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ASSESSMENT OF MAXILLOFACIAL FRACTURES ON CONE BEAM COMPUTED TOMOGRAPHY – AN OBSERVATIONAL STUDY

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ABSTRACT

Background - The study aimed to evaluate maxillofacial fractures involving specific bones and determine the extent of fracture lines using cone beam computed tomography.

Material and Method - This retrospective observational study analyzed Cone Beam Computed Tomography (CBCT) scans collected between January 2015 and December 2022 from the Department of Oral Medicine and Radiology, Vasantdada Patil Dental College and Hospital, Kavalapur, Sangli, and the Dentascan CBCT Center, Sangli. A minimum of 100 scans meeting the inclusion criteria were evaluated to ensure adequate data representation.

Result – The study analyzed 100 CBCT scans, revealing a male predominance (87%). Midfacial fractures (58%) were more common than mandibular (36%). Zygomatic complex was the most affected site, mostly unilateral. Mandibular fractures often involved multiple sites. Unilateral fractures were significantly more prevalent across both jaws ($p < 0.001$)

Conclusion – CBCT proved effective in evaluating maxillofacial fractures, with a higher incidence in males and predominant involvement of the midfacial skeleton, especially the zygomatic complex. Most fractures were unilateral. Mandibular fractures commonly affected multiple sites. The findings emphasize CBCT's value in accurate diagnosis and planning of maxillofacial trauma management.

KEYWORDS: Cone beam computed tomography, Maxillofacial fractures, Maxillofacial trauma, Facial bone fracture

INTRODUCTION

Trauma remains a major global health issue, with maxillofacial injuries being particularly significant due to their aesthetic, functional, and psychological impact1. Such injuries often lead to disfigurement, depression, anxiety, and social withdrawal, greatly affecting quality of life.2,3 Maxillofacial fractures occur predominantly in males under 35, largely due to high-risk behaviors. Geographic and socioeconomic factors also influence incidence rates.4 Understanding the demographic and etiological patterns of these injuries is vital for improving management, guiding preventive strategies, and optimizing resource allocation in healthcare.5,6

MATERIALS AND METHOD

This retrospective study analyzed CBCT scans collected between January 2015 and December 2022 from Vasantdada Patil Dental College and Dentascan CBCT Center, Sangli. A minimum of 100 eligible scans were evaluated to identify trends and patterns in maxillofacial fractures using previously recorded diagnostic imaging.

RESULTS

The present study was carried out in department of oral medicine and radiology of our institute. The purpose of this study was to evaluate the accuracy of cone beam computed tomography in determination of maxillofacial fractures. It was an observational study. We evaluated 100 CBCT scans. The data was collected and entered in Microsoft Excel 2010. Statistical analysis was done by using tools of descriptive statistics such as percentage for qualitative data. Chi square test was used to find out statistical difference among groups/sub-groups. Probability $p<0.05$, considered as significant as alpha error set at 5% with confidence interval of 95% set in the study. Power of the study was set at 80% with beta error set at 20%.

Table 1: Distribution of scans according to gender

100	87 (87%)	13 (13%)

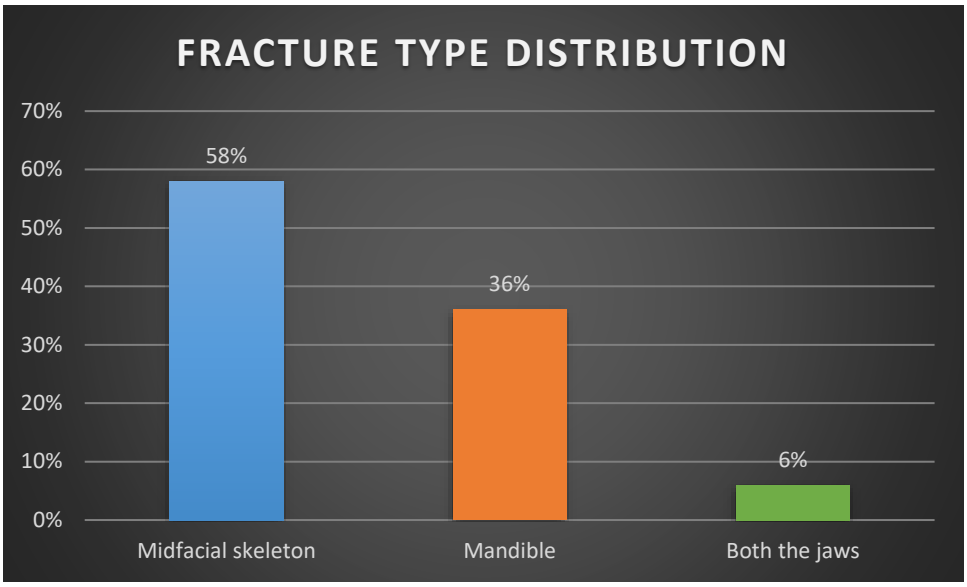
	Chi square test value = 18.92, p< 0.001**

Out of 100 CBCT scans, 87% (n=87) scans were of male while 13% (n=87) scans were of female. CBCT Scans of male patients were more than female patients. Highly statistically significant difference (p<0.001) exists among males and females' samples where male population have a higher majority.

