma . The datas pertinent to the present topic were extracted from the overall data collected and tabulated. Tabulation included information/ parameters like Name of the patient, Age, Gender, Etiology of the fracture, method of reduction- open/closed reduction, type of fixation- internal fixation/ IMF.

Statistical Analysis

After further verification of data by an external reviewer, it was imported to the SPSS software by IBM for statistical analysis. Percentages, mean, frequency of certain parameters were employed in the analysis. Chi-square test was used to detect the significance between open/closed reduction and type of fixation. p value <0.05 was considered to be statistically significant.

Results and Discussion

The following are the results obtained from the analysis – It was seen that there were 16 male and 2

females affected.(Table 2) The cause of the fracture was mainly due to Assault and RTA with 38.9% and 33.3 respectively. Other reasons include work injury and trauma(Table 1). The major finding of this study was to compare open/closed reduction and it is shown that incidence of open reduction(88.9%) was extremely high when compared to closed reduction(11.1%)(Table 3). When focussing on the type of fixation, it was seen that 94.4% was by internal fixation and only 5.6% accounting for IMF (Table 4). Crosstabulation as shown in Table 5 to find the association between method of reduction and type of fixation using Chi-square tests revealed a significant result (p value < 0.05). This explains that open reduction with internal fixation was found to be high and very few were with IMF. The descriptive statistics and association is represented in the form of tabulations and bar graphs below-

Table 1- This table shows the number and percentage distribution of etiology of mandible fracture. The two most common reason for mandible angle fracture is Assault(38.9%), RTA (33.3%) and the least common is work injury(5.6%)

Etiology	Number of Patients	Percentage (%)
RTA	6	33.3
Assault	7	38.9
Trauma	4	22.2
Work Injury	1	5.6
TOTAL	18	100.0

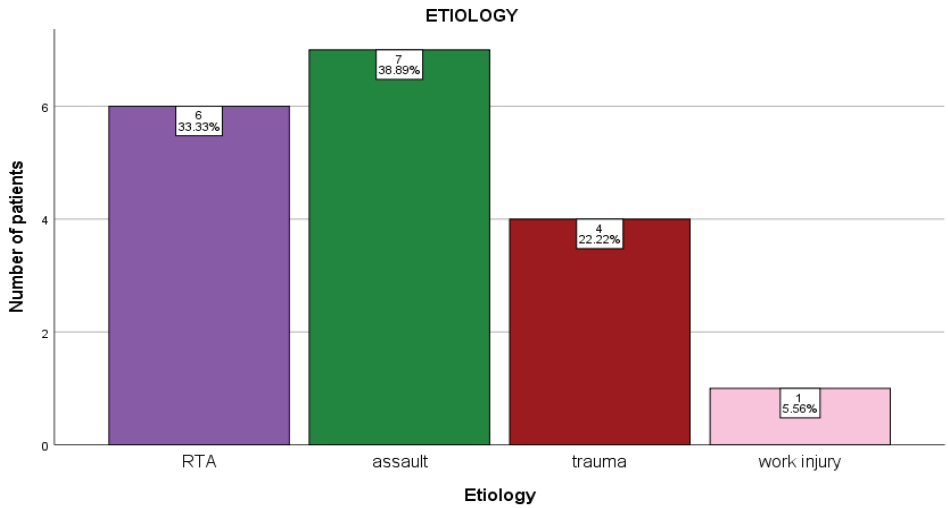

Figure 1- This graph shows distribution of various causes leading to mandible fracture in the angle region where X axis denotes Etiology and Y-axis denotes the number of patients. Violet colour denotes RTA, green denotes assault, brown denotes trauma and pink denotes work injury.. It shows that the two most common reasons for mandible fracture in the angle region are assault(38.9%)and RTA(33.3%).

Table 2- This table shows the number and percentage distribution of gender variation of patients with mandible fracture. It shows that males are more affected(88.9%) than females(11.1%).

