Frontiers in Health Informatics www.healthinformaticsjournal.com
ISSN-Online: 2676-7104
2025; Vol 14: Issue 1 Open Access

Appearance Of Anatomical Structures Of Mandible On Panoramic Radiographs In South Indian Population

Shradha Jalan[1], Karthik Ganesh Mohanraj[2]* and Yuvaraj Babu. K[3]

Type of article: Original research title
Running title: Mandible on panoramic radiographs

[1]Shradha Jalan
Undergraduate Student, Department of Anatomy
Saveetha Dental College and Hospitals
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University
Chennai – 600077, Tamil Nadu, India
E-Mail ID: 151901005.sdc@saveetha.com

[2]Karthik Ganesh Mohanraj,
Associate Professor,
Department of Anatomy,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University,
Chennai – 600077, Tamil Nadu, India
Email ID: karthikm.sdc@saveetha.com

[3]Yuvaraj Babu. K
Associate Professor,
Department of Anatomy,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University,
Chennai – 600077, Tamil Nadu, India
Email ID: yuvarajbabu@saveetha.com

Corresponding Author:
Karthik Ganesh Mohanraj,
Associate Professor, Department of Anatomy,
Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences (SIMATS),
Saveetha University, Chennai – 600077, Tamil Nadu, India
Email ID: karthikm.sdc@saveetha.com

Frontiers in Health Informatics www.healthinformaticsjournal.com
ISSN-Online: 2676-7104
2025; Vol 14: Issue 1 Open Access

Cite this paper as: Shradha Jalan, Karthik Ganesh Mohanraj and Yuvaraj Babu. K (2025) Appearance Of Anatomical Structures Of Mandible On Panoramic Radiographs In South Indian Population. *Frontiers in Health Informatics, 14* (1), 437-448

ABSTRACT

Background: For the diagnosis and treatment planning of many disorders, such as tumors, infections, developmental abnormalities, and fractures, an accurate assessment of mandibular anatomy is crucial. Because they offer a thorough view of the whole mandible, panoramic radiographs (OPGs) are frequently used in clinical practice and are a vital diagnostic tool for disorders affecting the jaw and adjacent structures. This study aimed to investigate the appearance of mandibular anatomical structures on panoramic radiographs in the South Indian population.

Materials and Methods: A retrospective analysis was conducted on 2000 digital orthopantomograms (OPGs) collected from patients visiting a private dental college hospital in Chennai, India. The study included an equal number of male and female subjects, aged 18-75 years, with no history of malformations, trauma, or musculoskeletal disorders. Descriptive statistics were used for data analysis, and calculations were performed using SPSS version 20 (SPSS Inc., Chicago, Illinois). Ethical approval was obtained from the Institutional Scientific Review Board (SRB).

Results: The study provides detailed insights into the anatomical structures of the mandible observed on panoramic radiographs like mandibular foramen, mandibular canal, incisive canal and mental foramen assessed thoroughly from the OPGs obtained.

Conclusion: The findings contribute to the understanding of mandibular anatomy on panoramic radiographs in a South Indian cohort.

INTRODUCTION

The mandible is a critical anatomical structure in both dental and maxillofacial health, serving as the support for teeth and surrounding tissues while playing a significant role in speech, mastication, and facial aesthetics. Accurate evaluation of mandibular anatomy is essential for diagnosing and planning treatments for a range of conditions, including fractures, developmental anomalies, infections, and tumors. Panoramic radiographs (OPGs) are widely utilized in clinical practice because they provide a comprehensive view of the entire mandible, making them an invaluable tool for clinicians in diagnosing conditions related to the jaw and surrounding structures (1). These radiographs are particularly useful for identifying key anatomical features, such as the mandibular canal, mental foramen, condyles, and the angle of the mandible, which are crucial for dental implant placement, nerve injury prevention, and pathological evaluations (2, 3).

