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EVALUATION OF CBCT FINDINGS OF BENIGN AND MALIGNANT INTRABONY LESIONS IN THE MAXILLOFACIAL AREAS

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ABSTRACT

Introduction and Objective: The objective of this study was to use cone beam computed tomography (CBCT) to help for more accurately diagnose of maxillofacial lesions in order to achieve CBCT views of each of these lesions.
Methods: Using CASE SERIES method in this project, CBCT images obtained from 87 patients with maxillofacial bone lesions, referred to private center of maxillofacial radiology and Radiology Department of Dental Faculty of Mashhad, were examined.
The information related to the imaging in each patient in the checklist included location of the lesion, the internal structure, and the criteria related to impact on the surrounding buildings. Then, based on the results of biopsy, lesions were divided into 6 groups including cysts, benign tumors, malignant tumors, tumor-like lesions, systemic diseases and miscellaneous group, and their findings were described based on frequency distribution tables.
Results: According to pathologic findings, odontogenic keratocyst was the most common lesion among all lesions. Cysts, malignant tumors, and Stefanie cysts (miscellaneous group) were more prevalent in males and malignant tumors and benign tumors were common in females. The most common involved site in the cysts was maxilla, especially in the anterior, followed by posterior mandible. However, in other groups, the mandible, especially the posterior, was the most common site involved. The internal view of most cysts and view of all malignant tumors were radiolucent. Benign tumors were seen as opaque, and the frequency of combined and radiolucent view was more in tumor-like lesions with the same percentage. Most cysts, benign tumors, and tumor-like tumors revealed a specific area with cortical margin, but in all of the malignant tumors, the invasive area was seen. Symptoms such as root resorption, dental displacement of surrounding buildings, and cortical swelling were more common in tumor-like tumors. The tendency to damage the cortex and the cortical area of the surrounding buildings was higher in malign tumors. Benign tumors were also associated with a higher proportion of dental displacement.
Conclusion: The results of this study showed that in assessing bone lesions in the maxillofacial area in order to determine a bone lesion in the early stages, its exact area in the bone, studying the expansion of the lesion to adjacent buildings, delicate calcifications within the lesion and Buccolingual swelling, it is necessary to use CBCT.

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Introduction

In maxillofacial area, tumors and cysts have a high prevalence. Malignant lesions of maxillofacial area can lead to the destruction of one or more of the bones in this area, functional and beauty problems and death. Early diagnosis of a malignant