	Number of Patients	Percentage (%)
Male	16	88.9
Female	2	11.1
TOTAL	18	100.0

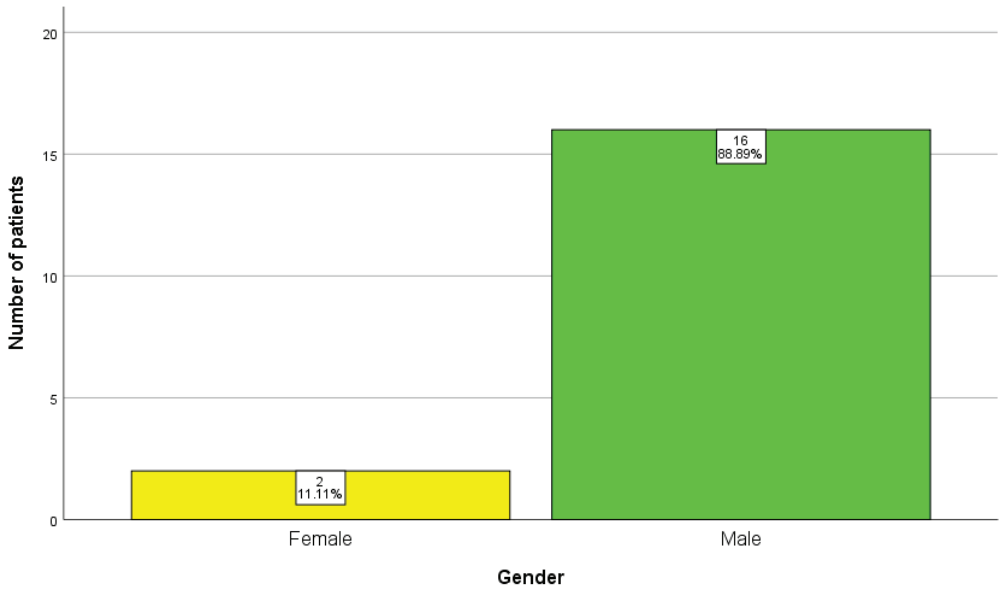

Figure 2 - This graph shows the number distribution of gender variation of patients with mandible fracture in the angle region where the X axis denotes gender and Y-axis denotes the number of patients. Yellow colour denotes female patients, green denotes male patients. It shows that males are more affected(88.9%) than females(11.1%).

Table 3 - This table shows the number and percentage distribution of the method of reduction adopted for treating the fracture. It shows that open reduction is more commonly adopted(88.9%) than closed reduction (11.1%).

	Number of Patients	**Percentage (%)**
Closed Reduction	2	11.1
Open Reduction	16	88.9
TOTAL	18	100.0