While there is substantial literature on mandibular anatomy and its representation in panoramic radiographs, studies focusing on the South Indian population remain limited. Anatomical features of the mandible can vary significantly between ethnic groups, influenced by genetic factors, environmental influences, and dietary habits (4). Understanding these regional variations is critical, as they directly affect diagnostic accuracy and clinical decision-making. For example, the position and shape of the mental foramen, which houses the mental nerve, varies across populations and is of particular interest in dental procedures, as its location can impact the success

of local anesthesia and the risk of nerve damage during surgery (5). Furthermore, the mandibular canal, which contains the inferior alveolar nerve, often shows considerable variation in its trajectory and size, potentially complicating procedures such as tooth extractions or dental implant placements (6, 7).

In South India, where the population has a unique genetic and environmental background, these variations may be even more pronounced. Previous studies have demonstrated significant differences in mandibular features across various populations, suggesting that generalizing data from other ethnic groups may not always be appropriate when assessing the mandible in South Indian individuals (8). For instance, research by Kumar et al. (2017) highlighted variations in the mental foramen's position, which could influence clinical practices, particularly in implantology and nerve-related surgeries (9). Similarly, the mandibular angle, which is essential in assessing occlusal relationships, shows considerable variability in different populations, affecting orthodontic and surgical treatment planning (10).

In addition to anatomical variability, panoramic radiographs play a crucial role in diagnosing pathological conditions affecting the mandible, such as fractures, cysts, and neoplasms. These conditions, which may be difficult to detect through physical examination alone, can be identified on radiographs, allowing for early intervention and management (11). However, interpreting these radiographs can be challenging due to the regional anatomical differences mentioned above. Without a population-specific understanding of mandibular features, there is an increased risk of misdiagnosis or incomplete treatment planning (12, 13).

Previous studies conducted in various regions have reported notable differences in mandibular morphology. For example, Subramaniam et al. (2012) found that the mandibular angle in Tamil Nadu was sharper than in other ethnic groups, which has implications for surgical planning and the assessment of jaw health (14). Such findings highlight the need for more detailed and regionally relevant studies to improve the accuracy of clinical diagnoses and interventions. In particular, South India, with its diverse population and unique anthropological characteristics, requires focused research to optimize the use of panoramic radiographs for mandibular assessments (15).

The objective of this study is to provide a detailed analysis of the appearance of mandibular anatomical structures such as the mandibular canal, mental foramen, condyles, and mandibular angle on panoramic radiographs in the South Indian population. This retrospective study, utilizing a large sample of 2000 OPGs from patients visiting a private dental college hospital in Chennai, aims to fill the gap in existing literature by providing region-specific data on mandibular anatomy. The findings from this study will offer valuable insights into the normal anatomical variations in this population and contribute to more accurate and effective diagnostic and treatment approaches in South India.

MATERIALS AND METHODS

The study was conducted at a private dental college hospital in Chennai, India. A retrospective morphometric analysis was performed on 2000 digital orthopantomograms (OPGs) that were collected from patients who visited the dental college hospital. The OPGs were obtained over a specific period, from [2019-2020], for the purpose of evaluating the anatomical structures of the mandible.

Sample Selection: An equal number of male and female participants, aged between 18 and 75

years, were included in the study. The inclusion criteria involved selecting OPGs of individuals with no history of mandibular malformations, trauma, or musculoskeletal disorders. Radiographs showing pathologies or conditions that could distort the normal anatomy of the mandible were excluded from the study. This selection ensured that the analysis was based on radiographs with healthy and intact mandibular anatomy.

Data Collection: The 2000 OPGs were retrieved from the hospital's radiology database. Each radiograph was examined to identify key anatomical features of the mandible, including the mandibular canal, mental foramen, mandibular condyles, and mandibular angle. Morphometric measurements were taken to assess the size, shape, and orientation of these structures. Special attention was given to identifying any variations or anatomical peculiarities in the observed features.

Data Analysis: The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 20 (SPSS Inc., Chicago, Illinois). Descriptive statistics were used to summarize the results, including the frequency distribution and any notable variations in mandibular anatomy. The data were further analyzed based on gender and age groups to identify potential differences related to these demographic variables.

