



Study of referral patterns for CBCT related to Dental Implants in Jalgaon district: A survey based study.

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Date of Submission: 08-03-2026

Date of Acceptance: 20-03-2026

Abstract:

Aim:

To determine the percentage of patients referred for Cone Beam Computed Tomography (CBCT) specifically for dental implant planning in the Jalgaon district through a survey-based study.

Method:

A retrospective analysis was performed on 118 consecutive CBCT referrals submitted to an oral and maxillofacial radiology service between February and March 2025 in Jalgaon district. Patient demographic data and referral details were systematically extracted from radiographic reports. Descriptive statistical methods were applied to characterize referral patterns, temporal trends, and clinical indications for CBCT imaging.

Results:

Out of 118 patients referred for CBCT imaging, 34.75% were for implantology, followed by 26.27% for oral surgery and 24.57% for endodontics. Among implant cases, 88% were pre-operative and 12% post-operative. Full-arch scans accounted for 53.66%, while sectional scans comprised 46.34%. A higher proportion of female patients (56.10%) underwent CBCT compared to males (43.90%).

Conclusion:

The study highlights that implantology constitutes the major indication for CBCT referrals in the Jalgaon district, emphasizing its critical role in pre-surgical planning and assessment. The findings underscore the growing reliance on CBCT for precise, three-dimensional evaluation, supporting safer and more predictable implant outcomes.

Keywords: Computed Tomography, Cone Beam, Dental Implants, 3D imaging, Dental Radiology, Implantology.

I. Introduction

Cone-beam computed tomography (CBCT) is an imaging modality that utilizes a cone-shaped X-ray beam directed toward a two-dimensional (2D)

detector. During image acquisition, the source-detector assembly completes a single rotational cycle around the object, capturing a series of 2D projections. These projections are subsequently reconstructed into a three-dimensional (3D) volumetric dataset using a modified version of the cone-beam reconstruction algorithm originally proposed by Feldkamp et al. in 1984.¹ In recent years, the use of cross-sectional imaging through cone-beam computed tomography (CBCT) in implant dentistry has expanded rapidly, supported by continuous scientific and technological advancements. Beyond the replacement of teeth lost due to trauma, pathology, or developmental anomalies, the growing emphasis on aesthetics and increased life expectancy have further contributed to the widespread acceptance of dental implants and related surgical interventions.²

The success of CBCT can be attributed primarily to its ability to provide volumetric imaging of the jawbone at relatively low cost and radiation dose, coupled with the advantages of compact design, affordability, and accessibility for in-house use.³ Technological advancements have significantly reduced radiation exposure, while simultaneously enhancing the quality of diagnostic information obtained. As a result, clinicians can now perform more objective evaluations and achieve safer, more accurate, and efficient treatment planning.⁴

In clinical practice, CBCT has become an indispensable imaging modality. Compared with conventional panoramic radiography, CBCT provides a significantly greater amount of diagnostic information. It enables clinicians to accurately visualize and assess the extent and boundaries of carious lesions, periapical and bone pathologies, impacted teeth, the maxillary sinus, and the inferior alveolar nerve with enhanced clarity and precision.^{5,21}

Recent technological advancements have introduced multiple field-of-view (FOV) options and variable



voxel sizes, enabling CBCT systems to be tailored more effectively to a wide range of specific diagnostic and clinical tasks.⁶ Currently, CBCT is considered the ideal imaging modality, as it has reduced implant failures by providing precise information regarding vital structures, bone height and width, bone density, and alveolar profile, while maintaining low radiation exposure.⁷ They found that CBCT detected 62% more periapical lesions than conventional radiographs, although the assessment of the subject teeth was increased by parallax views in the latter technique.⁸ CBCT is particularly valuable in the assessment of upper third molar extractions, as it provides both qualitative and quantitative information that is not attainable through two-dimensional imaging, especially in cases where the proximity or potential exposure of the maxillary sinus is a concern.⁹ The advent of CBCT has enabled clinicians to perform three-dimensional superimpositions, thereby minimizing the errors associated with conventional lateral cephalometric superimposition techniques.¹⁰

Importantly, critical details of the three-dimensional anatomy of the tooth or teeth and surrounding structures remain obscured, even when employing optimal intentions and paralleling techniques. CBCT offers an effective and safe approach to overcome these limitations and may, in time, transform the methods by which implant treatment outcomes are evaluated.¹¹

This study aims to determine the percentage of patients referred for Cone Beam Computed Tomography (CBCT) specifically for dental implant planning in the Jalgaon district through a survey-based study.

