CBCT IMAGING IN ASSESSING IMPACTED THIRD MOLARS
COVERING LETTER

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ABSTRACT:
Impaction denotes a tooth failing to attain its normal position to reach the occlusal table with third molars impaction being common in the mandible. The conventional radiographic views such as peri-apical, panoramic radiograph are two dimensional representations of three dimensional structure. Absence of information on relation of vital anatomical structures to impacted teeth, bone quality is a drawback for the operating surgeon which could lead to pre or post operative complications. CBCT imaging fills the lacunae of two dimensional imaging and holds a key role in impaction assessment.A retrospective analysis of 45 patients who underwent CBCT imaging prior to extraction of impacted third molars were included in the study and the data was analysed using SPSS.Among the 45 patients, 20 were males (44.4%) and 25 were females (55.5%) and the age group commonly affected with impaction was between 25-30 years (35.5%).The frequency of impacted third molars was more in mandible (80.0%) compared to maxilla (20%).There was significant correlation between nerve involvement and angulation of impacted third molars.CBCT imaging modality provides a three dimensional view to help in better treatment planning, anticipating possible complications post surgery. CBCT must be recommended as the only imaging modality in impaction assessment.

CLINICAL SIGNIFICANCE: CBCT imaging provides superior images for diagnosis and treatment planning.

KEYWORDS: CBCT, Extraction, Inferior alveolar nerve, Root morphology,Third molar.

INTRODUCTION:

Impaction is the failure of a tooth to reach its anatomical plane due to hindrance in the eruption path, inappropriate positioning of a tooth, absence of space, or other impediments. Impacted teeth are those which are unable to erupt in the dental arch within the expected time (1). They are classified by their direction, depth compared to the biting surface of adjacent teeth and the amount of the tooth crown that extends through bone or mucosa(2).Impactions can also be classified based on the position of the impacted third molar with the long axis of the second molars. Some of the types include: Mesio-angular, disto-angular, horizontal, and vertical types (3). Third molar impaction is a common condition, giving rise to symptoms, which necessitates its removal. Some of these teeth can be extracted without removal of surrounding bone, but most impacted lower wisdom teeth require surgical intervention (4). Surgical removal of third molars is one of the frequently performed surgical procedures in dentistry (5). Pain is often described as a distressing feeling,unpleasant emotional experience, and a subjective phenomenon (6) and it has been one of the main symptoms for patients to undergo third molar extractions. Poor oral hygiene associated around impacted teeth (7) can lead to pericoronitis (8) and requires extraction.Third molars have a high incidence of impaction and radiographic assessment is an essential tool in

understanding its morphology,position and the relation to the surrounding structures. Two-dimensional imaging mainly periapical radiographs are used as primary imaging modality. However, 2D images possess unique limitations such as magnification, distortion, and superimposition that can make misrepresentation of structures (9). For further better assessment panoramic imaging is also employed to evaluate impacted third molars, its associated structures and pathology (10). Cone-beam computed tomography (CBCT) is a radiographic imaging technique which renders three-dimensional visualization of an anatomical area. The high quality of imaging in CBCT has improved the diagnostic accuracy of diseases and quality of health care delivery to patients. (11). With the advent of cone beam computed tomography (CBCT), the errors produced in conventional radiography are eliminated and the excessive radiation exposure to patients who are subjected to medical CT could be reduced (12). CBCT is advantageous as it has lower radiation dose, minimal metal artifacts, cost effective, easier accessibility than multislice CT; however, multislice CT is considered better for bone density analysis using the Hounsfield unit scale (13).The identification, treatment planning, and evaluation of potential complications of impacted teeth are greatly improved through CBCT.The site evaluation becomes not only less invasive and less time-consuming but also gives a complete overview (14). The drawbacks of CBCT imaging include beam hardening and scatter from dental materials, and poor representation of the soft tissues.Common indications for CBCT in dentistry include jaw assessment for implant placement ; examination of teeth and facial structures for orthodontic treatment planning; evaluation of TMJ (15) for osseous degenerative changes, evaluation of mandibular third molar root proximity to mandibular canal prior to extraction, evaluation of teeth and bone for cysts and tumours (16), in endodontics for assessment of root canal, root resorption (17), maxillofacial pathology assessment like intraosseous carcinoma, MRONJ (18). With the rising number of oral potentially malignant disorders(19),(20) majorly due to consumption of smoking tobacco and smokeless tobacco (21) turning into oral cancer (22) the usage of CBCT and MRI (23) are used for primary tumour assessment and bone invasion metastatic (24) spread. Proper clinical (25) and radiographic analysis with early intervention can prevent malignant transformation(26).There is no standardised protocol on the requisition of the most suitable type of radiographic examination for impacted mandibular third molars. Evidence based studies emphasise the need to assess the relationship between the surrounding structures and the tooth, relationship of impacted tooth to vital structures like nerve, sinus, blood vessel, pathologies which would be decisive to prevent post impaction complications (27). Current literature does not specify the important role of CBCT requisition in impaction assessment.