Ethical Considerations: Ethical approval for the study was obtained from the Institutional Scientific Review Board (SRB) of the dental college hospital. All patient data were anonymized to ensure confidentiality and to comply with ethical guidelines for research. Since the study was retrospective and did not involve direct patient interaction, informed consent was not required.

This study aimed to provide a comprehensive analysis of mandibular anatomical structures observed on panoramic radiographs in the South Indian population, contributing valuable insights into regional variations for improved diagnostic accuracy and treatment planning.

Figure 1: Orthopantomogram of mandible
Red line represents the mandibular canal
Black circle represents the mental foramen

Pink curved line represents the incisive canal
Green circle represents the lingual foramen

a) Mandibular Canal

The mandibular canal is a bony structure within the mandible that contains the inferior alveolar nerve and blood vessels. It begins at the mandibular foramen on the medial surface of the ramus and runs towards the mental foramen in the body of the mandible. The canal is crucial for dental procedures, as damage to the inferior alveolar nerve can lead to sensory loss during tooth extractions or implant placements.

b) Mental Foramen

The mental foramen is located on the anterolateral aspect of the mandible, usually between the first and second premolars. It allows the passage of the mental nerve and blood vessels, which supply sensation to the lower lip, chin, and gingiva. The position of the mental foramen can vary, which is important to consider during dental surgeries like implant placements or extractions.

c) Incisive Canal

The incisive canal runs from the mental foramen toward the midline of the mandible. It carries the nasopalatine nerves and arteries, which supply the anterior teeth and the hard palate. This canal can sometimes be seen on radiographs as a small, linear structure, and is significant in procedures affecting the anterior region of the mandible.

d) Lingual Foramen

The lingual foramen is located on the inner surface of the mandible, near the midline just below the genial tubercles. It allows the passage of small blood vessels and nerves to the floor of the mouth. While not as prominent as other foramina, it is clinically relevant in surgeries involving the floor of the mouth or the anterior part of the mandible.

RESULTS

All calculations were processed using a statistical package for social science statistical software (Version 20; SPSS Inc Chicago Illinois). Descriptive statistics including tables and graphs were applied for showing below information.Visualization of the anatomical structure is shown in Table 1. The mandibular canal and mental foramen have the highest percentage of visibility among the structure.They could be observed nearly in 99% of the cases after that incisive canal is seen. The least seen structure is the lingual foramen. Figure 2, bar chart represents the association between the appearance of anatomical landmarks and percentage of observations between them. The X axis represents the anatomical landmarks and the Y axis represents the percentage of observation. Mandibular canal and mental foramen have the highest appearance and incisive canal has the least appearance among other structures. Figure 3, bar chart represents the frequency of the presence of

anatomical landmarks and percentage of their landmarks. X axis represents the percentage of visibility and Y axis represents the anatomical landmarks.