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tumor is effective on the prognosis of the disease its treatment**.** Lack of attention to the possibility of malignancy may leads to delayed diagnosis and treatment, the greater need for invasive therapy, and at worst conditions, it leads to early death (1) Simple radiographs prepares a two-dimensional image of the three-dimensional buildings, so bone destruction areas are covered with surrounding bone buildings and they may be ignored**.** These radiographs are normally display lower rate of destruction compared to real destruction (2). Computerized tomography (CT) is one hundred times more accurate than conventional radiography systems and it is able to show differences in the soft tissue. Higher resolution contrast of computerized tomography and the ability of three-dimensional image by combination of axial, Sagittal and coronal sections have made this technique as selective technique for diagnosis of neoplasms and infectious processes of the maxillofacial area paranasal sinuses (2-4). Cone beam computed tomography (CBCT) is a technology which has the potential to be applied for imaging of high-contrast structures of maxillofacial areas (5). CBCT scans are used increasingly to evaluate the bone pathology in maxillofacial skeleton, for example, cysts, benign tumors or malignant tumors, inflammatory conditions, sinonasal disorders and soft tissue calcifications (6). The use of CBCT technology with very low radiation dose compared with conventional CT allows clinician to understand three-dimensional structure of the lesion much better than the two-dimensional images (7). CBCT is a new technology using conical light source and two-dimensional detector to acquire images of the considered. Simultaneously movement of X-ray source in one side and detector in the other side is the base of work (rotating scan over 180 degrees)**.** In rotation, multiple exposures take place at regular intervals lasting about 20 to 40 that resulting images are called as the base images. Total base images are analyzed by computer software program in order to obtained initial images reconstructed. Specific applications of CBCT in dentistry include: (1) to evaluate the implant location. 2. Three-dimensional Orthodontic and cephalometric. 3- CBCT provides full view of TMJ, pharyngeal airway space, and soft tissue communications. 4. To localize the inferior alveolar canal. CBCT can be very useful in assessing the joint conditions and notably dental conditions such as hidden canine, additional teeth, broken or cracked teeth, periapical lesions and periodontal disease. Jaws cysts are pathologic cavity cysts filled with fluid which is a laid with epithelium and surrounded by a wall of connective tissue Cysts in jaw bones are common than other bones, because they usually stem from great number of remains of many dental epithelium remaining after tooth formation. Benign tumors grow slowly, with direct expansion, and they have unlimited growth potential. They are without pain and metastasis and do not interfere with an individual's life, unless they spread to other vital organs. Thy have often specific and are sometimes cortical area. Presence of radiolucent strip in the lesion environment is due to the presence of immature particles in the lesion environment separating the more matured internal radiopaque from the surrounding normal bone**.** The internal structure of radiolucent is mixed or is radiopaque. Displacement of adjacent teeth, jaw dilation and sometimes root resorption are also observed in smooth flat form. Malignant tumor indicates uncontrolled growth of tissue. Malignant tumors have more anaplasia and have the ability to metastasize to lymph nodes or to other remote areas. Majority of oral cancers in men occur the age range of 50 years and more, but malignant tumors occur at any age and in both genders**.** From radiography point of view, malignant tumors have unknown external area and they are without cortex or capsule. This permeable area shows non-uniform expansion of bone loss. Bone loss adjacent to soft tissue strongly indicates malignancy. The malignant tumor form of jaw is irregular. As most of malignancies do not generate bone and do not induce their formation, internal view of most of them is radiolucent**.** Some tumors such metastatic lesions of breast and prostate can induce bone formation and create abnormal bone view or osteosarcom generating abnormal bone. Tumor-like lesions refer to lesions that have no specific classifications and they are examined under fibro-osseous and responsive. Fibro-osseous lesions include lesions in which fibrous with abnormal bone cement or bone is replaced by normal bone. These lesions must be differentiated from tumors because they are treated differently**.** Miscellaneous lesions include: 1- Cherubism that is a rare disease inherited as dominant autosomal. It involves 2-20 years old people and it occurs mainly on both sides in in both jaws and creates cherub-like face in child. If it occurs only in one jaw, mandible will be more common. Maxillary tuberosity or ramus mandible takes place often in the posterior jaw (1) 2. Stafne cyst that is a hole in the mandibular lingual side of the mandibular parasite to permanent first molar, near the inferior border under the alveolar canal is seen more in men who are at their 5th and 6th decades. It has been also reported in people aged 11 to 87 years. Its prevalence is 0.1 to 0.48 percent (9). Lofthag-Hansen et al. (2007) compared the limitation of CBCT and intraoral radiography in diagnosis of periapical lesions. They selected 46 teeth in 36 patients with a mean age of 50 years, and they prepared 2 PAs and 1 CBCT of them. In this study, 32 lesions were diagnosed in both methods, but 10 cases were seen only in CBCT**.** They concluded that when pathological evidence of a lesion is not seen in PA, but clinical tests report the presence of a lesion or need to endodontic treatment, a 3-D supplementary radiography is required (10). In another study conducted by Hosseini Zarch et al in 2008 at Mashhad Dental Faculty under title of investigating the accuracy of diagnosis of conventional radiography in distinguishing benign lesions from malignant lesions in maxillofacial area, they collected intrabony maxillofacial lesions during a 6-year period**.** Among 136 intrabony lesions examined, 116 were benign and 20 were malignant lesions. The most common involved site was posterior mandible. The most common radiographic view in benign cysts and tumors was radiolucency with a certain area, in the malignant tumors and inflammatory, it was radiolucency with uncertain area, and in bone dysplasia, it was75% radiopaque with a certain area. The results of this study showed that conventional radiography diagnosis in 92% of cases was consistent with histopathologic results (in terms of being benign and malignant) (11). In a study conducted by Ozen et al in 2009, the CBCT diagnostic potential compared to intraoral digital and conventional intraoral radiography was studied. The results showed that the data obtained from both CBCTs were more accurate compared to digital and conventional intraoral radiography