Table 2: Distribution of scans according to age in years

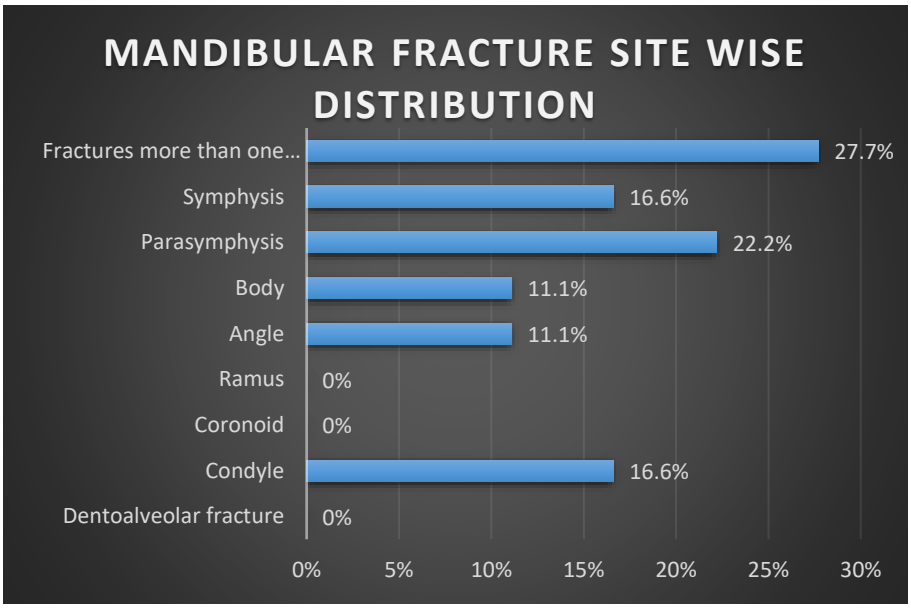
Age Distribution	34.9 (14.85)	33.07 (7.81)	34.73 (14.12)
	Unpaired t test = 0.450 , p =0.653 No statistical significant difference for Male vs Female		

Age of male was 34.9 years (14.85) while age of female was 33.07years (7.81) and overall mean age were 34.73 years (14.12). No statistically significant difference exists among male and female. add



Graph 1 - Distribution of scans according to site of fracture

Out of 100 CBCT scans, 58% (n=58) scans were involving midfacial skeleton, 36% (n=36) were of fracture involving mandible and 6% (n=6) scans fracture of both jaws. Statistically significant difference (p<0.05) exists among fracture type where majority fractures involve midfacial skeleton.



Graph 2 - Distribution of fractures in mandible

Distribution of fractures in midfacial skeleton table 3: -

1.	Zygomatic complex fracture (N=36)	Male – 30 (83.3%) Female -6 (16.6%) Unilateral-31 (86.1%) Bilateral-5 (13.8%)	Chi = 12.76, p = 0.003*
2.	Nasal bone fracture/Naso-orbito-ethmoidal fracture (n=5)	Male-4 (80%) Female-1 (20%)	Chi = 18.79, p< 0.001**
3.	Middle face fracture (n=3) Le Fort 1 Le Fort 2 Le Fort 3	 1 (33.3%) 1 (33.3%) 1 (33.3%)	Chi = 2.87, p =0.145
4.	Dentoalveolar fracture (n=14)	Male -10 (71.5%) Female – 4 (28.5%)	Chi = 9.87, p< 0.001**
5.	Fractures involving more than one site (n=5)	Male-4 (80%) Female-1 (20%)	Chi = 18.79, p< 0.001**

There were 5 CBCT scans of nasal bone fracture. Out of these CBCT scans of males were 80% (n=4) and females were 20% (n=1). Highly statistically significant difference ($p<0.001$) exists between male and female. There was male predominance in nasal bone fracture.

There was one case each of Lefort fracture (I, II, II) and hence no statistically significant difference ($p>0.05$) exist among three fracture type distribution. The distribution of each fracture was 33.3% (n=1).

There were 14 dentoalveolar fracture out of these males were 71.5 % (n=10) and females were 28.5% (n=4). Highly statistically significant distribution ($p<0.001$) exists in relation to gender distribution with predominance of males.

The CBCT scans of fracture involving more than one site were 5 in number. In that males were 80% and females were 20 %. Highly statistically significant distribution ($p<0.001$) exists in relation to gender distribution with predominance of males.

Out of 58 CBCT scans, Zygomatic complex fracture was (n=36), nasal bone fracture (n=5), middle face fracture (n=3), dentoalveolar fracture (n=14) and fractures involving more than one site (n=5). Out of 58 scans, the fracture site that was most common was the Zygomatic complex region (n=36). In Zygomatic complex fracture, males were 83.3% (n=30) and females were 16.6% (n=6).