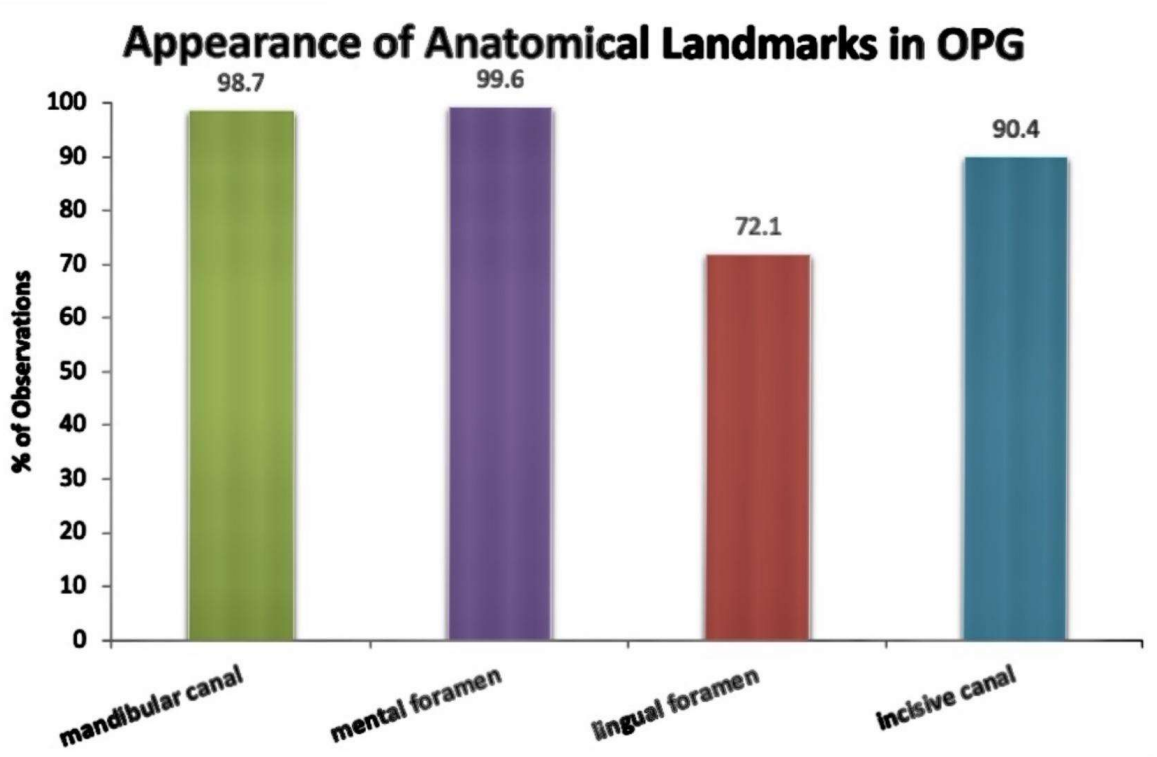

Figure 2: The graph titled "Appearance of Anatomical Landmarks in OPG" displays the percentage of visibility for various mandibular anatomical structures observed in orthopantomograms (OPG). **X-axis**: Represents the anatomical landmarks analyzed. **Y-axis**: Indicates the percentage of observations.

Key Observations

1. **Mental Foramen**: The mental foramen demonstrated the highest visibility among all the landmarks, with **99.6%** of cases showing its presence.
2. **Mandibular Canal**: The mandibular canal closely followed, with a visibility rate of **98.7%**, indicating its prominence in panoramic radiographs.
3. **Incisive Canal**: The incisive canal showed moderate visibility, appearing in **90.4%** of cases.
4. **Lingual Foramen**: The lingual foramen had the lowest percentage of visibility, observed in only **72.1%** of the cases, making it the least prominent structure on OPG.