The aim of the study is to evaluate the role of CBCT imaging in the assessment of third molar impaction.

MATERIALS AND METHODS:

A retrospective study was conducted in the Department of Radiology at Saveetha Dental College from June 2019 to March 2020. The college database was reviewed. 45 patients who had undergone CBCT imaging for extraction of a third molar were included in the study.The study was approved by the scientific review board (SRB) and institutional ethical committee (Approval number SDC/SIHEC/2020/DIASDATA /0619-0320).Two investigators - a primary researcher and a department faculty were involved in this study. Cross verification was done using case records, clinical photographs and CBCT images. Sampling bias was reduced as there was no sorting process involved; all the cases were included in the study.

Patients with pathologies like cyst and tumors associated with impacted third molars were excluded from the study. The retrieved data was then collected and formulated into an excel sheet and imported into SPSS software(IBM 20).The qualitative variables include the impaction type, proximity and involvement of Inferior alveolar nerve and the root morphology.

Frequency distribution using bar graphs and descriptive analysis was done using chi-square test to see the association between the nerve involvement and angulation of impacted lower third molars, and nerve involvement and gender.

RESULTS:

The study was conducted on 45 subjects who had a CBCT requisition for third molar extraction out of which 20 were males (44.4%) and 25 were females (55.6%) [Graph 1].
The frequency of impacted third molars was more in mandible (80%) when compared to maxilla (20%)[Graph 2]. There were 79 impacted third molar teeth in 45 patients which were classified into horizontal (37.97%), vertical (29.11%), mesio-angular (24.05%), distoangular (7.59%), buccoverted (1.27%). Bilaterally impacted third molars were commonly seen in mandible (80.77%) and in maxilla (19.23%)[Graph 3,4].
The age group commonly affected with third molar impaction was between 25-30 years (35.5%), 20-25 years (26.67%), 30-35 years (26.67%), 35-40 years (6.67%), 15-20 years (4.4%)[Graph 5].There was involvement of the Inferior alveolar nerve in relation to impacted teeth in about 73.6% and was not evident in about 26.3% of CBCT [Graph 6]. Altered root morphology of the impacted teeth included dilaceration(8.89%), curved roots(4.44%), developing roots(8.8%) and fused roots(6.67%) [Graph 7].
On chi-square analysis between the angulation and nerve involvement on the left side, 27 cases (87.1%) had nerve involvement ($p>0.05$)[Graph 8].
On chi-square analysis between the angulation and nerve involvement on the right side, 27 cases (75%) had nerve involvement ($p<0.05$)[Graph 9].
On chi square analysis between gender and nerve involvement, 35 teeth (83.3%) had nerve involvement ($p>0.05$)[Graph 10].

DISCUSSION:

Cone-beam computed tomography (CBCT) is a noninvasive technique that facilitates a comprehensive investigation of both the external and the internal anatomy of the structures from different angles obtained by reconstruction of images in three planes to acquire three-dimensional (3D) images (28). Radiographic diagnosis prior to third molar extraction plays a vital role to evaluate the impacted teeth and prevent post surgical complications. In an institutional study, the knowledge among dentists to request for CBCT in third molar assessment was only about 25% (29). Our study results showed that prevalence of impacted teeth was more in females (55.6%) than males (44.4%) which was similar to the study done by (30). Any tooth in the dental arch may become impacted but the most common are the mandibular third molars in the studies done by (8,31,32).
The commonly encountered type of impaction in our study population was horizontal (37.97%) which was contradicting the studies done by (1,31,32) as they reported mesio angular impaction as the common type.
The age group distribution in our study with maximum number of impactions seen was 25-30 years (35.5%) which was also the mean age group in the studies done by (30,33)et al., and with a mean of 27.6 years in the study by (30,33).
The knowledge of anatomical landmarks, course of the inferior alveolar nerve,mandibular canal is pivotal. The structural variation in the mandibular canal can have implications in mandibular anesthesia, extraction of impacted third molars (34). Relation of the third molar to that of the mandibular canal and its associated risk, post surgical was done in a study by(12,34–37) who had seen a true relationship to the inferior alveolar canal similar to that of our study and also assessed the incidence of nerve injury. Studies done by (12,34–37) have also seen the relationship with the mandibular canal but have used signs such as darkening of the roots approximating the canals as one of the diagnostic criteria in assessment. Studies done by (27) and (12,34–37) have studied the relationship of mandibular nerves but had correlations in different sectional views of CBCT imaging.
CBCT is capable of precise detection of root canal morphology compared to conventional two dimensional imaging methods (38). Our study reported varied root morphology seen in the impacted third molar with included dilaceration, fused and curved root. There are very few studies which reported root morphology in relation to an impacted tooth. These various parameters and information which are available in CBCT makes it mandatory to be the imaging modality to be implemented for evaluation of impacted teeth prior to extraction. Further multicenter studies with large sample size, different FOV would help to formulate a specific guideline for the role of CBCT imaging in impaction assessment.
In comparison of nerve involvement and angulation of the impacted lower molar teeth there was a significant correlation seen on the right side ($p<0.05$) and in mesioangular impacted teeth which was in concordance to the study done by (39). There was no significant correlation seen on the left side.