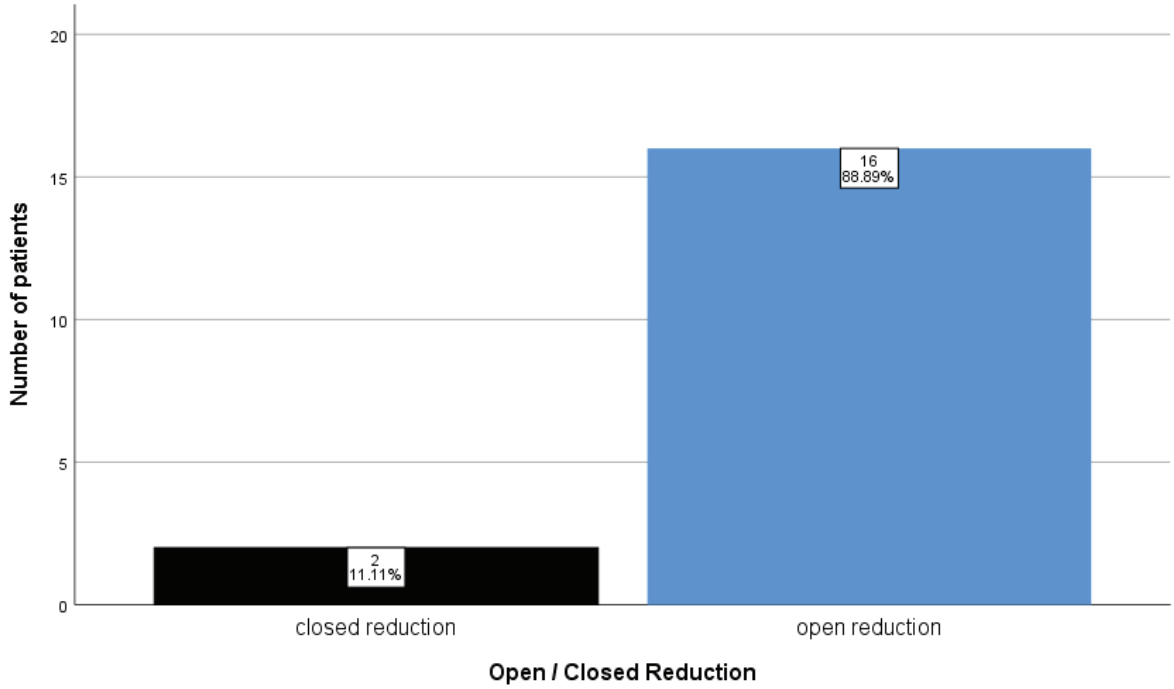

Figure 3 - This graph represents the number distribution of the method of reduction adopted for treating the fracture where X axis denotes type of reduction and Y-axis denotes the number of patients. Black colour denotes closed reduction and blue denotes open reduction. The graph shows that open reduction is more commonly adopted(88.9%) than closed reduction (11.1%).

Table 4- This table shows the number and percentage distribution of the type of fixation adopted for treating the fracture. The most commonly adopted type of fixation is internal type of fixation(94.4%) whereas IMF accounting for 5.6% only.

