Original Article

The Accuracy of Different Modalities in the Diagnosis of Oral Intraosseous Lesions in Comparison to Histopathological Findings

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Abstract

Objective: The study aimed to compare the diagnostic accuracy of different imaging modalities for detecting intraosseous jaw lesions, using histopathological diagnosis as the reference standard, and to assess interobserver agreement in response to initial radiographic reports.

Methods: A total of 108 patients diagnosed with intraosseous jaw lesions were included. Radiographic images (Cone Beam Computed Tomography, Computed Tomography, and Orthopantomography) and reports with the related histopathological diagnosis were collected. Two radiologists, blinded to the histopathological results, reviewed the images using a (semiquantitative) scoring system. Kappa coefficients were calculated to evaluate interobserver agreement.

Results: The majority of lesions were radiolucent (79.6%), with cystic lesions (50.0%) being the most common, particularly radicular cysts (24.1%). Well-defined borders were predominant (62.0%). Most lesions were related to the inferior alveolar canal (IAC) (20.4%), followed by the maxillary sinus (11.1%). Both observers showed substantial agreement in response to the extension of the lesions and relation to the tooth (0.701 and 0.660, respectively). CBCT showed the highest diagnostic accuracy between the two observers in detecting score 3 of the differential diagnosis (81.8%), which represents a correct first-ranked differential diagnosis corresponding to the histopathological findings.

Conclusions: CBCT has the best accuracy in the diagnosis of intraosseous jaw lesions, particularly for lesions' density, anatomical extension, and relation to the tooth. Still, certain radiographic interpretation parameters showed non-agreement between observers. Evidence-based diagnosis and treatment planning require standardized reporting and proper interobserver training.

Keywords: *Cone Beam Computed Tomography, Diagnostic accuracy, Histopathological findings, Intraosseous jaw lesions.*

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Introduction

Imaging is a cornerstone in the diagnosis of oral intraosseous lesions, as it provides a comprehensive view of bone architecture, lesion characteristics, and implications for adjacent osseous and non-osseous structures, facilitating early identification, characterization, and distinction of lesions[1,2].

Orthopantomography (OPG) offers a cost-effective panoramic overview of the jaws and is used for initial screening of lesion location, size, and relation to teeth, although its two-dimensional projection limits assessment of borders, cortical expansion, and internal structure, with reported diagnostic accuracy of approximately 64-70% for the first differential diagnosis[3]. Also, Computed Tomography (CT), particularly multidetector CT, provides superior cross-sectional detail of lesion extent, cortical involvement, soft tissue extension, and multiplicity, and its diagnostic performance correlates with biopsy findings in about 80-90% of mandibular cases[4]. In addition, Cone Beam Computed Tomography (CBCT) further enhances dentomaxillofacial imaging by delivering high-resolution three-dimensional visualization of lesion morphology, cortical expansion, and neurovascular relationships, and generally outperforms OPG (accuracy around 78-79% versus 64-70%), although histopathological examination remains necessary to distinguish benign and malignant entities[5]. Furthermore, Ultrasound (US) represents a non-ionizing adjunct that helps differentiate cystic from solid lesions and assess vascularity using Doppler techniques, with reported correlation with histopathology of roughly 94% in cystic lesions, while magnetic resonance imaging (MRI) contributes additional information on marrow and soft-tissue involvement without ionizing radiation. Nevertheless, all these imaging techniques provide primarily descriptive information, and histopathological evaluation continues to be the gold standard for definitive diagnosis[6].

Accurate diagnosis of intraosseous jaw lesions is of great importance in dental and maxillofacial practice; these lesions range from reactive, cystic, to neoplastic, benign[7]. The evolution of imaging techniques for their recognition, characterization, and differentiation has therefore proceeded with the goal of clinical decision-making. As alternative imaging modalities in the maxillofacial region, Cone Beam Computed Tomography (CBCT) and Orthopantomography (OPG) are the two most commonly used techniques[5]. Ultrasonography (US), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI), with or without Positron Emission Tomography (PET), are other techniques utilized in the detection and classification of intraosseous lesions[8].

CBCT has already been popularized for diagnostic purposes, owing to its high-resolution three-dimensional imaging. It is valuable for assessment of lesion size, cortical expansion, and associated structures; however, it can only partially differentiate between benign and malignant lesions[9,10]. CBCT can offer descriptive information related to the morphology of a lesion, but histopathological validation is more often necessary to arrive at a definitive diagnosis[11]. Therefore, CBCT has high accuracy in the detection and diagnosis of intraosseous jaw lesions, superior to OPG[5].