II. Materials and Methods:

Study Design

This is a descriptive, cross-sectional study conducted at a Dental CBCT Centre in the Jalgaon district, Maharashtra, India. The study aims to evaluate and analyze data of patients referred for CBCT imaging for dental implant purposes. Data were collected from patient records maintained at the CBCT Centre over a defined study period.

Study Population

The target population for this study included patients referred to the CBCT Centre in Jalgaon district for dental implant evaluation. Referrals originated from general dentists, prosthodontists, oral surgeons, and other dental specialists practicing within the district. Both male and female patients across various age groups were included to obtain a comprehensive understanding of referral trends and clinical indications.

Sample Size

Patient data were collected from the Dental CBCT Centre in Jalgaon district. The sample size was determined based on the total number of patients referred for CBCT scans during the study period. (n= 118)

Duration of Study: 2 months.

Inclusion Criteria

1. Patients from the Jalgaon district region.
2. Complete and retrievable patient data available in the CBCT Centre records.

Exclusion Criteria

1. Incomplete or missing patient records.
2. Duplicate referrals during the study period.

Data Collection Tool

The data were collected using a structured data extraction sheet designed to gather information on:

1. **Patient demographics** – age, gender, and location.
2. **Anatomical site of interest** – maxillary or mandibular region, anterior or posterior area.
3. **Imaging specifications** – field of view (FOV) and other technical parameters, if applicable.

The data extraction sheet was pre-tested on a small subset of cases to ensure clarity, completeness, and reliability of the recorded parameters.

Survey Method

This study utilized retrospective data collected from patient records maintained at the CBCT Centre. Data were recorded manually and organized electronically for analysis. No direct patient interaction occurred, as the study was based on secondary data review.

Data Analysis

The collected data were compiled, tabulated, and analyzed to identify patterns and trends in patient referrals for CBCT scans for dental implants. Descriptive statistics were used to summarize the data, including the distribution of age, gender and clinical indications.

Outcome Measures

The **primary outcome** of this study was to analyze the demographic and clinical characteristics of patients referred for CBCT imaging for dental implant assessment in the Jalgaon district. The **secondary outcomes** included identifying referral trends among practitioners and assessing common clinical indications for CBCT usage in implant planning.

III. Results:

The data collected from the CBCT center in the Jalgaon district were analyzed to evaluate referral patterns, demographic distribution, and the purpose



of CBCT scans related to dental implant procedures. Out of the total 118 patients referred for CBCT imaging, variations were observed across different dental specialties, scan types, and clinical purposes. The findings provide valuable insight into the growing utilization of CBCT in implant dentistry,

emphasizing its role in precise diagnosis, treatment planning, and post-operative assessment. The detailed distribution of cases based on specialty, gender, scan type, and surgical phase is presented in the following figures.

