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Evaluation of Cone-beam Computed Tomography to differentiate Odontogenic Periapical Cysts and Granulomas

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Abstract

Background: Cone-beam Computed Tomography is a useful diagnostic tools for the detection of odontogenic peripheral cysts and granulomas. **Objective:** The purpose of the present study was to assess the accuracy of CBCT for diagnosing periapical cyst and granuloma. **Methodology:** This cross-sectional study was conducted from February 2017 to November 2017. Following inclusion and exclusion criteria consecutive patients who were consult in the department of oral and maxillofacial surgery of Dhaka Dental College Hospital and Bangabandhu Seikh Mujib Medical University for periapical infection was selected. Only those patients showing a periapical lesion of minimum 5 mm size was included in the study subject. Intra-oral periapical radiograph showing criteria was presence of apical radiolucency of 5 mm, corticated borders and displacements of roots. The CBCT images were done for those patients. The following features were documented on CBCT like location at the apex of involved tooth, well defined corticated border, shape is curved or circular, internal structure of lesion is radiolucent, displacement and resorption of the roots of adjacent teeth with a curved outline and perforation of cortical plate. Histopathological specimens were obtained for microscopic examination. The findings of histopathological examinations were correlated with the findings of CBCT. **Results:** Out of 50 subjects, 41(82.0%) subjects were diagnosed as cyst and 9(18.0%) subjects were as granuloma. Postoperative histopathology revealed 37 out of 41 were cysts and 4 were granulomas. Out of 9 granulomas 3 were cysts and 6 were granulomas. In this study we found the PPV 90.2439 and NPV 66.66. Diagnostic Accuracy was measured by calculating TP, TN and total population. The accuracy was 86%. **Conclusion:** In conclusion Cone-beam Computed Tomography has high accuracy of CBCT for diagnosing periapical cyst and granuloma. *[Journal of National Institute of Neurosciences Bangladesh, July 2022;8(2):171-174]*

Keywords: Demographic characteristics; abdominal tuberculosis; socio-economic profiles

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Introduction

Cone-beam Computed Tomography (CBCT) can be the non-surgical alternative to differentiate the apical cyst and granuloma[1]. The CBCT can provide excellent

accuracy when lesions are larger than 1.4 mm, whereas the other radiographs show poor accuracy for those lesions. CBCT also provide better visualization of anatomy of root, location of lesion and the relationship between the lesion and vital structure[2]. CBCT also decreases the chance of superimposition of other structures on the lesion. Thus CBCT provide accurate pre-operative diagnosis and there by dictate the surgical planning. If the lesion is granuloma no need for surgical intervention but if it is cyst then immediate enucleation of the cyst[3].

Researchers have evaluated the accuracy of CBCT imaging to detect apical periodontitis (AP) compared with periapical (PA) radiographs[4-6]. Estrela et al[5] evaluated a new PA index based on CBCT imaging for the identification of AP. More AP was identified in their study using CBCT imaging (60.9%) than PA radiographs (39.5%) after examining 1,014 images. The authors concluded that a PA index based on CBCT imaging might offer an accurate diagnosis of AP. Their study provided convincing evidence of accurate diagnosis of AP using CBCT images. Tsai et al[7] used simulated PA lesions in human cadavers to assess the diagnostic accuracy of CBCT and PA radiographs. The authors indicated that CBCT imaging showed excellent accuracy when simulated lesions were larger than 1.4 mm, fair to good when between 0.8 and 1.4 mm, and poor when less than 0.8 mm. PA radiographs showed poor accuracy for all lesion sizes. Rodrigues et al[8] reported a rare case of lymphangioma mimicking AP, indicating that CBCT imaging could be useful for the diagnosis of well-circumscribed lesions.

Rosenberg et al[6] used CBCT images to differentiate PA cysts from granulomas with inconclusive findings, indicating a weak agreement between 2 radiologists (k = 0.14) and an overall accuracy of 0.65 for the first radiologist and 0.51 for the second compared with biopsy results. Simon et al (2006) differentiated PA cysts (cavitated lesions) from granulomas using CBCT imaging (NewTom 3G; NewTom, Verona, Italy). Seventeen PA lesions were scanned, and the gray values of each lesion were measured. The lesions were then surgically removed for biopsy examination. In 13 of 17 lesions, the diagnoses of CBCT images were consistent with pathological reports. The authors indicated that CBCT images may provide more accurate diagnosis than pathological reports[3].