	Number of Patients	Percentage
Internal Fixation	17	94.4
IMF	1	5.6
TOTAL	18	100.0

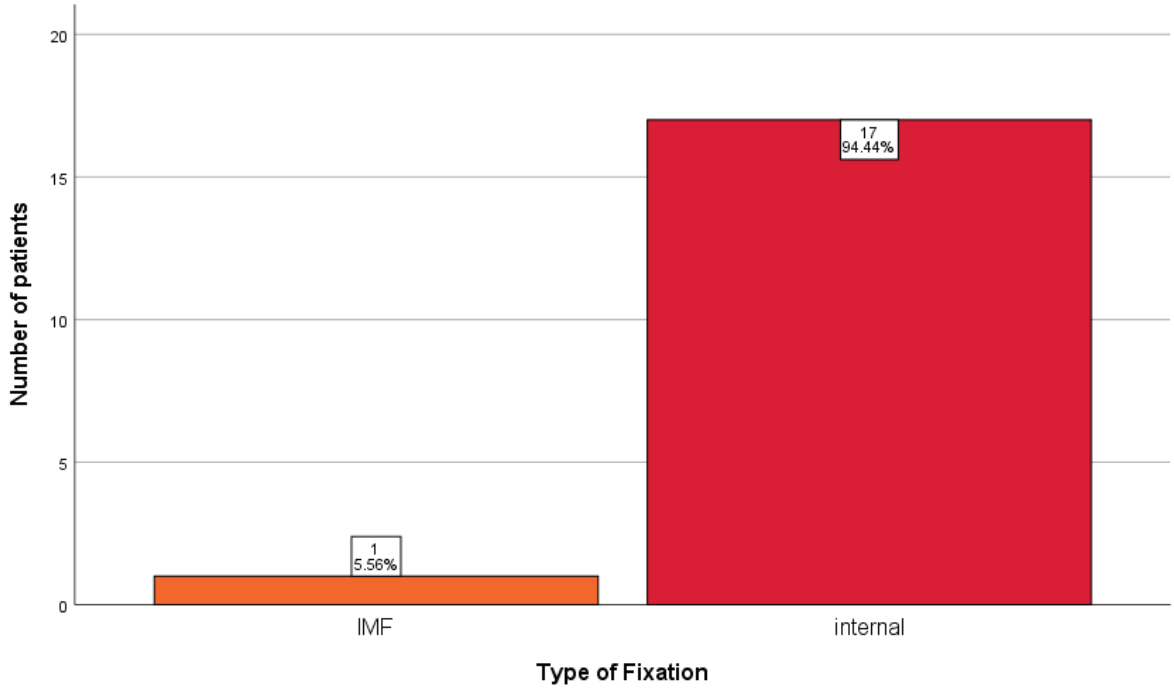

Figure 4- This graph represents the number distribution of the type of fixation adopted for treating the fracture where X axis denotes type of fixation and Y-axis denotes the number of patients. Orange colour denotes Intermaxillary Fixation (IMF) and red denotes Internal fixation. The graph shows that the most commonly adopted type of fixation is internal type of fixation(94.4%) whereas IMF accounting for 5.6%.

Table 5 - This table shows the association of method of reduction and type of fixation. Chi-square-statistically significant - p value - 0.004 (< 0.05).

	Value	df	Asymptotic Significance(2-sided)	Exact Significance (2-sided)
Pearson Chi-square	8.471	1	0.004	
Continuity Correction	1.621	1	0.203	
Likelihood Ratio	4.952	1	0.026	
Fisher's Exact test				0.111
N of Valid Cases	18			

The mandible,a single bone connecting to skull by temporomandibular joint is responsible for functions like mastication, phonation, swallowing and occlusal harmony[26] Since the mandible arch is open, located in the lower portion of face, it is more prone to road traffic accidents and interpersonal violence[27]. Studies have shown that assault and Road Traffic Accidents are considered to be the primary causes of mandible fractures. High incidence of Road Traffic Accidents could be attributed to poor road conditions, speed limit violation, drunk and drive and no proper safety measures being taken while driving[3].

Our study shows that the main etiology behind fractures was primarily due to assault(38.9%) and RTA (33.3%) as shown in Figure 1. Few others were due to trauma, interpersonal violence or a work injury. The proportion of males being affected was extremely higher than females. As seen in Figure 2, males are about 8 times more affected than females which is in agreement with a study where there was male predominance as well [28,29]. Male predominance is due to the fact that they are more easily prone to road traffic accidents, interpersonal violence often influenced with alcoholism [3,30].