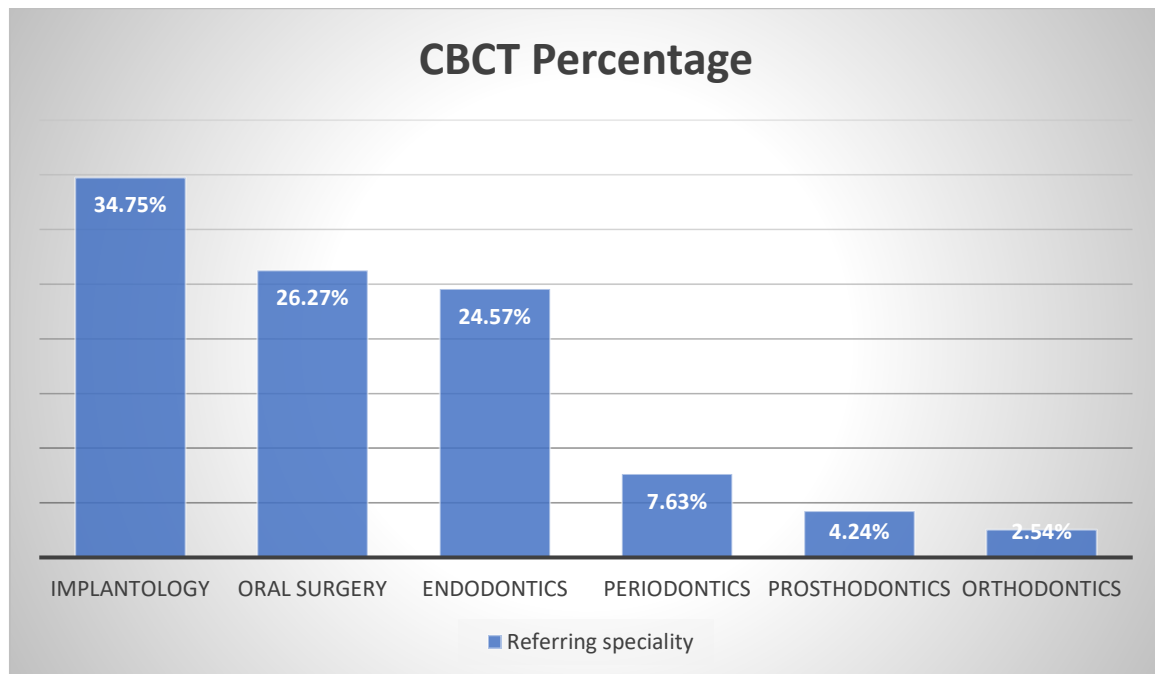


Fig. 1. Distribution of patients referred for CBCT investigation across different dental specialties in the Jalgaon district.

Referring Specialty	Number of Patients	Percentage (%)
Implantology	41	34.75%
Oral Surgery	31	26.27%
Endodontics	29	24.57%
Periodontics	9	7.63%
Prosthodontics	5	4.24%
Orthodontics	3	2.54%
Total	118	100%

Figure 1 illustrates the distribution of patients referred for Cone Beam Computed Tomography (CBCT) from different dental specialties among a total of 118 cases analyzed.

Implantology accounted for the highest proportion of referrals, representing **34.75% (41 patients)**, indicating that CBCT is most frequently utilized for implant planning and assessment. **Oral surgery** contributed **26.27% (31 patients)** of referrals, primarily for evaluation of impacted teeth and surgical planning. **Endodontics** followed closely with **24.57% (29 patients)**, reflecting the growing use of CBCT in the diagnosis of periapical lesions and complex root canal anatomies.

Referrals from **periodontics** comprised **7.63% (9 patients)**, likely for the assessment of bone defects and furcation involvements. Meanwhile, **prosthodontics** and **orthodontics** represented **4.24% (5 patients)** and **2.54% (3 patients)** of the total referrals, respectively, indicating comparatively limited yet specialized use of CBCT for occlusal evaluation, jaw relationships, and treatment planning. Overall, the data suggest that implantology remains the leading field utilizing CBCT, followed by oral surgery and endodontics, highlighting its central role in surgical and diagnostic procedures that require high spatial accuracy.