Ultrasound is considered a primary imaging alternative, non-expensive, that avoids ionizing radiation exposure, enabling the assessment of intraosseous jaw lesions. The utility of ultrasound in evaluating neck lesions is well established, especially for differentiating cystic from solid lesions, with Doppler ultrasound aiding assessment of vascularity. The study by Sidhu et al (2025) found that ultrasonography correlated with the histopathological findings, especially in cystic lesions, in which a definitive diagnosis was made in 93.8% of cases[12].

Magnetic Resonance Imaging (MRI) is an important imaging technique for the detection and characterization of intraosseous lesions, especially regarding the assessment of soft tissue involvement, marrow oedema, and vascularity. MRI is increasingly gaining importance in the evaluation of head and neck disease since it offers excellent contrast resolution without ionizing radiation[13]. It has an essential role in the differentiation of benign and malignant lesions, unlike computed tomography (CT) and cone-beam computed tomography (CBCT)[13].

This study aims to evaluate the diagnostic accuracy of CBCT, CT, and OPG for intraosseous jaw lesions using histopathology as the gold standard and to assess interobserver agreement related to original radiographic reports.

Patients and Methods

Sample of the Study

The digital files and original radiograph reports were collected from several private dental clinics and hospitals in Sulaimani City, Kurdistan Region, Iraq. Ethical approval was obtained from the College of Dentistry, University of Sulaimani (Approval No: COD-EC-24-0022, Date: 16 / 12 / 2024).

Digital radiographic files (DICOM format) and original reports were retrospectively collected from private dental clinics and hospitals in Sulaimani City, Kurdistan Region, Iraq. Inclusion criteria comprised patients with intraosseous jaw lesions confirmed by both radiographic imaging (CBCT, CT, or OPG) and corresponding histopathological reports. Exclusion criteria included poor image quality that precluded accurate diagnosis and cases in which imaging was performed for non-lesional indications. From an initial pool of 200 CBCT files, 123 were excluded, yielding 77 cases. Similarly, 70 CT files were screened, with 58 excluded due to incomplete data, leaving 13 cases. Additionally, 18 OPG cases met the inclusion criteria. This resulted in a final sample of 108 cases. Demographic data (age, sex, lesion site) and imaging modality were recorded, alongside original radiographic reports and histopathological diagnoses for comprehensive evaluation.

A comprehensive case sheet was created to standardize the evaluation of all radiographs. The following parameters were recorded: lesion density, borders, extent, shape, distribution, and localization. Additional observations encompassed the relationship of the lesion to adjacent structures, its impact on teeth and vital anatomical features, as well as cortical expansion and evidence of perforation.

Evaluation and Scoring

Two oral and maxillofacial radiologists independently reviewed the radiographic images, blind to the histopathological diagnosis. Each image was analyzed by Radiant Software and assessed according to the parameters outlined in the standardized case sheet. Each radiologist proposed up to three differential diagnoses for the observed radiological features, ranked in ordinal order. Diagnostic accuracy was then calculated in relation to the histopathological diagnosis using a scoring system: 3 points for a correct first-ranked diagnosis, 2 points for a correct second-ranked diagnosis, 1 point for a correct third-ranked diagnosis, and 0 points if none were correct[5].

Statistical Analysis

Data analysis was conducted using SPSS version 27, with descriptive statistics used for demographic and radiographic characteristics. Inter-observer agreement was quantified using Kappa coefficients (κ) to compare the diagnostic evaluations of two observers with the original reports. Kappa values were interpreted as follows: 0 = no agreement, 0.01–0.20 = slight, 0.21–0.40 = fair, 0.41–0.60 = moderate, 0.61–0.80 = substantial, and 0.81–1.00 = almost perfect. Diagnostic accuracy of each imaging modality was assessed by scoring from 0 to 3[5].

Results

The study sample included 108 patients, with a mean age of 32.18 ±17.97 years. Females slightly predominated (51.9%). The majority of the lesions were found in the mandible (56.5%) and on the left side (48.1%). The imaging modality showed CBCT in 77 cases (71.3%), CT in 13 cases (12.0%), and OPG in 18 cases (16.7%). Table 1.