and there was no significant difference between two intraoral radiographies. Ahmad and Freymiller (12) studied the use of CBCT in assessing bone losses in the maxillofacial area, cysts, benign and malignant tumors, inflammatory conditions, sinus destruction, and so on. The use of CBCT in benign lesions and cysts showed that CBCT can diagnose lesion in all lower and upper and mesiodistal dimensions (6). The objective of this study was to evaluate the CBCT findings of benign and malignant intrabony lesions in the maxillofacial area.

Method:

This study was conducted using cross-sectional descriptive method. The sample size using census method was considered among total number of files in the radiology department of the dentistry faculty and a private center for maxillofacial radiology in Mashhad city from 2008 to 2011. Inclusion criteria included all patients with intrabony or peripheral lesions in the maxillofacial area having the definitive histopathologic result as well as CBCT stereotypes from considered area**.** Exclusion criteria included 1) A patient with soft tissue lesions without bone effect in the maxillofacial area 2) no histopathology result in the patient's case. 3) No CBCT stereotype in patient case. To collect data, a checklist of information was prepared containing demographic data of patients and details of information obtained from CBCT images in desired plans and also the result of histopathology at the end of it. In this study, the scans obtained from the CBCT device, Promax 3D model mad in Finland, were evaluated with a spatial resolution of 160 microns, and a imagining range of 8 x 8 cm and 8 x 14 (stitch). After reviewing the clinical data in patients' cases, CBCT images were examined using Romexis software initially a panoramic-like image and then at three sagittal, coronal and axial sections by two radiologists. The images were then analyzed with 2 weeks interval and in cases where they differed; they discussed and reached a common view. Observers were also given the opportunity to use cross-sectional images as desired, and the brightness and contrast of the monitors to view the images were changeable. None of the observers was aware of the biopsy result. Then, the checklist prepared for each patient was completed based on CBCT results. The radiographic findings that were evaluated in the checklist included: 1- Status and location of the lesion: Anatomical position was determined based on single-focal nature, multi-focal nature or generalized lesion. 2. Lesion environment. 3. Interior building**.**

4-Evaluation of the lesion effects on surrounding buildings. Finally, the result of the biopsy was examined in the patient's case and recorded in the checklist. Then, based on the results of biopsy, lesions were divided into 6 groups: cysts, benign tumors, malignant tumors, tumor-like tumors, (13) systemic and miscellaneous diseases and their findings were described based on variables. To describe data, frequency distribution tables were used.

Findings

In investigating CBCT findings, benign and malignant intrabony lesions of the maxillofacial area of patients, 78 (89.65%) benign lesions, 8 (19.9%) malignant lesions and 1 (1.51%) case of systemic disease were observed. Benign lesions included 39 cysts, 16 benign tumors, 18 tumor-like lesions and 5 miscellaneous lesions. Seventy and nine lesions were central and only 8 lesions (4 nasolibial cysts and 4 malignant SCC tumors) were peripheral**.** The results of Table 1 show that 47 patients were males (54.02%) and 40 of them were females (45.98%). The prevalence of cysts in men was higher than that in women. Malignant tumors and Stefanie cysts (miscellaneous) were more common in men. The prevalence of tumor-like lesions and benign tumors was higher in women. In general, cysts were the most commonly diagnosed lesions in this study. OKC was the most commonly reported lesion with 11 cases (12.64%) among the total lesions and with frequency of 11 (28.20%) among the cysts observed in this study**.** The most common benign tumor was odontoma with a frequency of 6 cases (37.5%) among all benign tumors. The most common lesion was central giant cell granuloma and dysplasia fibrosis with the same frequency with 7 cases (38.88%) among tumor-like lesions. The most common malignant tumor was peripheral SCC with a frequency of 4 cases (50%) among all malignant tumors**.**