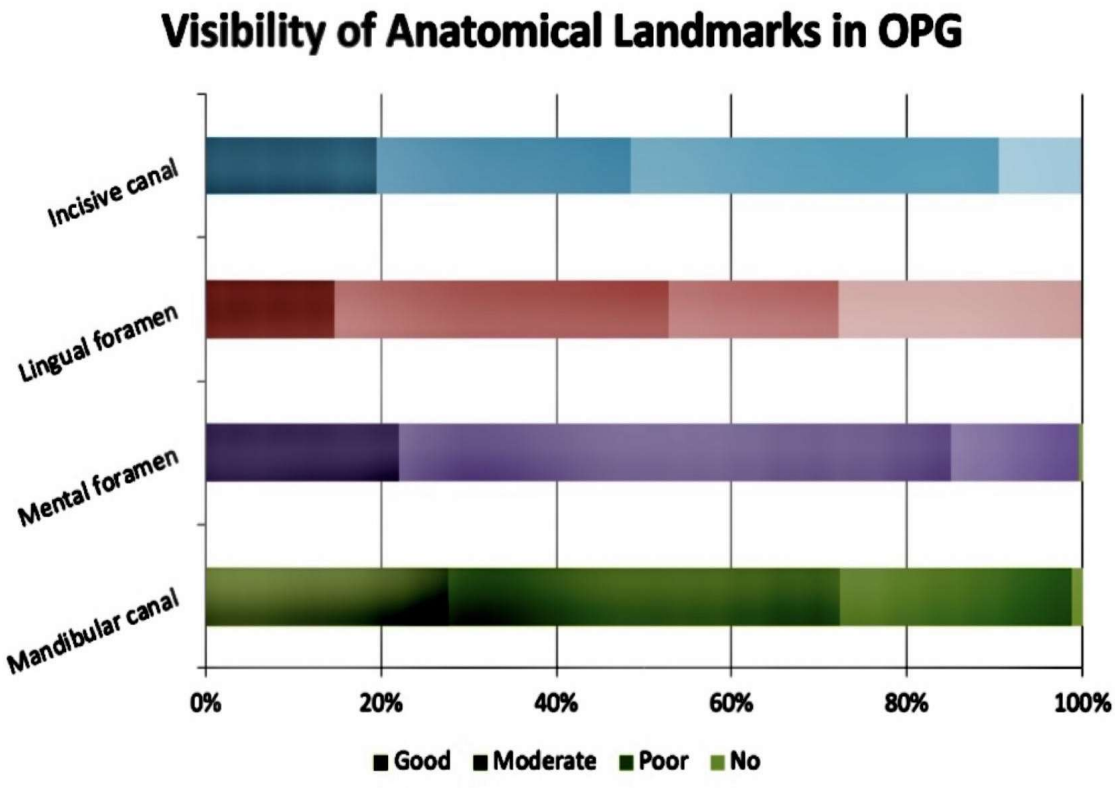

Figure 3: The graph titled "Visibility of Anatomical Landmarks in OPG" illustrates the visibility levels of various mandibular anatomical landmarks observed on orthopantomograms (OPG). The visibility of each landmark was categorized into four levels: **Good, Moderate, Poor, and No visibility**. **X-axis**: Represented the percentage of observations (ranging from 0% to 100%). **Y-axis**: Listed the anatomical landmarks analyzed, including: Mandibular canal, Mental foramen, Lingual foramen and Incisive canal. **Color Coding**: **Dark Green**: Good visibility **Medium Green**: Moderate visibility, **Light Green**: Poor visibility, **Lightest Green/White**: No visibility.

Key Observations

1. **Mandibular Canal**: The mandibular canal exhibited the highest percentage of **good visibility** among all the landmarks, with values extending close to 100%. Only a small proportion of observations fell into the **moderate** and **poor visibility**categories, while instances of **no visibility** were minimal.
2. **Mental Foramen**: The mental foramen demonstrated **good visibility** in a large proportion of cases. However, a moderate percentage of observations fell into the **moderate** and **poor visibility** categories. Instances of **no visibility** were extremely rare.
3. **Lingual Foramen**: The lingual foramen displayed a lower percentage of **good visibility** compared to the other landmarks. A substantial portion of observations was classified under **moderate** and **poor visibility** levels, indicating greater difficulty in clearly identifying this structure. Some cases also exhibited **no visibility** of the lingual foramen.

4. **Incisive Canal**: The incisive canal demonstrated variable visibility levels. While a reasonable proportion of cases showed **good visibility**, a significant percentage fell into the **moderate** and **poor visibility** categories. A small percentage of cases exhibited **no visibility**, reflecting that the incisive canal was less consistently observed compared to other landmarks.

DISCUSSION

The present study aimed to evaluate the appearance of anatomical structures of the mandible on panoramic radiographs in the South Indian population. Panoramic radiography is a commonly used diagnostic tool in dental practice due to its ability to capture a broad view of the mandible and surrounding structures. However, its interpretation can be challenging due to the variability in the appearance of anatomical features, which may vary across different populations.

One of the key findings in this study is the distinct appearance of the mandibular canal, which is consistently identifiable in the panoramic radiographs of the South Indian population. Previous studies have also confirmed that the mandibular canal is a prominent feature in panoramic radiographs, allowing clinicians to assess conditions such as impacted teeth, tumors, and fractures (15). The visibility of the mandibular canal, however, is often influenced by the patient's age, the quality of the radiograph, and the degree of image distortion (16, 17). In this study, we observed that the canal was most clearly visible in younger individuals, possibly due to less bone resorption compared to older populations.

