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Original Research Article

USE OF CONE BEAM COMPUTED TOMOGRAPHY GRAY SCALE VALUES FOR DIAGNOSING TUMORS AND CYSTS

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Abstract: *The retrospective study was conducted in the Department of Radiology of the hospital from January 2022 to January 2023 to assess the ability of CBCT gray scale value to diagnose tumors and cysts and evaluate differences in bony changes of both. A total of 50 patients were included in the study. CBCT scanner with 68-1073μSv radiation dose was used for obtaining 3D images. Gray scale values were obtained on the tangential section. Radiological diagnosis was made after calculating mean gray values for benign lesions or cysts. Myxoma, odontogenic ghost cell tumor, and the adenomatoid odontogenic tumor had lower grayscale values, and multiple myeloma, cementoblastoma, acanthomatous ameloblastoma, residual cyst, and lateral periodontal cyst had higher values. The mean grayscale value for the tumor was 1468 ± 70.5, and for the cyst was 1292.1 ± 6.5. There was a significant correlation between both (P<0.001). The bone density of normal and pathological maxillofacial regions was compared. The radiolucent area (e.g., axillary sinus) had the lowest, and the radiopaque region (e.g., enamel) had the highest gray scale value. CBCT gray value is a powerful diagnostic tool for tumors, cysts, and other orofacial lesions and has better outcomes than conventional 2-D imaging.*

Keywords: Cone Beam Computed Tomography, Maxillofacial Lesions, Grayscale

Introduction

Dental radiography is essential for diagnosing orofacial pathologies. Traditionally, diagnosis is based on histopathological, radiological, and clinical examination. However, conventional radiography does not differentiate between cysts and tumors. Due to this limitation, cone beam computed tomography (CBCT) is becoming increasingly popular. Several three-dimensional CBCT systems provide a better alternative to conventional dental radiography (Scarfe, 2019). Developed CBCT systems with high-contrast images and lower radiation exposure are now used to diagnose orofacial pathologies. CBCT images help in complex diagnosis, bone density assessment, and pathologies (Langella et al., 2023). A study has shown that CBCT gray scale and CT Hounsfield unit (HU) have a linear relationship (Razi et al., 2019).

CBCT can detect minor contrast differences so that it can display different attenuations. It is called bit depth and determines shades of gray in the system for displaying attenuation. CBCT detectors can detect gray scale difference≥ 12 bit. The 12-bit detector has 4096 shades for displaying contrast, and the 16-bit detector has 65,536 shades. It is possible to obtain increased bit depth in CBCT imaging, but it needs a larger file and more computational time. Some studies report the usefulness of CBCT imaging for detecting cysts and tumors (Etöz et al., 2021; Ver Berne et al., 2023). However, there are limited studies about its application in dentistry. This study aims to assess the ability of CBCT gray scale value to diagnose tumors and cysts and evaluate the difference in bony changes of both.

Methodology

The retrospective study was conducted in the Department of Radiology of the hospital from January 2022 to January 2023. The study included patients suspected of mixed lesions, maxillofacial tumors (benign non odontogenic or odontogenic), or cysts that appeared radiolucent on the conventional radiograph. Patients with maxillofacial trauma, pregnant females, and radiopaque tumors or cysts were excluded. Informed consent of the participants was taken. The ethical board of the hospital approved the study.