The majority of lesions were radiolucent in appearance (79.6%). Regarding lesion borders, well-defined margins predominated (62 %), while ill-defined borders were recorded in 21 cases (19.4%), and 16 cases (14.8%) lacked border documentation. (Table 2, Figure 1a, b).

In terms of anatomical extension, 61 cases (56.5%) involved more than one region. Isolated involvement of the anterior region was observed in 18 cases (16.7%), posterior molar in 12 cases (11.1%), and premolar region in 7 cases (6.5%). The lesion shape was undocumented in the majority of cases (68.5%). Among those identified, irregular contours were most common (13%), followed by round shapes (7.4%). Assessment of lesion distribution revealed a predominance of unilateral presentation (79.6%), with bilateral involvement in 20 cases (18.5%). Regarding locularity, unilocular lesions were present in 28 cases (25.9%) and multilocular in 17 cases (15.7%), while 63 cases (58.3%) did not report this feature, as shown in Table 2 and Figures 1(c) and 1 (d).

The most frequently reported relationship to the tooth was apical involvement (42.6%), followed by coronal (13.0%). Root resorption was evident in 27 cases (25 %), Figure 1 (e). The root resorption was absent in 41 cases (38.0%), and the status was not mentioned in 35 cases (32.4%). Tooth displacement was noted in 23 cases (21.3%). Association with impacted teeth was reported in 18 cases (16.7%), and 33 cases were not documented. Regarding vital structures, the inferior alveolar canal (IAC) was most involved (20.4%), followed by the maxillary sinus (11.1%) and nasal cavity (6.5%). Involvement of the mental foramen and lingual foramen was minimal (1.9% each). Cortical expansion was reported in 58 cases (53.7%), Figure 1 (f, g), while cortical perforation was seen in 59 cases (54.6%), Figure 1 (h), Table 3.

Table 4 summarizes the agreement levels between observer 1 and the original radiographic report, observer 2 and the original report, and between the two observers, using kappa (κ) coefficients interpreted on a scale of “no agreement" (κ = 0) to "almost perfect" (κ = 0.81).

With respect to lesion density, agreement between observers 1 (κ = 0.553) and 2 (κ = 0.566) and the original report was moderate, and inter-observer agreement was substantial (κ = 0.801). Lesion extension also showed moderate agreement with the original report for observer 1 (κ = 0.448) and observer 2 (κ = 0.543), and substantial agreement between observers (κ = 0.701).

When examining the laterality of lesions (unilateral/bilateral), there was moderate agreement for observer 1 versus the original report (κ = 0.432), substantial agreement for observer 2 versus the original report (κ = 0.713), and moderate inter-observer agreement (κ = 0.571).

Several features showed no agreement between observer 1 and the original report (κ = 0.000) and between observers (κ = 0.000), including borders, shape, locularity, root resorption, tooth displacement, impacted tooth association, cortical expansion, and cortical perforation.

The relation to the tooth showed fair agreement with the original report for both observers (observer 1: κ = 0.254, observer 2: κ = 0.324) and substantial agreement between observers (κ = 0.660).

Cystic lesions comprised the predominant diagnostic category (50%). Within this group, radicular cysts were the most frequently detected (24.1%), followed by odontogenic keratocyst (12 %). Odontogenic tumors comprised 25.9%, with ameloblastoma being the predominant neoplasm (9.3%). Developmental odontogenic lesions were the least frequent category (1.9%), Table 5.

Of the 108 case evaluations, CBCT (n = 77) showed the highest total diagnostic accuracy for score 3 of differential diagnosis (81.8%). The second observer showed higher accuracy than the first observer (87.7 versus 77.9) in identifying score 3 of the differential diagnosis in the reports in Figure 2.

Table 1: Demographic and clinical characteristics of study participants.

Demographic and Clinical Characteristics		N (%)
Sex	Female	56 (51.9%)
	Male	52(48.1%)
Lesion location	Mandible	61 (56.5%)
	Maxilla	44 (40.7%)
	Both	3 (2.8%)
Lesion side	Right	40 (37.0%)
	Left	52 (48.1%)
	Both sides	16 (14.8%)
Imaging modality	CBCT	77 (71.3%)
	CT	13 (12.0%)
	OPG	18 (16.7%)

Abbreviations: % = percentage; n = number; CBCT = cone-beam computed tomography; CT = computed tomography; OPG = orthopantomogram (panoramic radiograph).