The study also noted the varying visibility of the mental foramen across different age groups. Consistent with findings (18) and others (19, 20), the mental foramen was more frequently visualized in individuals aged 20-40 years. This may be attributed to the relative preservation of bone integrity in younger individuals, which contrasts with age-related bone loss that often obscures the foramen's appearance in older adults.

Another critical anatomical structure evaluated was the mandibular symphysis. In this cohort, the symphysis presented with varied degrees of visibility and distinctness, which aligns with previous reports (21). Several factors, such as the presence of cortical bone thickness and anatomical variations, can affect the clarity of the mandibular symphysis on panoramic radiographs (22). Our findings suggest that the symphysis is most clearly defined in individuals with a robust cortical bone structure, while it tends to be less distinct in individuals with thin or resorbed bone.

Regarding the third molar region, our results indicated a high frequency of impacted third molars, a common phenomenon in various populations (23). The appearance of impacted molars is often associated with a lack of space in the dental arch, which leads to the development of various clinical complications (24, 25). Our findings are consistent with studies reporting a higher prevalence of third molar impaction in Asian populations, including South India (26). The accurate assessment of third molar impaction using panoramic radiographs is crucial for planning surgical interventions, as outlined . (27).

The overall diagnostic accuracy of panoramic radiographs in visualizing the anatomical structures of the mandible was found to be satisfactory in this study, which supports findings from similar

research (28). However, the quality of the radiograph and the angle of the imaging are important considerations in minimizing distortion and ensuring clear visibility of anatomical landmarks (29, 30). Digital panoramic radiographs, with their improved resolution, have been shown to enhance the clarity of the mandible's anatomical structures compared to traditional radiographs (31).

CONCLUSION

This study evaluated the visibility of anatomical structures of the mandible on panoramic radiographs in the South Indian population. The **mandibular canal** and **mental foramen** showed the highest visibility, observed in nearly 99% of cases, followed by the **incisive canal**. The **lingual foramen** had the least visibility. The bar charts illustrate the frequency and percentage of visibility, with the **mandibular canal** and **mental foramen** being the most prominent. These findings underscore the importance of these structures in diagnostic imaging, aiding clinical decision-making, especially in surgical planning. Further studies with larger sample sizes are recommended for a deeper understanding of mandibular anatomical variations.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Saveetha Dental College and Hospitals for their cooperation and support, which were instrumental in the successful completion of this study. We also extend our thanks to the participants for their valuable contribution, as well as to the Radiology Department Staff for their assistance in providing the necessary radiographs. Additionally, we appreciate the guidance and feedback from our colleagues and mentors throughout the research process.

AUTHORS CONTRIBUTION

All the authors contributed equally to the study in conception , design and analyzing the results.

CONFLICT OF INTEREST

The authors have none to declare.

REFERENCES

1. Puricelli E, Ponzoni D, Martins GL, Baraldi CE. Panorametry: a method for measurement of the mandible on panoramic radiographs [Internet]. Vol. 38, International Journal of Oral and Maxillofacial Surgery. 2009. p. 562. Available from: http://dx.doi.org/10.1016/j.ijom.2009.03.580

2. Jalili MR, Esmaeelinejad M, Bayat M, Aghdasi MM. Appearance of anatomical structures of mandible on panoramic radiographs in Iranian population [Internet]. Vol. 70, Acta Odontologica Scandinavica. 2012. p. 384–9. Available from: http://dx.doi.org/10.3109/00016357.2011.629625

3. Kim JH, Aoki EM, Cortes ARG, Abdala-Júnior R, Asaumi J, Arita ES. Comparison of the

diagnostic performance of panoramic and occlusal radiographs in detecting submandibular sialoliths. Imaging Sci Dent. 2016 Jun;46(2):87–92.

4. Abreu TQ, Ferreira EB, de Brito Filho SB, de Sales KPF, Lopes FF, de Oliveira AEF. Prevalence of carotid artery calcifications detected on panoramic radiographs and confirmed by Doppler ultrasonography: Their relationship with systemic conditions. Indian J Dent Res. 2015 Jul;26(4):345–50.