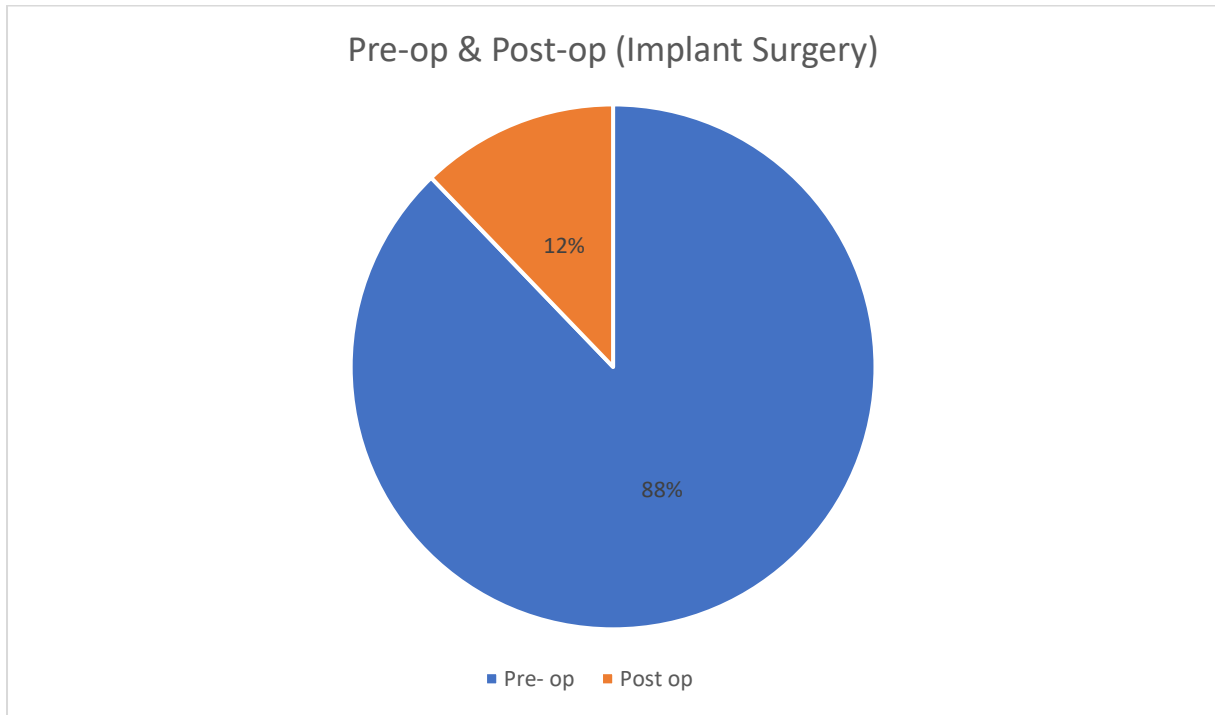


Fig. 2. Distribution of CBCT scans taken for pre-operative and post-operative evaluation in implant surgery.

Category	Number of Patients	Percentage
Pre-operative (Pre-op)	36	88%
Post-operative (Post-op)	5	12%
Total	41	100%

In Fig. 2, the pie chart illustrates the distribution of CBCT scans undertaken in relation to implant surgery, differentiating between pre-operative and post-operative assessments. A substantial majority of scans were performed in the pre-operative phase (87.8%), comprising the predominant portion of the dataset. This indicates that CBCT was primarily employed for diagnostic evaluation, assessment of bone quality and quantity, and pre-surgical treatment planning. In contrast, a smaller proportion of scans was conducted post-operatively,

primarily for the purpose of verifying implant placement, evaluating osseointegration, and detecting potential complications. The marked predominance of pre-operative scans underscores the critical role of CBCT in the initial diagnostic and planning stages of implant therapy, while the comparatively lower frequency of post-operative (12.19%) scans suggests their selective utilization in cases requiring outcome verification or complication management. □