Table 1: Frequency of lesions observed in the studied population based on gender separately in terms of lesions

Lesions	Male		Female		Total	
	n	%	n	%	n	%
Cysts	24	61.54	15	38.46	39	100.00
Benign tumors	7	43.75	9	56.25	16	100.00
Tumor-like lesions	4	22.22	14	77.78	18	100.00
Malignant tumors	7	87.50	1	12.50	8	100.00
Systemic diseases	1	100	0	0.00	1	100.00
Miscellaneous	4	80.00	1	20.00	5	100.00

The most common site of involvement in cysts was maxilla (58.98%), especially in the anterior them posterior mandible. However, in other groups, the mandible, especially the posterior, was the most common site of involvement. Among benign tumors, only 2 cases of ameloblastoma and odontogenic myxoma extension were observed from the anterior to the posterior. In the tumor-like group, 5 lesions (2 cases of CGCG, 2 cases of dysplasia fibrosis and 1 COF) were observed. The only malignancy with extension from the anterior to the posterior was also one case of peripheral SCC. In benign tumors, maxilla extension to sinus was found in only one case of odontogenic myxoma (25%). In malignant tumors group, only one case of lymphoma occurred in maxilla, which was associated with sinus involvement. Among benign tumors, 2 cases of single-focal lesions were observed out of jaw, which one case related to hemangioma in the cheek bone and one case related to meningeal in the frontal bone. The results of the table indicated that the internal view of most of cysts and all malignant tumors of the jaw is radiolucent, but in benign tumors, the internal structure of the radiopaque is dominant. The frequency of combined and radiolucent view was more in tumor-like lesions with similar percentage. In tumor-like lesions, the internal structure of radiopaque was observed only in dysplastic fibrosis with ground-glass view (3 cases) and one case of COF. Out of the 39 cysts in this study, only 3 cysts have combined view that one case was infectious buccal furcation cyst, the other was an infectious residual cyst, and the third case was OKC. This view was the result of scattered dystrophic calcifications in these lesions. Other cysts had radiolucent view. Among radiolucent cysts, 3 cases were manifested in multi-locular form, which included two cases of OKC (with severe but small symptoms) and 1 case was COC. Out of the 6 Odontom that all of them had radiopaque view, four cases were compound type, one case was complex type, and one of them was percoronal three-focal in the composite and composite mixture form. In addition, among 2 ameloblastomas studied in this study, one case of locular ion and case was multilocular manifested in honeycomb view in anterior and complete ion locular in posterior. Out of the 3 myxoma, one case of combined multi-locular view was observed, and in the other two cases, Radiolucent and multi-locular view was observed.

Table 2: Frequency distribution of CBCT results of lesions based on the internal view of lesion in the studied population separately

Internal structure	**Cysts**	
	n	%
Radiolucent	36	92.31
Radiolucent-radiopaque	3	7.69
Total	39	100.00
	Benign tumors	
	n	%
Radiolucent	5	31.25
radiopaque	8	50.00
Radiolucent-radiopaque	3	18.75
Total	16	100.00
	Tumor-like	
	n	%
Radiolucent	7	38.89
radiopaque	4	22.22
Radiolucent-radiopaque	7	38.89
Total	18	100.00
	Malignant tumors	
	n	%
Radiolucent	8	100.00
Total	8	100.00