Table 2: Frequency distribution of radiographic characteristics in the lesion.

Radiographic Characteristics	N (%)	Radiographic Characteristics	N (%)
Density		**Border**	
Radiolucent	86 (79.6%)	Well-defined	67 (62.0%)
Radiopaque	5 (4.6%)	Ill define	21 (19.4%)
Mixed	12 (11.1%)	Both	4 (3.7%)
Not mentioned	5 (4.6%)	Not mentioned	16 (14.8%)
Extension		**Shape**	
Anterior	18 (16.7%)	Round	8 (7.4%)
Premolar region	7 (6.5%)	Oval	4 (3.7%)
Posterior molar region	12 (11.1%)	Irregular	14 (13.0%)
Maxillary tuberosity	1 (0.9%)	Scallop	5 (4.6%)
More than one	61 (56.5%)	Toothlike structure	3 (2.8%)
Not mentioned	9 (8.3%)	Not mentioned	74 (68.5%)
Site		**Number**	
Unilateral	86 (79.65)	Unilocular	28 (25.9%)
Bilateral	20 (18.5%)	Multilocular	17 (15.7%)
Not mentioned	2 (1.9%)	Not mentioned	63 (58.3%)

Abbreviations: % = percentage; N = number.

Table 3: Radiographic interpretations in relation to teeth, vital structures, and cortical involvement.

Interpretation parameters	N (%)	Interpretation parameters	N (%)
Relation to the tooth		**Root resorption**	
Apex	46 (42.6%)	Yes	27 (25.0%)
Coronal	14 (13.0%)	No	41 (38.0%)
Lateral	2 (1.9%)	No teeth	5 (4.6%)
Not related	7 (6.5%)	Not mentioned	35 (32.4%)
Not mentioned	39 (36.1%)		
Tooth displacement		**Association with an impacted tooth**	
Yes	23 (21.3%)	Associated	18 (16.7%)
No	27 (25.0%)	Not related	57 (52.8%)
No teeth	4 (3.7%)	Not mentioned	33 (30.6%)
Not mentioned	54 (50.0%)		
Effect on the vital structure		**Cortical expansion**	
IAC	22 (20.4%)	Present	58 (53.7%)
Mental foramen	2 (1.9%)	Absent	13 (12.0%)
Lingual foramen	2 (1.9%)	Not clear	18 (16.7%)
Maxillary sinus	12 (11.1%)	Not mentioned	19 (17.6%)
Nasal cavity	7 (6.5%)		
Incisive foramen	3 (2.8%)	**Cortical perforation**	
Not affected	17 (15.7%)	Present	59 (54.6%)
Hard palate	1 (0.9%)	Absent	19 (17.6%)
More than one	23 (21.3%)	Not clear	18 (16.7%)
Not mentioned	19 (17.6%)	Not mentioned	12 (11.1%)

Abbreviations: n = number; % = percentage; IAC = inferior alveolar canal. *The differential diagnosis was documented in 58 cases, accounting for 53.7% of the total, while in 50 cases, or 46.3%, it was not mentioned.

Table 4: Comparison of observer assessments with original reports' reliability using kappa coefficients.

Interpretation of the lesion	**Observer 1 vs original report**		**Observer 2 vs original report**		**Observer 1 vs Observer 2**	
	κ value	Strength of agreement	κ value	Strength of agreement	κ value	Strength of agreement
Density of the lesion	0.553	Moderate	0.566	Moderate	0.801	Substantial
Borders	0.00	No agreement	0.444	Moderate	0.00	No agreement
Extension of the lesion	0.448	Moderate	0.543	Moderate	0.701	Substantial
Lesion's shape	0.00	No agreement	0.165	Slight	0.00	No agreement
Unilateral/ Bilateral lesion	0.432	Moderate	0.713	Substantial	0.571	Moderate
Unilocular/Multilocular lesion	0.00	No agreement	0.093	Slight	0.00	No agreement
Relation to the tooth	0.254	Fair	0.324	Fair	0.660	Substantial
Root resorption	0.00	No agreement	0.192	Slight	0.00	No agreement
Tooth displacement	0.00	No agreement	0.192	Slight	0.00	No agreement
Association with an impacted tooth	0.00	No agreement	0.370	Fair	0.00	No agreement
Effect on the vital structure	0.419	Moderate	0.323	Fair	0.525	Moderate
Cortical expansion	0.00	No agreement	0.487	Moderate	0.00	No agreement
Cortical perforation	0.00	No agreement	0.586	Moderate	0.00	No agreement

Abbreviations: κ = kappa coefficient. Strength of agreement is interpreted as follows: 0: No agreement, 0.01–0.20: Slight, 0.21–0.40: Fair, 0.41–0.60: Moderate, 0.61–0.80: Substantial, 0.81–1.00: Almost perfect.