Association between gender and nerve involvement showed higher male prevalence but studies also report that age and gender are not contributing factors in determining nerve involvement (40).

CONCLUSION:

This study was done with an aim to assess the number of CBCT imaging performed prior to a third molar extraction and its assessment. CBCT provides a three dimensional view which can help in better treatment planning and for anticipation of future post surgery complications out of which the most commonest is the trauma to the mandibular nerve. This assessment is limited with two dimensional radiographs. Though CBCT imaging might be costlier and poses a higher radiation dose to the patient, weighing the risk versus benefit effects CBCT should be employed as sole imaging modality for impaction assessment as it provides multiple diagnostic information to the surgeon.

CLINICAL SIGNIFICANCE: CBCT imaging provides superior images for diagnosis and treatment planning.

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AUTHORS CONTRIBUTION:

Abhinaya LM has made substantial contributions towards study design, acquiring an analysis of data,drafting the final paper and revising it critically.

M.Arvind has made substantial contributions towards study design, acquiring an analysis of data,drafting the final paper and revising it critically.

Deepika Rajendran has made substantial contributions in proofreading and final drafting.

CONFLICT OF INTEREST:

NIL

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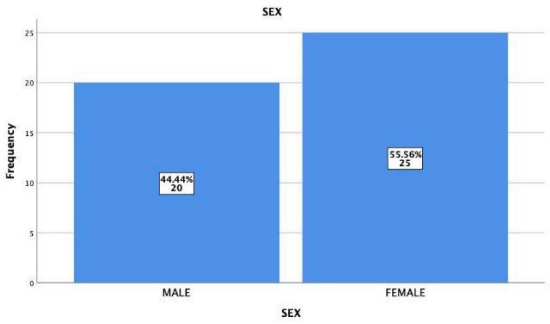
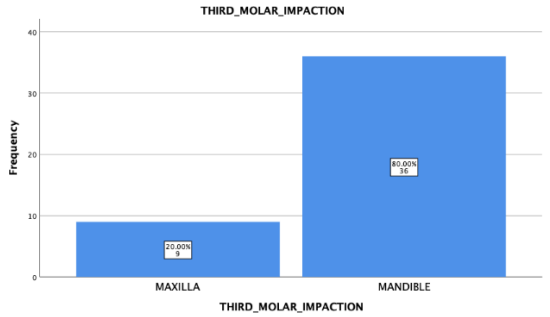
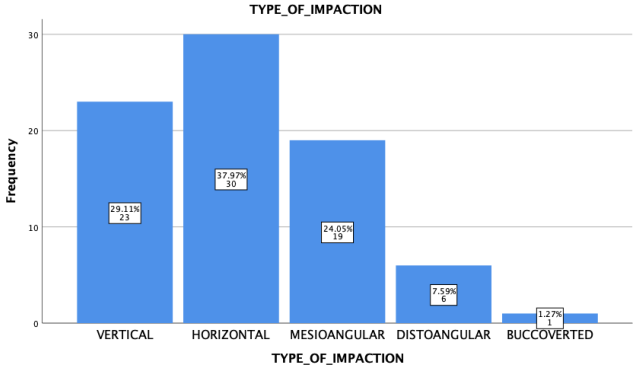
GRAPHS:



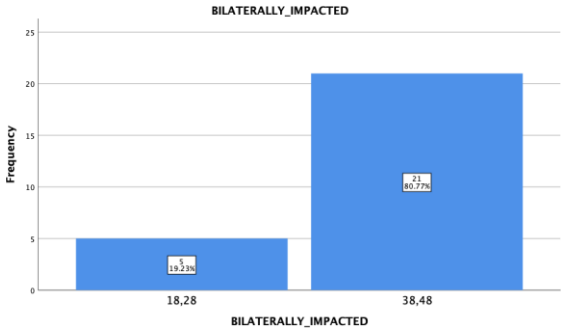
GRAPH 1: This graph depicts the frequency of sex distribution in the study population. X-axis depicts the gender of patients and Y-axis depicts the number of patients in the study population.Graph 1 shows that the number of females in the study were 25 (55.5%) and the number of male were 20 (44.44%).