The results indicate that in most cysts, benign and tumor-like tumors, the area of lesion has been specified with cortical margin, but in all of the malignant tumors, the area of invader was seen. Tumor-like lesions and then cysts (with very low difference) with higher percentage than other groups were associated with root resorption of teeth involved. In the cysts group, the most root resorption related to OKC (5 cases). Root resorption was observed in benign tumors in myxoma and ameloblastoma and in tumor-like tumors in CGCG (5 cases) and one case of COF. In malignant tumors, root resorption was observed only in leukemia, which occurred with a spike pattern. However, in benign lesions, in most cases, the root resorption was seen in

trimmed and the curve form. Among the lesions studied in this study, 3 cases with severe root resorption were observed including radicular cavity, OKC and COC from cysts. In stafne cyst due to its position under the because of his position under alveolar canal, there was no possible to access to teeth and root resorption. Root resorption was not seen in osteopetrosis (Table 3).

Table 3: Frequency distribution of CBCT findings of lesions based on external root resorption in the studied population separately

external root resorption of tooth	**Cysts**	
	n	%
Yes	11	34.37
No	21	65.62
Total	*32	100.00
	Benign tumors	
	n	%
Yes	3	25.00
No	9	75.00
Total	*12	100.00
	Tumor-like	
	n	%
Yes	6	35/29
No	11	64/70
Total	*17	100.00
	Malignant tumors	
	n	%
Yes	1	25.00
No	3	75.00
Total	*4	100.00

*****This figure is related to the total number of cases in each group that occurred in the tooth-bearing area. It should be noted that patients with lesions out of jaw, toothless areas, or away from the teeth, as well as toothless patients were not included in the table.

The results of Table 4 indicate that benign tumors with a higher percentage than other groups were associated with tooth displacement (83.33%). In the cysts group, the highest tooth displacement was related to OKC (10 cases) and dentigerous cysts (all 3 cases). In stafne cyst due to its position under the because of his position under alveolar canal, there was no possible to access to teeth and tooth displacement. No tooth displacement was observed in osteopetrosis, several latent teeth were observed that in fact, lesion prevented the teeth growing. Multiple teeth missing were also seen.

Table 4: Frequency distribution of CBCT results of lesions based on tooth displacement in the studied population separately

Cysts		**tooth displacement**
%	n	
54.54	18	**Yes**
45.45	15	**No**
100.00	*33	**Total**
Benign tumors		
%	n	
83.33	10	**Yes**
16.67	2	**No**
100.00	*12	**Total**
Tumor-like		
%	n	

47.06	8	**Yes**
52.94	9	**No**
100.00	*17	**Total**
Malignant tumors		
%	n	
25.00	1	**Yes**
75.00	3	**No**
100.00	*4	**Total**

This figure is related to the total number of cases in each group that occurred in the tooth-bearing area. It should be noted that patients with lesions out of jaw, toothless areas, or away distance from the teeth, as well as toothless patients were not included in the table. The results indicated that malignant tumors with a higher percentage than other groups were associated with destruction of surrounding buildings (85.71%). In stafne cyst and osteopetrosis, no damage in the surrounding buildings was seen.