Table 5: Frequency distribution of diagnosed intraosseous jaw lesions across pathological categories.

Category	**Diagnosis**	**N (%)**
Cysts of the jaw **n=54 (50.0%)**	Dentigerous cyst	11 (10.2%)
	Odontogenic keratocyst (OKC)	13 (12.0%)
	Radicular cyst	26 (24.1%)
	Residual cyst	1 (0.9%)
	Lateral periodontal cyst	1 (0.9%)
	Nasopalatine duct cyst	1 (0.9%)
	Paradental cyst	1 (0.9%)
Odontogenic Tumors **n=24 (25.9%)**	Ameloblastoma	10 (9.3%)
	Adenomatoid odontogenic tumor	2 (1.9%)
	Calcifying epithelial odontogenic tumor (pindborg tumor)	2 (1.9%)
	Odontoma	4 (3.7%)
	Odontogenic Fibromyxoma	3 (2.8%)
	Central odontogenic fibroma	3 (2.8%)
Benign Non-Odontogenic Tumors **n=10 (9.3%)**	Central giant cell granuloma (CGCG)	3 (2.8%)
	Fibrous dysplasia	2 (1.9%)
	Juvenile Ossifying Fibroma	2 (1.9%)
	Osteoma	1 (0.9%)
	Cemento-ossifying fibroma	2 (1.9%)
Malignant lesions **n=10 (9.3%)**	Primary intraosseous carcinoma	1 (0.9%)
	Metastatic tumors to the jaw	2 (1.9%)
	Osteosarcoma	2 (1.9%)
	Ewing sarcoma	1 (0.9%)
	Multiple myeloma/plasmacytoma	3 (2.8%)
	Squamous cell carcinoma	1 (0.9%)
Inflammatory jaw lesions **n=5 (4.6%)**	Osteomyelitis	1 (0.9%)
	Actinomycosis	2 (1.9%)
	Periapical granuloma	2 (1.9%)
Salivary gland tumors **n=5 (4.6%)**	Pleomorphic adenoma	1 (0.9%)
	Mucoepidermoid carcinoma	2 (1.9%)
	Adenocystic carcinoma	2 (1.9%)
Developmental odontogenic lesions **n=2 (1.9%)**	Hyperplastic dental follicle	2 (1.9%)

Abbreviations: n = number; % = percentage; OK = odontogenic keratocyst; CGCG = central giant cell granuloma; OPG = orthopantomogram.