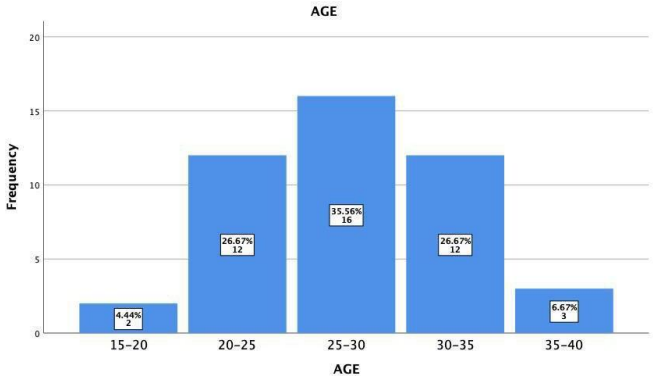
GRAPH 2: This graph depicts the frequency of third molar impaction in maxilla and mandible. X-axis of this graph denotes the site of impacted teeth (maxilla and mandible). Y-axis represents the number of patients in the study population with impacted third molars. Graph 2 shows that 9 patients had maxillary impacted teeth (20%) and 36 patients had mandibular teeth impaction (80%).



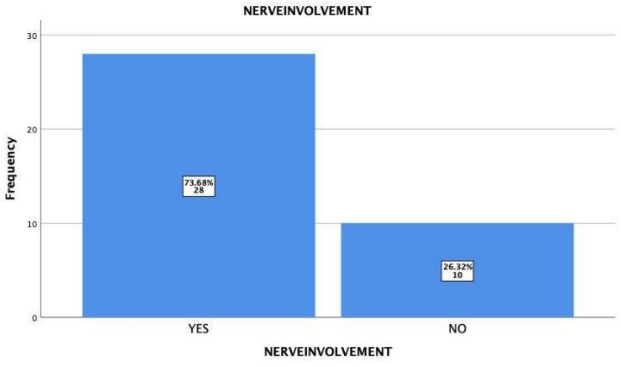
GRAPH 3 : This graph shows the different types of impaction in the study. X-axis depicts the type of impaction seen and Y-axis depicts the number of teeth that were impacted in the study population. 30 teeth were horizontally impacted (37.97%), 23 teeth were vertically impacted (29.11%), 19 teeth were mesio-angularly impacted (24.05%), 6 teeth were disto angularly impacted (7.59%) and one teeth was buccoverted (1.27%). This graph depicts the total number of impacted teeth (unilateral and bilateral impaction) in a study population of 45 patients.



GRAPH 4 : This graph depicts the frequency of bilaterally occurring impaction in maxilla and mandible. X-axis depicts the bilaterally impacted third molar in maxilla and mandible and Y-axis depicts the numbers of patients in the study population. 21 patients (80.77%) in the mandible and 5 patients in maxilla (19.23%) had bilateral impacted third molars.

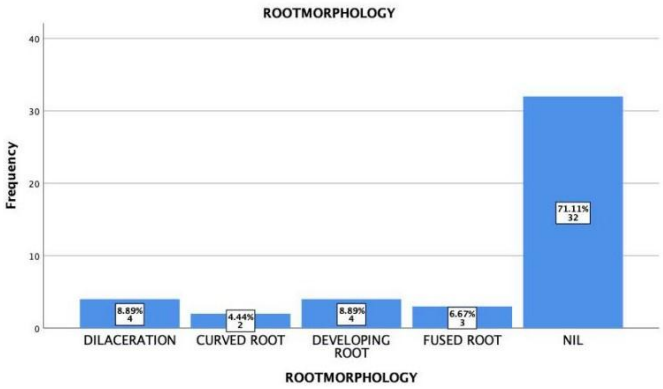


GRAPH 5 : This graph shows frequency of patients in different age groups with impacted third molars. X-axis depicts the age groups distributed among the study population and Y-axis depicts the frequency in numbers of patients.16 patients were 25-30 years age group (35.5%), 12 patients in 20-25 years (26.67%), 12 patients in 30-35 years (26.67%), 3 patients in 35-40 years (6.67%), 2 patients in 15-20 years age group (4.4%).