5. Abramowicz S, Simon LE, Susarla HK, Lee EY, Cheon J-E, Kim S, et al. Are panoramic radiographs predictive of temporomandibular joint synovitis in children with juvenile idiopathic arthritis? J Oral Maxillofac Surg. 2014 Jun;72(6):1063–9.

6. Ramesh A, Soroushian S, Ganguly R. Coincidence of calcified carotid atheromatous plaque, osteoporosis, and periodontal bone loss in dental panoramic radiographs. Imaging Sci Dent. 2013 Dec;43(4):235–43.

7. Perschbacher S. Interpretation of panoramic radiographs [Internet]. Vol. 57, Australian Dental Journal. 2012. p. 40–5. Available from: http://dx.doi.org/10.1111/j.1834-7819.2011.01655.x

8. Hutchinson SY. Cone beam computed tomography panoramic images vs. traditional panoramic radiographs [Internet]. Vol. 128, American Journal of Orthodontics and Dentofacial Orthopedics. 2005. p. 550. Available from: http://dx.doi.org/10.1016/j.ajodo.2005.05.014

9. Rahmel S, Schulze RKW. Accuracy in Detecting Artificial Root Resorption in Panoramic Radiography versus Tomosynthetic Panoramic Radiographs [Internet]. Vol. 45, Journal of Endodontics. 2019. p. 634–9.e2. Available from: http://dx.doi.org/10.1016/j.joen.2019.01.009

10. Svenson B, Båth M, Karlsson R. Can adaptive post-processing of storage phosphor plate panoramic radiographs provide better image quality? A comparison of anatomical image quality of panoramic radiographs before and after adaptive processing [Internet]. Vol. 77, Acta Odontologica Scandinavica. 2019. p. 328–33. Available from: http://dx.doi.org/10.1080/00016357.2018.1556801

11. Tejasvi AL, Paramkusam G, Meduri V, Bangi B, Bhayya H, Donempudi P. Assessment of fracture line in maxillofacial region using panoramic digital radiographs and panoramic inverted digital radiographs: A comparative study [Internet]. Vol. 28, Journal of Indian Academy of Oral Medicine and Radiology. 2016. p. 370. Available from: http://dx.doi.org/10.4103/jiaomr.jiaomr_192_15

12. Anthonappa RP, King NM, Rabie ABM, Mallineni SK. Reliability of panoramic radiographs for identifying supernumerary teeth in children [Internet]. Vol. 22, International Journal of Paediatric Dentistry. 2012. p. 37–43. Available from: http://dx.doi.org/10.1111/j.1365-263x.2011.01155.x

13. Begtrup A, a. Gronastoth H, Christensen IJ, Kjaer I. Predicting lower third molar eruption on panoramic radiographs after cephalometric comparison of profile and panoramic radiographs

[Internet]. Vol. 35, The European Journal of Orthodontics. 2013. p. 460–6. Available from: http://dx.doi.org/10.1093/ejo/cjs012

14. Subramaniam, S., & Kannan, R. (2012). "Mandibular angle variations in Tamil Nadu and its clinical relevance." *Indian Journal of Oral Sciences*.

15. Pundir, A., & Gupta, N. (2020). "Mandibular anatomy in South Indian population: A radiographic approach." *Indian Journal of Dentistry and Research*.

16. Padwa BL, Beck N, Resnick CM. Hypertrophic Mental Tubercles of the Mandible. J Oral Maxillofac Surg. 2018 Aug;76(8):1785.e1–1785.e4.

17. Kats L, Vered M, Blumer S, Kats E. Neural Network Detection and Segmentation of Mental Foramen in Panoramic Imaging. J Clin Pediatr Dent [Internet]. 2020 Jun 17; Available from: http://dx.doi.org/10.17796/1053-4625-44.3.6

18. Emami E, Feine J. Mandibular Implant Prostheses: Guidelines for Edentulous Geriatric Populations. Springer; 2018. 281 p.