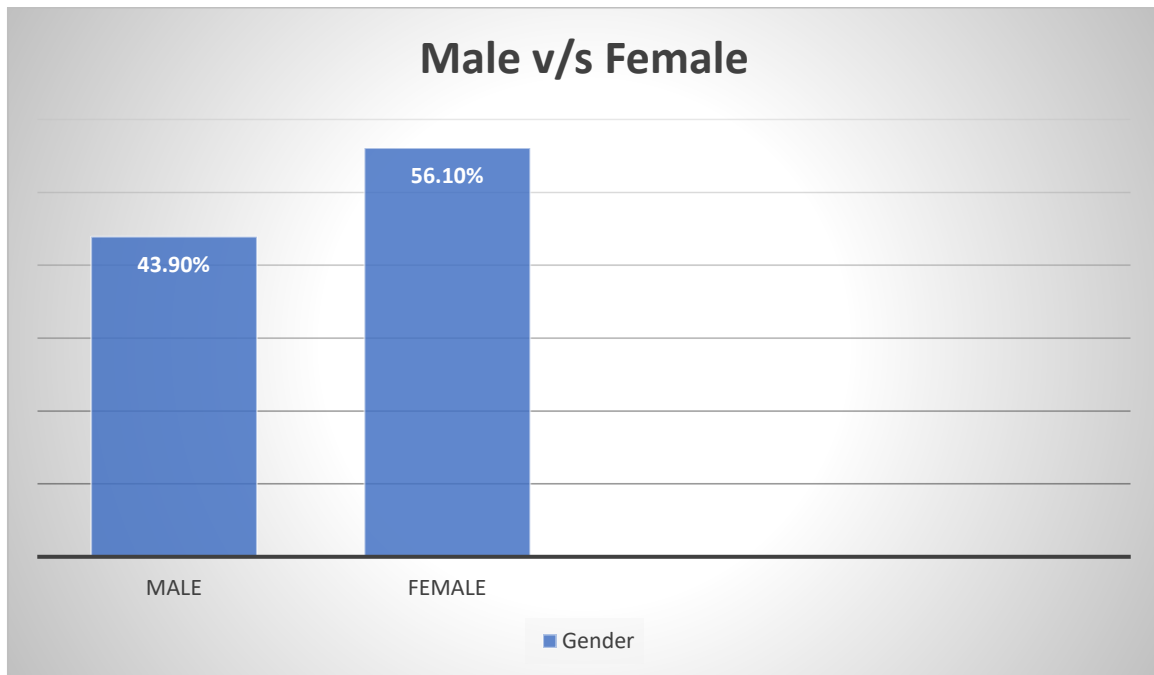


Fig. 3. Gender-wise distribution of implant patients referred for CBCT evaluation.

Gender	Number of Patients	Percentage
Male	18	43.90%
Female	23	56.10%
Total	41	100%

The bar chart in Fig. 3. illustrates the gender-wise distribution of patients who underwent Cone Beam Computed Tomography (CBCT) investigations for dental implant placement surgery. As depicted, a higher number of female patients ($n \approx 23$ i.e. 56.10%) were referred for CBCT compared to male patients ($n \approx 18$ i.e. 43.90%). This indicates a

predominance of female patients seeking CBCT evaluation for implant-related procedures within the study population. The findings suggest a gender-related trend in referral patterns, with females constituting a greater proportion of the total cases assessed for implant planning through CBCT imaging.