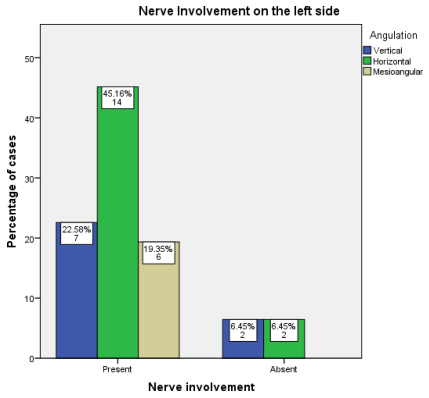


GRAPH 6: This graph depicts the involvement of inferior alveolar nerve seen in CBCT images. X-axis depicts the presence or absence of nerve involvement and Y-axis depicts the frequency in numbers of the

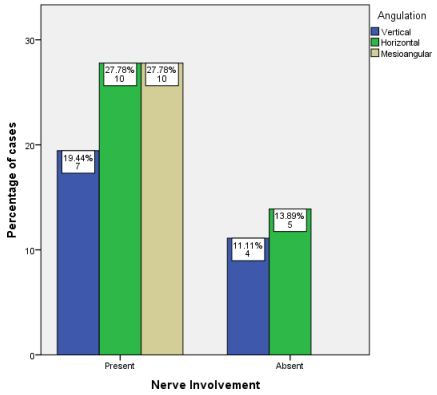
patients in the study population. There was involvement of the Inferior alveolar nerve in relation to impacted teeth in 28 patients (73.6%) and 10 patients (26.3%) had no nerve involvement.



GRAPH 7 : This graph depicts the varied root morphology in the impacted third molars imaged in CBCT. X-axis depicts the different root morphology present and Y-axis depicts the frequency in numbers of the patients in the study population. Altered root morphology of the impacted teeth included 4 dilaceration (8.89%), 2 curved roots (4.44%), 4 with developing roots (8.8%) and 3 patients with fused roots (6.67%). 32 patients (71.1%) did not present with any root morphology alteration.

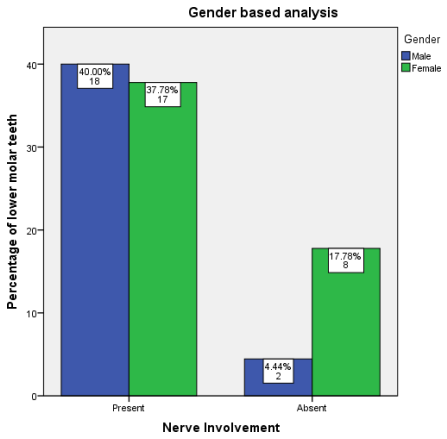


GRAPH 8: Bar graph depicting the association between the angulation of lower molar impaction and nerve involvement for the left side. X-axis shows the nerve involvement status and Y- axis shows the percentage of cases. Blue colour represents vertical impaction, Green indicates horizontal and Brown represents mesioangular impaction. 27 cases had nerve involvement and 4 cases had no nerve involvement. A chi-square analysis to study association between angulation and nerve involvement (chi-square - 2.25; df-2; p-.325[p>0.05]) which is not statistically significant. The correlation between the inferior alveolar nerve and angulation of 27 impacted teeth on the left side was not significant.



GRAPH 9: Bar graph depicting the association between the angulation of lower molar impaction and nerve involvement for the right side. X-axis shows the nerve involvement status and Y- axis shows the

percentage of cases. Blue colour represents vertical impaction, Green indicates horizontal and Brown represents mesioangular impaction. 27 cases had nerve involvement and 9 cases had no nerve involvement. A chi-square analysis to study association between angulation and nerve involvement (chi-square - 6.972; df-2; p-0.062[p<0.05]) which is statistically significant. The correlation between the inferior alveolar nerve and angulation of 27 impacted teeth on the right side was significant.



GRAPH 10: Bar graph depicting the association between the gender in the study population and nerve involvement. X-axis shows the involvement of the nerve and Y-axis represents the percentage of cases involved. Blue represents male and Green represents female. 35 cases had nerve involvement and 10 cases did not have nerve involvement. A chi-square analysis to study the association between gender and nerve involvement (chi-square - 1.969; df-1; p-0.07[p>0.05]) which is not significant. There is no correlation between gender and nerve involvement in patients with impacted teeth.