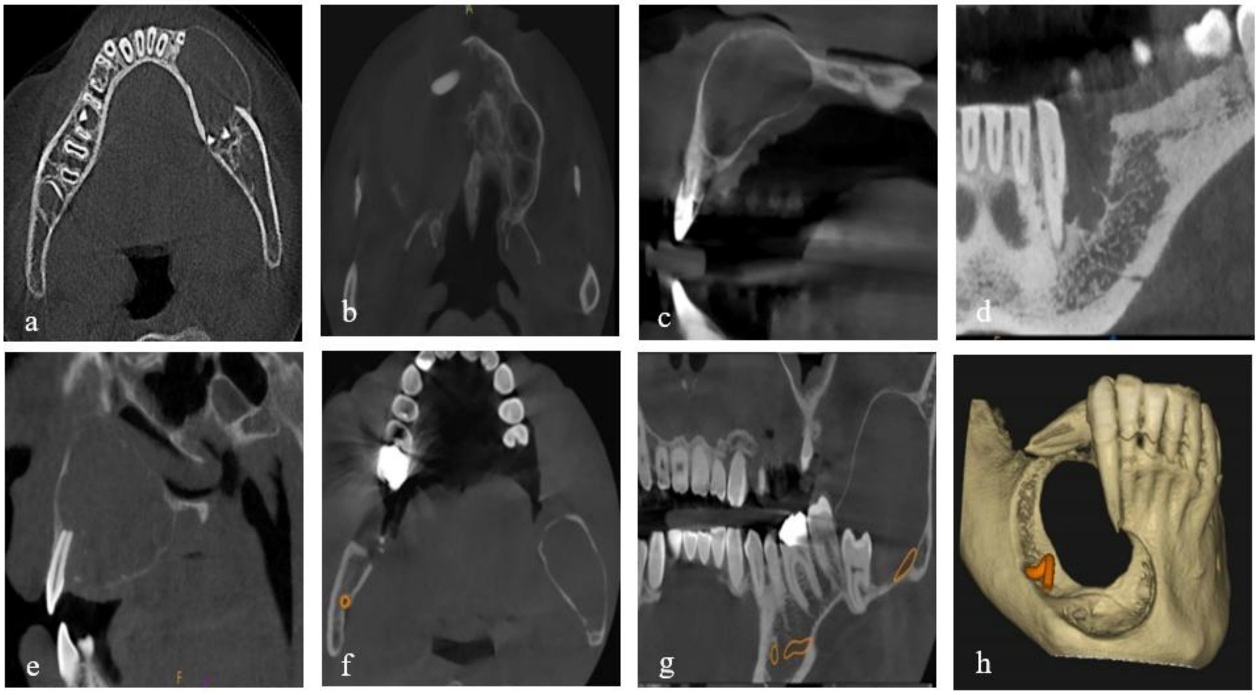

Figure 1: CBCT images depicting distinct jaw lesions with different characterization: (a) axial sections of a dentigerous cyst with well-defined borders, and (b) axial section of adenoid cystic carcinoma showing ill-defined margins. (c) sagittal views of a radicular cyst presenting a unilocular radiographic pattern; (d) coronal views of ameloblastoma exhibiting a characteristic multilocular appearance. (e) Demonstrates a sagittal view revealing apical root resorption associated with a radicular cyst. (f) axial and (g) coronal views with buccolingual expansion in a dentigerous cyst. Furthermore, image (h) shows a three-dimensional view of cortical perforation in fibromyxoma.

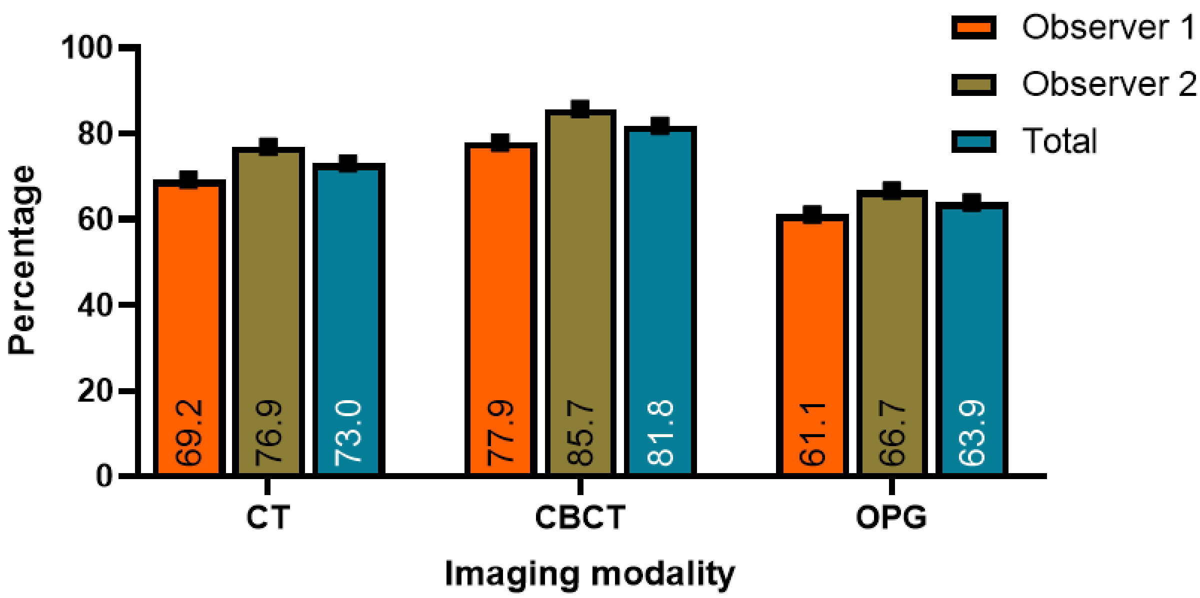

Figure 2. The accuracy of differential diagnosis (score 3) in response to the two radiologists.