Distribution of fracture in maxilla according to unilaterality/bilaterality: -

Unilateral fracture was 86.1% (31) and bilateral fracture were 13.8% (n=5). There were a greater number of unilateral fractures of Zygomatic complex region than bilateral ones. Highly statistically significant difference ($p< 0.001$) exists among gender and type of fracture in ZMC fracture.

Distribution of fracture in both jaws -

Out of 100 CBCT scans 6 were fracture of both jaws out of which 2 scans of zygomatic complex fracture with Para symphyseal fracture, 1 scan of zygomatic complex fracture with dentoalveolar fracture of 11, 21 region and Para symphyseal fracture, 1 scan of zygomatic complex fracture with condyle fracture, 1 scan of zygomatic complex fracture with Para symphyseal and ramus of mandible. 1 scan zygomatic complex fracture with body of mandible fracture found.

Distribution of fractures in mandible according to anatomic site graph 2: -

Fractures involving more than one site were 27.7% (n=10) which was the highest in distribution. According to single site distribution of fracture, paranymphs fractures were more common 22.2% (n=8) followed by symphysis and condyle fractures which were 16.6% (n=6). There was same distribution of fracture in angle as well as body region which was 11.1 %(n=4.) Fractures involving more than one site were 27.7% (n=10). No statistically significant difference ($p>0.05$) was observed for anatomic sites distribution.

Distribution of fracture in mandible according to multiple site: -

According to multiple fracture sites, Para symphysis + body account for 5.5% (n=2) fractures, Para symphysis + angle account for 5.5% (n=2) fractures, Para symphysis + condyle account for 5.5% (n=2) fractures, body + angle accounts for 2.75% (n=1) fracture and ramus + condyle account for 2.75% (n=1) fracture.

Distribution of fracture in mandible according to unilaterality/bilaterality: -

Out of 36 fracture scans, majority was distributed unilaterally 83.3 % (n=30) and only few cases were found bilaterally 16.7 % (n=6). Highly statistically significant difference ($p<0.001$) exists among fracture type distribution

DISCUSSION

Table 1 shows the gender distribution of CBCT scans, where 87% (n=87) were males and 13% (n=13) were females—a statistically significant difference ($p<0.05$). Similar male predominance was reported by Kamulegeya A (2009)7, Jung et al. (2014)8, Samman M (2018)9, and Srinivasan B (2019)1º, with male-to-female ratios ranging from 3:1 to 7.7:1. Table 2 demonstrates that the mean age of males was 34.9 ± 14.85 years and females 33.07 ± 7.81 years, with no significant gender difference. Comparable age trends were observed in studies by Ogundare BO (2003)11, Adebayo ET (2003)12, Al Ahmed (2004)13, Bali R (2013)14, Arabion H (2014)15, Shah B (2017)16, and Srinivasan B (2019)10. Graph 1 shows

fracture site distribution, with midfacial fractures most common (58%), followed by mandibular (36%) and both jaws (6%) ($p<0.05$). Bataineh BA (1998)17 and Bali R (2013)18 reported similar findings, highlighting midfacial involvement and road traffic accidents as key causes. Table 3 details midfacial fractures, showing zygomatic complex (36%) as most frequent, followed by dentoalveolar (14%). Males were predominantly affected across categories ($p<0.05$). Al Ahmed (2004)13, Abhinav RP (2019)2, and Sethuraman G (2023)19 reported comparable patterns. This study shows that 84.4% of maxillary fractures were unilateral ($p<0.05$), consistent with Park KP (2015)20. Study indicates that both-jaw fractures occurred exclusively in males aged 15–55 years, aligning with Park KP (2015)20. Graph 2 indicates fracture in mandible according to anatomic site which is 27.7 % fractures involved more than 1 site in mandible. Para symphysis fracture 22.2% followed by 16.6 % in condyle and symphysis region supported King R E (2004)22 and Ogundare BO (2003)11. This study presents mandibular multiple fractures—Para symphysis + body, angle, and condyle (5.5% each). Jung et al. (2014)8, Gazal G (2015)21, and King RE (2004)22 reported similar patterns. This study shows unilateral mandibular fractures (83.3%) were significantly higher ($p<0.05$), supported by Gazal G (2015)21, Samman M (2018)23, and Moura LB (2018)24, who also noted predominance of Para symphysis and condylar combinations.

CONCLUSION

This retrospective study demonstrated the accuracy of Cone Beam Computed Tomography (CBCT) in identifying and evaluating maxillofacial fractures. Males under 35 years showed the highest incidence, with zygomatic complex and Para symphysis fractures most common. Unilateral fractures predominated. CBCT provided precise visualization, aiding diagnosis, treatment planning, and epidemiological insight for preventive strategies.

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