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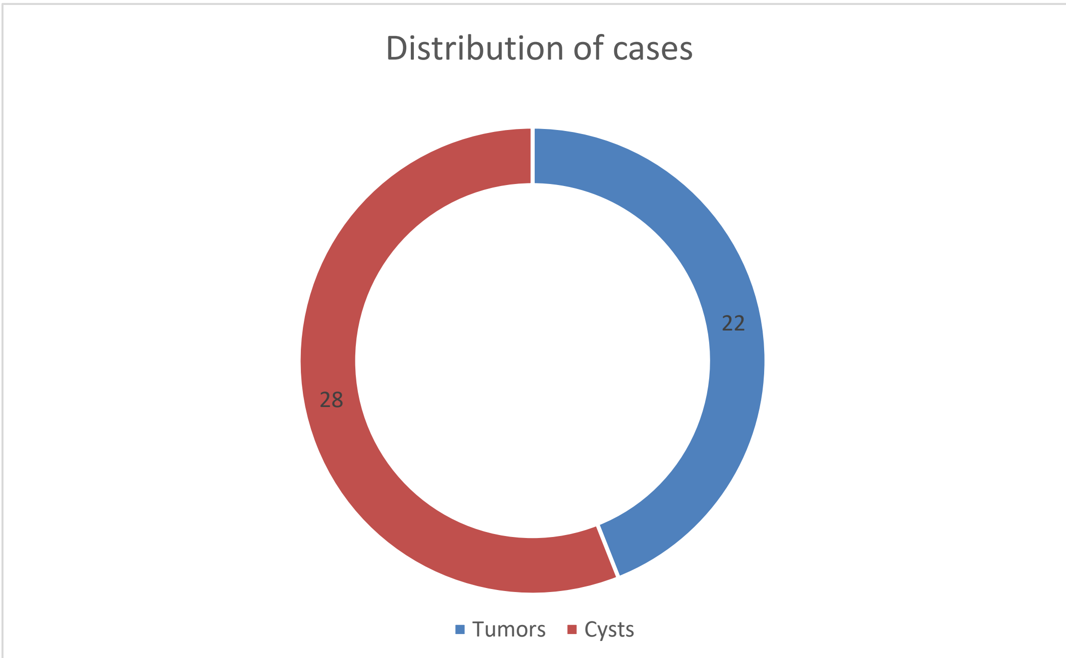
2D panoramic and periapical radiographs of all patients were taken. CBCT scanner with 68-1073 µSv radiation dose was used for obtaining 3D images. The radiographic images of lesions were interpreted based on four criteria, including the effect on adjacent structure, shape and periphery, internal structure, and shape. Gray scale values were obtained on the tangential section. A reference point was taken to analyze the values, and the lesions' epicenter was evaluated. The epicenter was located at the intersection point of two perpendicular lines. The epicenter was located at the region without any bony trabeculae for mixed lesions. Radiological diagnosis was made after calculating mean gray values for benign lesions or cysts.

SPSS version 23.0 was used for data analysis. Inferences were drawn. P value < 0.001 was considered statistically significant

Results

A total of 50 patients were included in the study. There were 22 cases of tumors and 28 cases of cysts (Figure 1).



The mean age of patients with cysts was 29.4 years, and of patients with tumors was 34.1 years. Clinical symptoms, including facial asymmetry, swelling, consistency, and pain, were reported in patients with the provincial diagnosis of tumors and cysts. In patients with cysts, 16 (57.1%) had pain, 9 (32.1%) had swelling, and 3 (10.7%) had facial asymmetry. In patients with tumors, 10 (45.4%) patients had pain, 17 (77.2%) had swelling, and 14 (63.6%) had facial asymmetry. Intraoral findings in cysts and tumors included pus discharge, expansion, vestibular obliteration, and missing, mobile, or displaced teeth. The expansion was categorized into lingual and buccal and was more common in tumors than cysts. 6 (27.2%) tumor cases had a lingual and buccal expansion, and 3 (10.7%) cysts had buccal expansion. As detected by radiography, the lesion location is shown in Table I. 27 (96.4%) cysts appeared radiolucent, while 8 (36.3%) tumors were radiolucent. 8 (28.5%) cysts and 2 (9%) tumors had well-defined boundaries. 18 (81.8%) tumors and 17 (60.7%) cysts had significantly ill-defined boundaries. 5 (17.8%) cases of cysts and 4 (18.1%) tumors were associated with root resorption. 1 (4.5%) case of tumor and 4 (14.2%) cyst cases were associated with expansion of cortical plate and teeth displacement.

Gray scale values from the epicenter of the lesion were used to calculate bone density (Table II). Myxoma, odontogenic ghost cell tumor, and the adenomatoid odontogenic tumor had lower grayscale values, and multiple myeloma, cementoblastoma, acanthomatous ameloblastoma, residual cyst, and lateral periodontal cyst had higher values. The mean grayscale value for the tumor was 1468 ± 70.5, and for the cyst was 1292.1 ± 6.5. There was a significant correlation between both (P<0.001). The bone density of normal and pathological maxillofacial regions was compared. The radiolucent area (e.g., axillary sinus) had the lowest, and the radiopaque region (e.g., enamel) had the highest gray scale value (Table III).