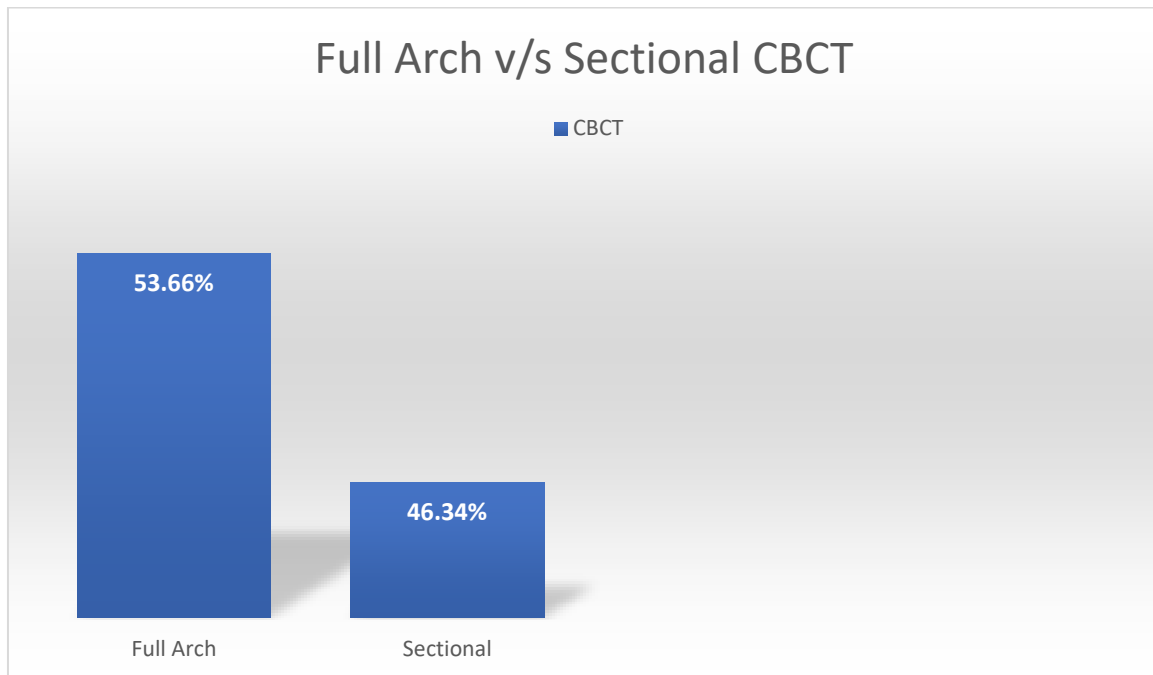


Fig. 4. Distribution of patients based on the type of CBCT scan — Full Arch versus Sectional.

CBCT Type	Number of Patients	Percentage
Full Arch	22	53.66%
Sectional	19	46.34%
Total	41	100%

The bar graph in Fig. 4. illustrates the distribution of Cone Beam Computed Tomography (CBCT) investigations performed for full arch and sectional assessments. It was observed that the number of CBCT scans requested for full arch evaluation (n=22 i.e. 53.66%) was higher compared to sectional evaluation (n=19 i.e. 46.34%). This indicates a greater preference for comprehensive full-arch imaging

IV. Discussion:

The present study aims to determine the proportion of patients referred for Cone Beam Computed Tomography (CBCT) specifically for dental implant planning in the Jalgaon district. By analyzing referral data through a structured, survey-based approach, the study seeks to identify prevailing trends and patterns in CBCT utilization. This analysis will provide insights into the role of CBCT in implant diagnostics and planning among dental practitioners in the region.

Over the past decade, the adoption of Cone-Beam Computed Tomography (CBCT) in implant dentistry has increased significantly, reflecting continuous innovations in imaging technology and growing evidence supporting its diagnostic and clinical value.^{24,25} Recent technological

advancements have not only minimized patient radiation exposure but also substantially improved the precision, resolution, and diagnostic value of CBCT imaging in implant dentistry. In comparison to conventional panoramic radiography, CBCT offers a markedly higher level of diagnostic detail, allowing for three-dimensional evaluation of bone quality, anatomic relationships, and implant site morphology.

In recent years, the use of cross-sectional imaging through Cone-Beam Computed Tomography (CBCT) in implant dentistry has expanded rapidly, driven by continuous scientific and technological advancements.²² These developments have notably reduced radiation exposure while enhancing the quality and accuracy of diagnostic information obtained. Compared with conventional panoramic radiography, CBCT provides a significantly greater amount of diagnostic detail, enabling precise assessment of bone morphology and anatomical landmarks.²³ Currently, CBCT is considered the ideal imaging modality, as it has reduced implant failures by providing accurate information regarding vital structures, bone dimensions, density, and alveolar profile, while ensuring minimal radiation exposure.⁷



The findings of this study underscore the importance of implementing structured training programs and awareness campaigns to improve practitioners' knowledge regarding the use of CBCT in implant diagnostics and planning. Strengthening such educational initiatives can promote evidence-based decision-making and enhance the quality of patient care. Additionally, the observed referral patterns may provide valuable insights for policymakers and dental radiology centers, enabling them to optimize service delivery and resource utilization in accordance with regional demands and referral trends.¹³

Out of the 118 patients included in the study, 41 (34.7%) were referred for CBCT imaging specifically for dental implant planning, indicating that implant-related evaluations constitute a significant portion of CBCT referrals in the Jalgaon district.

According to Melania Olimpia Cojocaru *et al.*, CBCT evaluations are most frequently indicated for implantology procedures, as they play a crucial role in precise pre-surgical planning. Before the surgical placement of dental implants, a comprehensive assessment must be performed to analyze implant dimensions, positioning, and angulation to ensure optimal placement. Pre-surgical evaluation protocols highlight the importance of accurately determining bone volume and identifying adjacent anatomical structures that may influence implant positioning.^{19,20}

CBCT imaging provides essential data regarding the morphological characteristics of the residual alveolar ridge, including bone quality and quantity. Parameters such as vertical bone height, horizontal width, and ridge length are key determinants of the available bone volume, directly influencing the selection of implant diameter and length. Thus, CBCT serves as an indispensable diagnostic tool for achieving safe, precise, and predictable implant placement.^{12,17}