The various sites of mandibular fractures include angle, condyle, symphysis region etc. wherein angle region being the most common region. Complete clinical history is very essential for the diagnosis of the fracture. Radiological evidence like orthopantogram and CT scans favour in diagnosing and give us a clear view of the extent of fracture[31].

Incidence of open or closed reduction as a treatment modality has been determined in this study. Figure 3 shows that the percentage of open reduction of mandibular angle fracture is 89%. Other literature studies also are in support of increased open reduction as the adopted treatment modality[9]. They have different approaches to treat and are often associated with complications such as sepsis or infection commonly seen in angle fractures of the mandible. Rate of infection ranges from 5% - 32% with angle fractures and can sometimes be associated with grossly carious and periodontally involved teeth which have to be extracted[12].

The main aim of closed or open reduction treatment in mandibular angular fracture is to establish functional harmony [2]. Open reduction Internal Fixation(ORIF) in mandibular angle fracture shows greater prevailing treatment modality accounting 94% in our study. Association of method of fixation and reduction revealed that open reduction is generally adopted with internal fixation.[3]

Closed reduction or Inter Maxillary Fixation(IMF) is least adopted (Figure 5) among prevailing modality of fixation in mandibular angle fracture. The ORIF is more advantageous over IMF,as ORIF brings back the mandibles anatomy and functions effectively with early postoperative recovery,which is in concordance with other studies. [3,17] It necessitates for even more development in this modality otherwise lack of skills and knowledge leads to non adherence of these procedures[32].