Discussion

Today, CBCT has become an important diagnostic tool for dentists, maxillofacial surgeons and ear, nose and throat specialists. CBCT scans are increasingly used to evaluate the bone pathology in the maxillofacial skeleton, for example cysts, benign and malignant tumors, and soft tissue calcification (6). Considering that no study has been conducted to interpret the findings of CBCT scans related to intrabony lesions of the maxillofacial area in a wide range so far, this study examined some evidence and examples of the benefits and limitations of this technique in diagnosis of maxillofacial diseases**.** In this study, cysts were more common in males (61.54%), malignant tumors and stafne tumors were also more common in males, but tumor-like lesions and benign tumors were more common in females. In a study by Hosseini Zarch (11), cysts were more common in males, and benign tumors were more common in females, which it was in line with our study. In study by Akbari (13), cysts were more common in males, while tumor-like lesions were more common in females. In contrast, benign tumors, unlike our study, had equal distribution between two genders. CBCT scans give us much more diagnostic information than panoramic radiographs. In the present study, one case of dentigerous cyst with additional mesiodens tooth in the middle region of the palate was observed that the primary panoramic image was not able to show it since lesion and tooth were out of focal taraf, but the lesion site was well shown in two and three-dimensional scans of CBCT. In present study, most of lesions (93.10%) were seen as single-focal, and two lesions revealed generalized jaw involvement and other skull bones. This result was in line with results of Akbari et al. (13). According to the findings of this study, the most frequent site of involvement in the cysts (odontogenic and non-odontogenic) was maxilla (58.97%), and it was in mandible in benign tumors (56.25%) and tumor-like (61.11%) lesions. In a study by Hosseini Zarch (11), it was shown that 60% of cysts and benign tumors tend to mandible. In the study conducted by Akbari (13), the most common site for occurrence of cysts and tumor-like and benign tumors was posterior mandible. Based on the results of this study, the most common site of involvement in odontogenic cysts was maxilla (51.72%), followed by mandible with very slight difference (48.27%). In line with the present study, Varinauskas in Latin (14) reported 63% of odontogenic cysts associated with maxilla. Additionally, Sanatkhani et al. (15) also stated that the most common site of involvement in the jaw odontogenic cysts is posterior mandible. In a study conducted by Meningaud et al. (16) to examine jaw odontogenic cysts, the ratio of mandible to maxima involvement was reported 3 to 1 and the most frequent involved site of mandible in their study was angle area (36% of cases), and it was in the premolar-molar area in the maxilla (45%). In the present study, the tendency to expand from the anterior to the posterior in the cysts group was more than that in other lesions (28.20%), followed by that in tumor-like lesions, which it was in line with the study conducted by Akbari et al. (13)**.** The most common radiographic finding in the current study was in the cysts (odontogenic and non-odontogenic) ionic locular radiolucency (specified area and cortical). However, in benign tumors, radiopaque view with specified area and cortical had higher prevalence. In the study of Akbari (13) and Hosseini Zarch (11), they reported the internal view of benign tumors and cysts often radiolucent with a specific area, which they are not in line with results of our study for benign tumors**.** The dominant view of the tumor-like lesions in our study was radiolucent and combined with an equal frequency (38.88%) and with cortical area (50%), in contrast, in the study by Akbari (13), radiopaque with cortical area was the most common finding of tumor-like lesions. According to our findings, 89.65% of the odontogenic cysts were radiolucent and the others were a combination of radiopaque and radiolucent. The study of Sanatkhani et al. (15), in line with the findings of this study, evaluated 94.8% of cysts as radiolucent and others were combination of radiopaque and radiolucent**.** The results of this study indicated that the prevalence of root resorption in the odontogenic cysts was 37.04%, while this rate was 25% in benign tumors. The current study results also showed that in 64.28% of odontogenic cysts, there was a dental displacement. In a study by Sanatkhani et al. (15), in 20% of odontogenic cysts, root resorption took place, and in 40% of cases, tooth displacement occurred. The reason for this difference is that in the study of Sanatkhani panoramic radiography was used, and many dental displacements,

especially in the buccolingual direction, cannot be examined in panoramic radiography**.** Based on the results of our study, tumor-like lesions with higher percentage compared to other groups were associated with displacement of surrounding buildings (68.75%), which it was more evident in dysplasia fibrosis, but in the Akbari study (13), cysts with a higher percentage (66.7%) were associated with the displacement of surrounding buildings. Finally, it could be stated that CBCT is a new method for differential diagnosis, selection of appropriate site for biopsy, treatment plan and lesion monitoring, and it can provide more accurate information about the size and location of the lesion**.**

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