A substantial majority of scans were performed in the pre-operative phase (87.8%). In a systematic review, that there is currently no definitive evidence to support the standard use of CBCT for postoperative evaluation of peri-implant bone, and recommended that at this time, with certain exceptions, intraoral radiography should remain the main diagnostic imaging modality in monitoring implants post-operatively.¹⁶

A substantial majority of scans were performed in the pre-operative phase (87.8%). Three-dimensional presurgical evaluation is essential for accurately identifying vital anatomical structures such as the mandibular canal, maxillary sinus floor, and mental foramen, as well as for

assessing bone quantity and quality. Such detailed assessment enhances the likelihood of successful implant placement and supports precise bone grafting procedures when required. CBCT imaging has now become a routine and widely preferred diagnostic tool, particularly in implant dentistry, owing to its superior accuracy and reliability. (George Fokas *et al.*)¹⁴

The findings suggest a gender-related trend in referral patterns, with females constituting a greater proportion of the total cases assessed for implant planning through CBCT imaging. In contrast, as per Chrcanovic *et al.* 27 203 dental implants were inserted in male patients, with 1185 failures (4.36%), and 25 154 implants were inserted in female patients, with 1039 failures (4.13%).¹⁵ Another study said, of the 2,272 patients referred to the University of Louisville for CBCT scans, 1,316 (58.0%) were women and 956 (42.0%) were men.¹⁸

V. Conclusion:

The present study highlights that a significant proportion of patients referred for Cone Beam Computed Tomography (CBCT) in the Jalgaon district were for dental implant planning, emphasizing the growing reliance on CBCT in implantology. The findings indicate that implantology accounted for the highest number of referrals (34.75%), followed by oral surgery and endodontics. This trend reflects increasing awareness among dental practitioners regarding the importance of three-dimensional imaging for accurate diagnosis, treatment planning, and surgical precision.

CBCT has proven to be an invaluable tool in modern dental practice by providing detailed information about bone dimensions, density, and anatomical landmarks while maintaining low radiation exposure. The results of this study underline the need for continued education and training programs to promote optimal utilization of CBCT technology, ensuring improved diagnostic accuracy and better patient outcomes in implant dentistry and other dental specialties.

Acknowledgment:

The authors acknowledge the *Dental CBCT Centre, Jalgaon*, for their support in providing access to the clinical data, which formed the basis of this study.

References:

- [1]. De Vos, W., Casselman, J., & Swennen, G. (2009). Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: a systematic review of