CBCT is a good diagnostic modality for these lesions8. These noninvasive techniques not only improve the quality of patient care but also allow the granulomas healing process to be studied. The results of this study provide some knowledge that may help in preoperative appropriate diagnosis between cysts and granuloma and dictate the surgical planning. The main purpose of the present study was to evaluate a set of diagnostic criteria for differentiating PA cysts from granulomas according to their CBCT imaging characteristics.

Methodology

Study Settings and Population: This cross sectional study was conducted from February 2017 to November 2017. Following inclusion and exclusion criteria 50 consecutive patients who were consult in the department of oral and maxillofacial surgery of Dhaka Dental College Hospital and Bangabandhu Seikh Mujib Medical University for periapical infection was selected. Only those patients showing a periapical lesion of minimum 5 mm size was included in the study subject. Intra-oral periapical radiograph showing criteria was presence of apical radiolucency of 5 mm, corticated borders and displacements of roots.

Study Procedure: The CBCT images were done for those patients. The following features were documented on CBCT like location at the apex of involved tooth, well defined corticated border, shape is curved or circular, internal structure of lesion is radiolucent, displacement and resorption of the roots of adjacent teeth with a curved outline and perforation of cortical plate. Enucleation of cyst or root-end resection was performed as routine protocols. Histopathological specimens were obtained for microscopic examination. The findings of histopathological examinations were correlated with the findings of CBCT.

Statistical Analysis: Statistical tests were conducted to examine the accuracy of CBCT. The accuracy of CBCT was evaluated by comparing its performance with the current gold standard test i.e. histopathological examination. Hence both the test was carried out on all the subjects in the study. True-Positives (TPs), False-positives (FPs), True-Negatives (TNs) and False-Negatives (FNs) in CBCT diagnoses were determined using histopathological findings as the gold standard. Sensitivity (SEN), Specificity (SPE), Positive predictive value (PPV), Negative predictive value (NPV) and diagnostic accuracy of CBCT in the diagnosis periapical cyst from granuloma was calculated.

Results

Out of 50 subjects, 41(82.0%) subjects were diagnosed as cyst and 9(18.0%) subjects were as granuloma. Postoperative histopathology revealed 37 out of 41 were cysts and 4 were granulomas. Out of 9

granulomas 3 were cysts and 6 were granulomas (Table 1).

Table 1: Accuracy of CBCT in diagnosing Odontogenic Peripheral Cysts and Granulomas (n=50)

CBCT	Postoperative histopathology		Total
	Positive	Negative	
Positive	37(92.5%)	4(40.0%)	41(82.0%)
Negative	3(7.5%)	6(60.0%)	9(18.0%)
Total	**40(80.0%)**	**10(20.0%)**	**50(100.0%)**

Out of 41 cases were diagnosed as cyst by CBCT and histopathology (TP) and rest 4 were diagnosed as granuloma by histopathology (FP). The CBCT and histopathology report were granuloma in 6 out of 9 cases (TN). But in the 3 cases the CBCT finings differed from histopathology, In these cases CBCT findings were granuloma but biopsy were as cyst (FN) (Figure I).

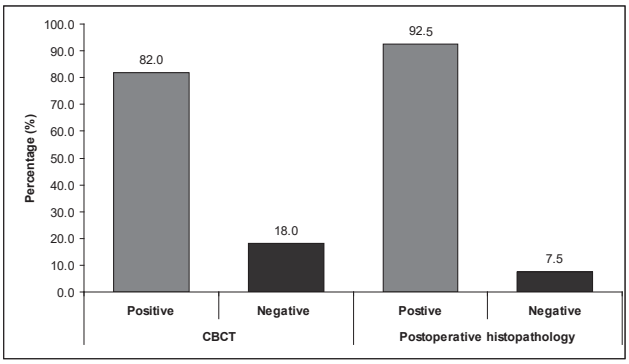

Figure I: Bar Diagram Showing the CBCT and Postoperative Histopathology Findings

In this study we found the PPV 90.2439 and NPV 66.66. Diagnostic Accuracy was measured by calculating TP, TN and total population. The accuracy was 86% (Figure II).