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Table I Regional distribution of lesions

Site	Cyst	Tumor
Anterior maxilla	10	1
Posterior right maxilla	6	1
Posterior left maxilla	3	1
Right maxillary sinus	2	0
Left maxillary sinus	0	0
Posterior mandible	5	12
Posterior left mandible	2	7
Total	28	22

Table II Mean grayscale reading in various cysts

Cyst	Mean grayscale value (± standard deviation)
Aneurysmal bone cyst	1230
Dentigerous cyst	1303 ± 145.4
Infected radicular cyst	1337.7 ± 57.6
Lateral periodontal cyst	1385
Odontogenic keratocyst	1259 ± 17.51
Radicular cyst	1240.8 ± 68.9
Residual cyst	1364.4± 72.5

Table III Mean gray scale value at different sites

Site	The mean gray scale value
Enamel	3101
Dentin	2456
Pulp	1332
Cancellous bone	1286
Cortical bone	2353
Inferior alveolar nerve	1154
Maxillary sinus	498

Discussion

Maxillofacial lesions, including cysts and tumors, can be odontogenic or non-odontogenic. Non-mineralized odontogenic lesions, including odontogenic keratocyst, dentigerous cyst, and ameloblastoma, appear well-defined, well corticated, unilocular lesions associated with impacted teeth. Mineralized odontogenic lesions, including compound and complex odontomas, appear as multiple masses(Hung et al., 2022). Non-odontogenic benign fibro-osseous lesions resemble odontogenic lesions and are difficult to diagnose and differentiate using 2D imaging(Santosh and Ogle, 2020). The advent of 3-D CT imaging has revolutionized radiology. CT imaging measures radiation attenuation in Housefield Unit (HU) tissues. HU measures quantitative scale and radio density(Rai et al., 2020). Dental CBCT has various advantages, such as lower radiation doses, high resolution, and smaller equipment. CBCT scanner has software containing the data set of the case. This software contains tools for measuring multi-planer dimension, radiographic density, and men voxel gray values(Marar et al., 2020). Gray values in CBCT are approximate, and pixel intensity (PI) does quantitative and qualitative architecture and bone density analysis. The size and number of pixels and available shades of gray determine the quantity of information in radiography(Karjodkar, 2019).

The current study shows a significant correlation between the grayscale values of tumors and cysts because of differences in bone density. Due to this, it can be an important diagnostic tool. Studies have reported that gray values are higher than conventional HU values (Assouline et al., 2021; Slaidina et al., 2022). A study reported that CBCT is more effective for evaluating jaw lesions than multi-slice computed tomography(Cardoso et al., 2020). Another study reported that HU can be clinically derived from grayscale values of CBCT(Weiss and Read-Fuller, 2019). This, along with reduced radiation exposure, greater resolution, and increased assessment, make

CBCT an accurate modality for diagnosing orofacial pathology. It was reported that the grayscale has a correlation coefficient of .99, standard for bone density calculation, and the presence of soft tissue alters the outcome. In a previous study, 256 gray scales were used to obtain radiographic images. It was concluded that granulomas have a lower grayscale value and narrower range than cysts (De Rosa et al., 2020). Another study conducted to evaluate periapical lesions reported that the grayscale value helps provide a differential diagnosis of solid and fluid-filled cavities (Chanani and Adhikari, 2017). Similarly, other studies have also reported the usefulness of the CBCT gray scale for differential diagnosis and treatment planning of bony lesions(Antony et al., 2020; Karamifar et al., 2020). The limitation of this study is its small size; a larger study is recommended for detailed analysis.

Conclusion

CBCT gray value is an important diagnostic tool for tumors, cysts, and other orofacial lesions and has better outcomes than conventional 2-D imaging.

Conflict of interest

The authors declared an absence of conflict of interest.

References

Antony, D. P., Thomas, T., and Nivedhitha, M. (2020). Two-dimensional periapical, panoramic radiography versus three-dimensional cone-beam computed tomography in the detection of periapical lesion after endodontic treatment: A systematic review. *Cureus* **12**.

Assouline, S. L., Meyer, C., Weber, E., Chatelain, B., Barrabe, A., Sigaux, N., and Louvrier, A. (2021). How useful is intraoperative cone beam computed tomography in maxillofacial surgery? An overview of the current literature. *International journal of oral and maxillofacial surgery* **50**, 198-204.