The limitations of the study is that it includes a very small sample size, single centered and completely relies on inpatient records for the analysis. The results are compromised in a retrospective manner and providing treatment recommendations based on such a small sample size is challenging. Therefore, a well designed, extensive study should be done in the near future to implicate the result of those studies in clinical practise.

Conclusion

Within the limits of the present study, open reduction with internal fixation(ORIF) was found to be adopted as the common treatment modality in patients with mandible fractures in the angle region. The fracture showed more prevalence in males and the most common etiology was found to be assault and road traffic accidents(RTA).With this small sampled retrospective study it is difficult to implicate the result of this study into maxillofacial operating criterias. .Hence a large sized multicentered randomized control trial should be done to to generalise the outcome of this study

Conflict of Interest: The authors declare no conflict of interest.

Acknowledgement: We would like to thank our statistician for helping in preparing various statistical parameters of this manuscript. The authors are also thankful to Saveetha Dental College for providing a platform to express our knowledge.

Source of Funding : Self

Ethical Clearance: It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

References

1. Rix L, Stevenson AR, Punnia-Moorthy A. An analysis of 80 cases of mandibular fractures treated with miniplate osteosynthesis. Int J Oral Maxillofac Surg [Internet]. 1991 Dec;20(6):337–41. Available from: http://dx.doi.org/10.1016/s0901-5027(05)80261-9
2. Patrocínio LG, Patrocínio JA, Borba BHC, Bonatti BDS, Pinto LF, Vieira JV, et al. Mandibular fracture: analysis of 293 patients treated in the Hospital of Clinics, Federal University of Uberlândia. Braz J Otorhinolaryngol [Internet]. 2005 Sep;71(5):560–5. Available from: http://dx.doi.org/10.1016/s1808-8694(15)31257-x
3. Abhinav RP, Selvarasu K, Maheswari GU, Taltia AA. The Patterns and Etiology of Maxillofacial Trauma in South India. Ann Maxillofac Surg [Internet]. 2019 Jan;9(1):114–7. Available from: http://dx.doi.org/10.4103/ams.ams_233_18
4. Schubert W, Kobienia BJ, Pollock RA. Cross-sectional area of the mandible. J Oral Maxillofac Surg [Internet]. 1997 Jul;55(7):689–92; discussion 693. Available from: http://dx.doi.org/10.1016/s0278-2391(97)90577-2
5. Jesudasan JS, Abdul Wahab PU, Muthu Sekhar MR. Effectiveness of 0.2% chlorhexidine gel and a eugenol-based paste on postoperative alveolar osteitis in patients having third molars extracted: a randomised controlled clinical trial [Internet]. Vol. 53, British Journal of Oral and Maxillofacial Surgery. 2015. p. 826–30. Available from: http://dx.doi.org/10.1016/j.bjoms.2015.06.022
6. Barde D, Madan R, Mudhol A. Prevalence and pattern of mandibular fracture in Central India [Internet]. Vol. 5, National Journal of Maxillofacial Surgery. 2014. p. 153. Available from: http://dx.doi.org/10.4103/0975-5950.154818
7. Kumar S. Relationship between Dental Anxiety and Pain Experience during dental extractions [Internet]. Vol. 10, Asian Journal of Pharmaceutical and Clinical Research. 2017. p. 458. Available from: http://dx.doi.org/10.22159/ajpcr.2017.v10i3.16518
8. Packiri S, Gurunathan D, Selvarasu K. Management of Paediatric Oral Ranula: A Systematic Review. J Clin Diagn Res [Internet]. 2017 Sep;11(9):ZE06–9. Available from: http://dx.doi.org/10.7860/JCDR/2017/28498.10622
9. Paza AO, Abuabara A, Passeri LA. Analysis of 115 mandibular angle fractures. J Oral Maxillofac Surg [Internet]. 2008 Jan;66(1):73–6. Available from: http://dx.doi.org/10.1016/j.joms.2007.05.025
10. Mathews BL. Oral and maxillofacial trauma. Edited by Raymond J. Fonseca and Robert V. Walker, WB Saunders, Philadelphia, 1991, 1360 pp, $275.00 [Internet]. Vol. 14, Head & Neck. 1992. p. 80–80. Available from: http://dx.doi.org/10.1002/hed.2880140120
11. Marimuthu M, Andiappan M, Wahab A, Muthusekhar MR, Balakrishnan A, Shanmugam S. Canonical Wnt pathway gene expression and their clinical correlation in oral squamous cell carcinoma [Internet]. Vol. 29, Indian Journal of Dental Research. 2018. p. 291. Available from: http://dx.doi.org/10.4103/ijdr.ijdr_375_17
12. Ellis E 3rd, Sinn DP. Treatment of mandibular angle fractures using two 2.4-mm dynamic compression plates. J Oral Maxillofac Surg [Internet]. 1993 Sep;51(9):969–73. Available from: http://dx.doi.org/10.1016/s0278-2391(10)80036-9
13. Jain SV, Vijayakumar Jain S, Muthusekhar MR, Baig MF, Senthilnathan P, Loganathan S, et al. Evaluation of Three-Dimensional Changes in Pharyngeal Airway Following Isolated Lefort One Osteotomy for the Correction of Vertical Maxillary Excess: A Prospective Study [Internet]. Vol. 18, Journal of Maxillofacial and Oral Surgery. 2019. p. 139–46. Available from: http://dx.doi.org/10.1007/s12663-018-1113-4
14. Champy M, Lodde JP, Muster D, Jaeger JH, Schmidt R. Biomechanical study of mandibular osteosynthesis [Internet]. Vol. 13, Journal of Biomechanics. 1980. p. 803. Available from: http://dx.doi.org/10.1016/0021-9290(80)90271-7
15. Champy M, Loddé JP, Schmitt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach [Internet]. Vol. 6, Journal of Maxillofacial Surgery. 1978. p.