- the literature. *International journal of oral and maxillofacial surgery*, 38(6), 609-625.
- [2]. Rios, H. F., Borgnakke, W. S., & Benavides, E. (2017). The use of cone-beam computed tomography in management of patients requiring dental implants: an American Academy of Periodontology best evidence review. *Journal of periodontology*, 88(10), 946-959.
- [3]. Jacobs, R., Salmon, B., Codari, M., Hassan, B., & Bornstein, M. M. (2018). Cone beam computed tomography in implant dentistry: recommendations for clinical use. *BMC oral health*, 18(1), 88.
- [4]. Distefano, S., Cannarozzo, M. G., Spagnuolo, G., Bucci, M. B., & Lo Giudice, R. (2023). The “dedicated” CBCT in dentistry. *International Journal of Environmental Research and Public Health*, 20(11), 5954.
- [5]. Fan, W., Zhang, J., Wang, N., Li, J., & Hu, L. (2023). The application of deep learning on CBCT in dentistry. *Diagnostics*, 13(12), 2056.
- [6]. Kamburoğlu, K. (2015). Use of dentomaxillofacial cone beam computed tomography in dentistry. *World journal of radiology*, 7(6), 128.
- [7]. Venkatesh, E., & Elluru, S. V. (2017). Cone beam computed tomography: basics and applications in dentistry. *Journal of Istanbul University faculty of Dentistry*, 51(3 Suppl 1), 102-121.
- [8]. Durack, C., & Patel, S. (2012). Cone beam computed tomography in endodontics. *Brazilian dental journal*, 23, 179-191.
- [9]. Weiss, R., & Read-Fuller, A. (2019). Cone beam computed tomography in oral and maxillofacial surgery: an evidence-based review. *Dentistry journal*, 7(2), 52.
- [10]. Nanjannawar, L. G., Agrawal, J. M., Agrawal, M. S., & Parushetti, A. D. (2013). CBCT in orthodontics: the wave of future. *The journal of contemporary dental practice*, 14(1), 153-157.
- [11]. Patel, S., Dawood, A., Ford, T. P., & Whaites, E. (2007). The potential applications of cone beam computed tomography in the management of endodontic problems. *International endodontic journal*, 40(10), 818-830.
- [12]. Cojocar, M. O., Drăghici, E. C., Khaddour, A. S., Ghiță, R. E., Marinescu, I. R., Simionescu, A. M., ... & Scrieci, M. (2024). Frequency for the use of CBCT analysis in dentistry. *Rom J Dent Res*, 1(2), 6-18.
- [13]. Hol, C., Hellén-Halme, K., Torgersen, G., Nilsson, M., & Møystad, A. (2015). How do dentists use CBCT in dental clinics? A Norwegian nationwide survey. *Acta Odontologica Scandinavica*, 73(3), 195-201.
- [14]. Fokas, G., Vaughn, V. M., Scarfe, W. C., & Bornstein, M. M. (2018). Accuracy of linear measurements on CBCT images related to presurgical implant treatment planning: A systematic review. *Clinical oral implants research*, 29, 393-415.
- [15]. Chrcanovic, B. R., Albrektsson, T., & Wennerberg, A. (2015). Dental implants inserted in male versus female patients: a systematic review and meta-analysis. *Journal of oral rehabilitation*, 42(9), 709-722.
- [16]. Friedlander-Barenboim, S., Hamed, W., Zini, A., Yarom, N., Abramovitz, I., Chweidan, H., ... & Almoznino, G. (2021, August). Patterns of cone-beam computed tomography (CBCT) utilization by various dental specialties: a 4-year retrospective analysis from a dental and maxillofacial specialty center. In *Healthcare* (Vol. 9, No. 8, p. 1042). MDPI.
- [17]. Arnheiter, C., Scarfe, W. C., & Farman, A. G. (2006). Trends in maxillofacial cone-beam computed tomography usage. *Oral Radiology*, 22(2), 80-85.
- [18]. Boyle, E. M. (2010). Emerging trends in cone-beam computed tomography utilization. University of Louisville.
- [19]. Ma, L., Jiang, W., Zhang, B., Qu, X., Ning, G., Zhang, X., & Liao, H. (2019). Augmented reality surgical navigation with accurate CBCT-patient registration for dental implant placement. *Medical & biological engineering & computing*, 57(1), 47-57.
- [20]. Kong, Z. L., Wang, G. G., Liu, X. Y., Ye, Z. Y., Xu, D. Q., & Ding, X. (2021). Influence of bone anatomical morphology of mandibular molars on dental implant based on CBCT. *BMC Oral Health*, 21(1), 528.
- [21]. Hussaini, S., Glogauer, M., Sheikh, Z., & Al-Waeli, H. (2024). CBCT in dental implantology: a key tool for preventing peri-implantitis and enhancing patient outcomes. *Dentistry Journal*, 12(7), 196.
- [22]. Saha, N., & Nair, V. (2023). Role of CBCT in dental implant treatment plan: a review. *J Med Health Res*, 8, 1-5.
- [23]. Guerrero, M. E., Noriega, J., Castro, C., & Jacobs, R. (2014). Does cone-beam CT alter treatment plans? Comparison of preoperative implant planning using panoramic versus



- cone-beam CT images. *Imaging science in dentistry*, 44(2), 121-128.
- [24]. Worthington, P., Rubenstein, J., & Hatcher, D. C. (2010). The role of cone-beam computed tomography in the planning and placement of implants. *The Journal of the American Dental Association*, 141, 19S-24S.
- [25]. Morgan, N., Meeus, J., Shujaat, S., Cortellini, S., Bornstein, M. M., & Jacobs, R. (2023). CBCT for diagnostics, treatment planning and monitoring of sinus floor elevation procedures. *Diagnostics*, 13(10), 1684.