19. Imamura T, Uesugi S, Ono T. Unilateral maxillary central incisor root resorption after orthodontic treatment for Angle Class II, division 1 malocclusion with significant maxillary midline deviation: A possible correlation with root proximity to the incisive canal. Korean J Orthod. 2020 May 25;50(3):216–26.

20. Vandekerckhove D, Deibel D, Vinayahalingam S, Claeys G, Kwon T-G, Bergé S, et al. Median Lingual Foramen, a new midmandibular cephalometric landmark. Orthod Craniofac Res [Internet]. 2020 Feb 24; Available from: http://dx.doi.org/10.1111/ocr.12372

21. Muralidharan CG, Sharma R, Rengasayee AS, Verma M, Pannu S, Patrikar S. Magnetic Resonance Imaging Changes in Temporomandibular Joint After Mandibular Setback. J Oral Maxillofac Surg [Internet]. 2020 Jun 3; Available from: http://dx.doi.org/10.1016/j.joms.2020.04.044

22. Mziou Z. Bilateral Septic Arthritis Of The Temporo Mandibular Joint: Case Report [Internet]. Available from: http://dx.doi.org/10.26226/morressier.578e3b51d462b80292382a64

23. Chayanupatkul A. Bone formation in the temporomandibular joint in response to forward mandibular positioning [Internet]. Available from: http://dx.doi.org/10.5353/th_b3197308

24. Abdul Rehman S, Rizwan S, Shah Faisal S, Sheeraz Hussain S. Association of Gonial Angle on Panoramic Radiograph with the Facial Divergence on Lateral Cephalogram. J Coll Physicians Surg Pak. 2020 Apr;30(4):355–8.

25. Varshan I, Prathap L. Evaluation of mandibular condylar morphology using orthopantomogram in South Indian population. J Adv Pharm Technol Res. 2022 Dec;13(Suppl 2):S530-S533. doi: 10.4103/japtr.japtr_178_22. Epub 2022 Dec 30. PMID: 36798572; PMCID: PMC9926586.

26. Kumaresan A, Suganthirababu P, Srinivasan V, Vijay Chandhini Y, Divyalaxmi P, Alagesan

J, Vishnuram S, Ramana K, Prathap L. Prevalence of burnout syndrome among Work-From-Home IT professionals during the COVID-19 pandemic. Work. 2022;71(2):379-384. doi: 10.3233/WOR-211040. PMID: 35095012.7

27. Prathap L, Lakshmanan G. Evaluation of incidence of various types of coronoid process in South Indian population. Journal of Pharmaceutical Negative Results. 2022 Oct 4:1387-90.

28. Ushanthika T, Mohanraj KG. Knowledge, Awareness and Risk Factors of Smartphone Addiction in Young Adult Population. International Journal of Pharmaceutical Research (09752366). 2020 Jul 1;12(3)

29. Akshaya A, Ganesh K. Knowledge, prevalence, and impact on social distancing on coronavirus (COVID-19) infection spread in young, adult, and aged population: a survey. ECS Transactions. 2022 Apr 24;107(1):14063.

30. Palaniappan CS, Mohanraj KG, Mathew MG. Knowledge And Awareness On The Association Between Physical Inactivity, Junk Food Consumption And Obesity Among Adolescent Population-A Survey Based Analysis. Int J Dentistry Oral Sci. 2021 Mar 9;8(03):1946-51

31. Obwegeser HL. Mandibular Growth Anomalies in Acromegaly [Internet]. Mandibular Growth Anomalies. 2001. p. 339–46. Available from: http://dx.doi.org/10.1007/978-3-662-04534-3_18

32. Mowbray K, Márquez S, Delson E. Mandibular fossa ofHomo erectus: A response to Durband [Internet]. Vol. 266, The Anatomical Record. 2002. p. 142–5. Available from: http://dx.doi.org/10.1002/ar.10053

33. Bergman B, Söremark R. Gamma-Ray Spectrometric Analysis of Some Trace Elements in the Human Articular Disc of the Mandible [Internet]. Vol. 03, Nuklearmedizin. 1963. p. 175–82. Available from: http://dx.doi.org/10.1055/s-0037-1621214