14–21. Available from: http://dx.doi.org/10.1016/s0301-0503(78)80062-9

16. Pape H-D, Champy M, Gerlach KL. Tension osteosynthesis versus compression-osteosynthesis in the treatment of mandible fractures [Internet]. Vol. 26, International Journal of Oral and Maxillofacial Surgery. 1997. p. 58. Available from: http://dx.doi.org/10.1016/s0901-5027(97)81019-3
17. Jadhav A, Mundada B, Deshmukh R, Bhutekar U, Kala A, Waghwani K, et al. Mandibular Ramus Fracture: An Overview of Rare Anatomical Subsite. Plast Surg Int [Internet]. 2015 Nov 3;2015:954314. Available from: http://dx.doi.org/10.1155/2015/954314
18. Ellis E 3rd. Treatment of mandibular angle fractures using the AO reconstruction plate. J Oral Maxillofac Surg [Internet]. 1993 Mar;51(3):250–4; discussion 255. Available from: http://dx.doi.org/10.1016/s0278-2391(10)80166-1
19. Christabel A, Anantanarayanan P, Subash P, Soh CL, Ramanathan M, Muthusekhar MR, et al. Comparison of pterygomaxillary dysjunction with tuberosity separation in isolated Le Fort I osteotomies: a prospective, multi-centre, triple-blind, randomized controlled trial [Internet]. Vol. 45, International Journal of Oral and Maxillofacial Surgery. 2016. p. 180–5. Available from: http://dx.doi.org/10.1016/j.ijom.2015.07.021
20. Rao TD, Santhosh Kumar MP. Analgesic Efficacy of Paracetamol Vs Ketorolac after Dental Extractions [Internet]. Vol. 11, Research Journal of Pharmacy and Technology. 2018. p. 3375. Available from: http://dx.doi.org/10.5958/0974-360x.2018.00621.2
21. Kumar S. The emerging role of Botulinum Toxin in the treatment of Orofacial Disorders: Literature Update [Internet]. Vol. 10, Asian Journal of Pharmaceutical and Clinical Research. 2017. p. 21. Available from: http://dx.doi.org/10.22159/ajpcr.2017.v10i9.16914
22. Kumar S, Rahman R. Knowledge, Awareness, and practices regarding Biomedical Waste Management among Undergraduate Dental Students [Internet]. Vol. 10, Asian Journal of Pharmaceutical and Clinical Research. 2017. p. 341. Available from: http://dx.doi.org/10.22159/ajpcr.2017.v10i8.19101
23. Patil SB, Durairaj D, Suresh Kumar G, Karthikeyan D, Pradeep D. Comparison of Extended Nasolabial Flap Versus Buccal Fat Pad Graft in the Surgical Management of Oral Submucous Fibrosis: A Prospective Pilot Study. J Maxillofac Oral Surg [Internet]. 2017 Sep;16(3):312–21. Available from: http://dx.doi.org/10.1007/s12663-016-0975-6
24. Kumar S, Sneha S. Knowledge and Awareness regarding Antibiotic prophylaxis for Infective Endocarditis among Undergraduate Dental Students [Internet]. Asian Journal of Pharmaceutical and Clinical Research. 2016. p. 154. Available from: http://dx.doi.org/10.22159/ajpcr.2016.v9s2.13405
25. Kumar S. Knowledge, Attitude and Awareness of Dental Undergraduate Students regarding HIV/AIDS patients. Asian J Pharm Clin Res [Internet]. 2017 May 1;10(5):175. Available from: https://innovareacademics.in/journals/index.php/ajpcr/article/view/17277
26. Busuito MJ, Smith DJ, Robson MC. Mandibular Fractures in an Urban Trauma Center [Internet]. Vol. 26, The Journal of Trauma: Injury, Infection, and Critical Care. 1986. p. 826–9. Available from: http://dx.doi.org/10.1097/00005373-198609000-00008
27. Holt GR, Richard Holt G, Mattox DE. Fourth Annual Maxillofacial Trauma Workshop [Internet]. Vol. 72, Plastic and Reconstructive Surgery. 1983. p. 437. Available from: http://dx.doi.org/10.1097/00006534-198309000-00132
28. Olson RA, Fonseca RJ, Zeitler DL, Osbon DB. Fractures of the mandible: a review of 580 cases. J Oral Maxillofac Surg [Internet]. 1982 Jan;40(1):23–8. Available from: http://dx.doi.org/10.1016/s0278-2391(82)80011-6
29. Ellis E, Moos KF, El-Attar A. Ten years of mandibular fractures: An analysis of 2,137 cases [Internet]. Vol. 59, Oral Surgery, Oral Medicine, Oral Pathology. 1985. p. 120–9. Available from: http://dx.doi.org/10.1016/0030-4220(85)90002-7
30. Dongas P, Hall GM. Mandibular fracture patterns in Tasmania, Australia. Aust Dent J [Internet]. 2002 Jun;47(2):131–7. Available from: http://dx.doi.org/10.1111/j.1834-7819.2002.tb00316.x
31. Iizuka T, Lindqvist C, Hallikainen D, Paukku P. Infection after rigid internal fixation of mandibular fractures: A clinical and radiologic study [Internet].

Vol. 49, Journal of Oral and Maxillofacial Surgery. 1991. p. 585–93. Available from: http://dx.doi.org/10.1016/0278-2391(91)90340-r

32. Patturaja K, Pradeep D. Awareness of Basic Dental Procedure among General Population [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1349. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00258.4