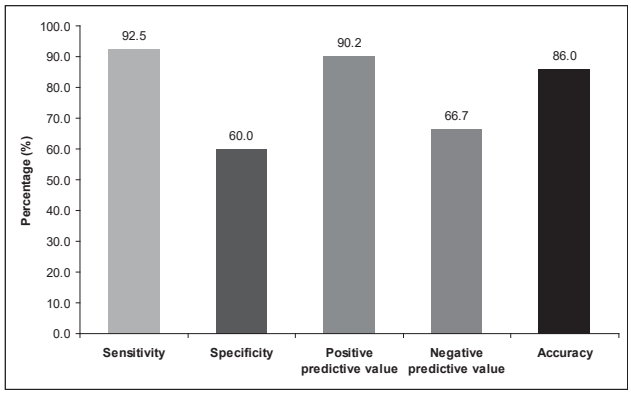

Figure II: Bar diagram showing the diagnostic value

Discussion

Odontogenic periapical lesions can be classified as either cyst or granuloma. Approximately 50% of periapical radiolucencies account for granuloma. Incidents of radicular cyst are relatively less than granuloma[9]. Differentiating between cyst and granuloma is essential as the treatment plan is different. A cyst will require removal of its source and surgical enucleation on the other hand a granuloma may heal without surgical treatment if given the opportunity[1]. These two most commonly seen periapical radiolucencies cannot be differentiated accurately by conventional radiographs as it has some limitations. The 3 dimensional structure is compressed into 2 dimensional image and lesions confined into cancellous bone are difficult to detect. CBCT provides excellent accuracy in diagnosing periapical cyst and granuloma[10].

The accuracy of CBCT was evaluated in distinguishing periapical cyst and granuloma[11]. Pretreatment diagnosis of periapical radiolucency help oral surgeon to dictate the treatment planning and also to reduce unnecessary surgical exposure. Total 50 patients were included in this study. About 37 out of 41 cases diagnosed as cyst by CBCT and histopathology (TP) and rest 4 were diagnosed as granuloma by histopathology (FP). Simon et al[2] found 13 out of 17 cases where the CBCT and histopathological diagnosis coincided as cyst. In 4 out of 17 the CBCT read cyst with the oral pathologists diagnosis being granuloma.

In this study the CBCT and histopathology report were granuloma in 6 cases out of 9 cases (TN). But in the 3 cases the CBCT findings differed from histopathology. In these cases CBCT findings were granuloma but biopsy were as cyst (FN). Rosenberg et al[6] studied on 45 patients and found 14 out of 45 cases resulting in a coincident diagnosis of 4 evaluators both pathologist and radiologist.

Sensitivity and specificity were used to assess the diagnostic ability of CBCT scan to differentiate cyst from granuloma[12]. Sensitivity was calculated as the proportion of true-positive test result cyst with same diagnosis by CBCT and biopsy. Specificity was calculated as the proportion of true negative results granulomas diagnosed by both CBCT and biopsy.

The assessment of sensitivity is the ability of a diagnostic instrument of identify a lesion, in this instance, a cyst correctly compared with a gold standard[13]. It is computed by calculating the ration of the true-positives, the number of lesions detected by the diagnostic instrument, to the total number of lesions identified by the gold standard. Specificity refers to the

ability of a diagnostic instrument of detect the absence of a lesion, in this instance, a granuloma when, in fact, the lesion is not present. It is computed by calculating the ration of true-negatives, in this case, the number of granulomas, detected to the total number of granulomas identified by the pathologist. In this study the sensitivity and specificity of CBCT was found 92.5% and 60% respectively. Tsai et al[7] found specificity of two CBCT machines as 0.892 (Motia) and 0.862 (Kodak).

In this study we found the PPV 90.2439 and NPV 66.66. Diagnostic Accuracy was measured by calculating TP, TN and total population. The accuracy was 86%. Tsai et al[7] had shown 0.767% (Kodak) and 0.753% (Mortia) accuracy of CBCT in his study. Rosenberg et al[6] found accuracy of CBCT by two radiologist as 51.0% & 63.0% Stavropoulos and Wenzel had shown 61% diagnostic accuracy of CBCT. Flores et al[14] had shown 94.0% accuracy of CBCT and 88.2% accuracy of biopsy.

Conclusion

The results of this study may help the oral surgeon to accurately diagnose the periapical radiolucency as radicular cyst or granuloma and thereby dictate surgical planning. The result acquired by CBCT can help in early surgical treatment of cyst and can reduce the unnecessary surgery and its complication.

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