Cardoso, L. B., Lopes, I. A., Ikuta, C. R. S., and Capelozza, A. L. A. (2020). Study between panoramic radiography and cone beam-computed tomography in the diagnosis of ameloblastoma, odontogenic keratocyst, and dentigerous cyst. *Journal of Craniofacial Surgery* **31**, 1747-1752.

Chanani, A., and Adhikari, H. D. (2017). Reliability of cone beam computed tomography as a biopsy-independent tool in differential diagnosis of periapical cysts and granulomas: An In vivo Study. *Journal of Conservative Dentistry: JCD* **20**, 326.

De Rosa, C. S., Bergamini, M. L., Palmieri, M., de Santana Sarmento, D. J., de Carvalho, M. O., Ricardo, A. L. F., Hasseus, B., Jonasson, P., Braz-Silva, P. H., and Costa, A. L. F. (2020). Differentiation of periapical granuloma from radicular cyst using cone beam computed tomography images texture analysis. *Heliyon* **6**.

Etöz, M., Amuk, M., Avcı, F., and Yabacı, A. (2021). Investigation of the effectiveness of CBCT and gray scale values in the differential diagnosis of apical cysts and granulomas. *Oral Radiology* **37**, 109-117.

Hung, K. F., Ai, Q. Y. H., Wong, L. M., Yeung, A. W. K., Li, D. T. S., and Leung, Y. Y. (2022). Current Applications of Deep Learning and Radiomics on CT and CBCT for Maxillofacial Diseases. *Diagnostics* **13**, 110.

Karamifar, K., Tondari, A., and Saghiri, M. A. (2020). Endodontic periapical lesion: an overview on the etiology, diagnosis and current treatment modalities. *European Endodontic Journal* **5**, 54.

Karjodkar, F. R. (2019). "Essentials of oral & maxillofacial radiology," Jaypee Brothers Medical Publishers.

Langella, J., Finkelman, M. D., Alon, E., Fida, Z., Martin, A., and Amato, R. (2023). Incidental findings in small field of view cone-beam computed tomography scans, part 2: interpretation with aid of a checklist. *Journal of Endodontics* **49**, 390-394.

Marar, R. F. A., Uliyan, D. M., and Al-Sewadi, H. A. (2020). Mandible bone osteoporosis detection using cone-beam computed tomography. *Engineering, Technology & Applied Science Research* **10**, 6027-6033.

Rai, S., Misra, D., and Misra, A. (2020). Cone-beam computed tomography assessment of bone using grayscale values in patients with diabetes mellitus. A case–control observational study. *Journal of Indian Society of Periodontology* **24**, 560.

Razi, T., Emamverdizadeh, P., Nilavar, N., and Razi, S. (2019). Comparison of the Hounsfield unit in CT scan with the gray level in cone-beam CT. *Journal of dental research, dental clinics, dental prospects* **13**, 177.

Santosh, A. B. R., and Ogle, O. E. (2020). Odontogenic tumors. *Dental Clinics* **64**, 121-138.

Scarfe, W. C. (2019). Cone beam computed tomography: Volume acquisition. *White and Pharoah's Oral Radiology E-Book: Principles and Interpretation: Second South Asia Edition E-Book*, 150.

[Citation Naseem, K., Saeed, U., Yasin, A., Siddiqi, M.A. (2023). Use of cone beam computed tomography gray scale values for diagnosing tumors and cysts. *Biol. Clin. Sci. Res. J.*, **2023***: 345*. doi: https://doi.org/10.54112/bcsrj.v2023i1.345]

Slaidina, A., Nikitina, E., Abeltins, A., Soboleva, U., and Lejnieks, A. (2022). Gray values of the cervical vertebrae detected by cone beam computed tomography for the identification of osteoporosis and osteopenia in postmenopausal women. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology* **133**, 100-109.

Ver Berne, J., Saadi, S. B., Politis, C., and Jacobs, R. (2023). A deep learning approach for radiological detection and classification of radicular cysts and periapical granulomas. *Journal of Dentistry*, 104581.

Weiss, R., and Read-Fuller, A. (2019). Cone beam computed tomography in oral and maxillofacial surgery: an evidence-based review. *Dentistry journal* **7**, 52.