Discussion

The evaluation of intraosseous jaw lesions requires an appropriate radiographic image modality to obtain comprehensive diagnostic information, which aids in planning an effective treatment strategy[5].

In the present study, mandibular lesions were more prevalent, accounting for 56.5% of the cases. This observation is consistent with the regional and international studies. A retrospective clinicopathological study conducted in Baghdad, Iraq, similarly reported a predominance of lesions in the mandible, particularly in the posterior regions[14]. Likewise, a recent cross-sectional study from Hail, Saudi Arabia, demonstrated greater involvement of the posterior mandibular region compared to the maxilla[15]. Furthermore, a large retrospective analysis of 1,121 intraosseous jaw lesions identified the mandible as the most frequently affected site[16].

Interestingly, lesions are more common in the mandible, but specific types of lesions, such as radicular cysts, occur more frequently in the maxilla. In this study, a total of 26 cases of radicular cysts were identified, of which 16 (61.5%) were detected in the maxilla. A study of Deshmukh et al (2014) supports this finding, reporting that the prevalence of radicular cysts in the maxilla is about 60% compared to the mandible[17], as also documented in prior CT-based studies[18].

A well-structured radiographic report not only distinguishes between benign, aggressive, and malignant lesions but also guides clinicians in making an accurate diagnosis and determining effective treatment plans. To achieve this, the radiologist should carefully describe the key features of the lesion including its location, size, borders, locularity, density, and the impact on surrounding structures[19,20].

The characterization of lesion borders remains a pivotal element in the radiologic assessment of intraosseous jaw pathologies, as it provides essential information regarding biological behavior and potential aggressiveness. The systematic review by Singh et al. demonstrated that lesions with well-defined, corticated margins are generally indicative of benign, slow-growing entities such as radicular or dentigerous cysts, whereas poorly defined or non-corticated borders suggest aggressive or malignant behavior[21].

In the present study, the borders were described in (85.1%) of reports, with a predominance of well-defined margins (62%), consistent with features typically associated with benign and less aggressive entities. By contrast, a CBCT-based investigation by Begum et al. (2025) reported that the majority of mandibular radiolucent lesions exhibited scalloped borders, indicating aggressive lesions (64%), while only 36% demonstrated smooth margins, referring to non-aggressive lesions[22].

Furthermore, the lack of documentation of border characterization in 16 cases (14.8%) in this study highlights a limitation of routine radiographic reporting in predicting lesion aggressiveness, which potentially influences the subsequent treatment planning.

The locularity of lesions is another fundamental radiographic criterion that should be documented in the radiographic report[20].

Multilocular patterns are frequently associated with aggressive lesions, whereas unilocular lesions are more often indicative of odontogenic cysts[23]. However, as emphasized by the systematic review by Zaghden et al., the locularity alone is not pathognomonic, as they highlighted that unilocular lesions, although commonly cystic in origin, can also represent neoplastic processes, thus creating diagnostic overlap and uncertainty when locularity is interpreted in isolation. Therefore, while locularity remains a key radiographic parameter, it must always be assessed in conjunction with other imaging features and clinical findings[24].

In the present study, unilocular lesions were more predominant (28 cases, 25.9%), of which cystic lesions were more prominent (17/28, 60.7 %), specifically showing radicular and keratocyst. Notably, in 63 cases (58.3%), locularity was not documented in the radiographic reports, representing a significant reporting gap given its diagnostic relevance, reinforcing the importance of interpreting locularity alongside other imaging and clinical features.

Evaluating root resorption offers valuable insight into the aggressiveness of a lesion and its potential impact on adjacent teeth. Although root resorption is not a consistent feature of all intraosseous jaw lesions, it is more frequently associated with ameloblastoma and central giant cell granulomas, whereas it is less commonly observed in dentigerous and radicular cysts[20].

Sueyoshi et al. demonstrated that ameloblastoma had significantly higher rates of root resorption compared to OKCs, dentigerous cysts, and simple bone cysts using the CT imaging modality[25]. Whereas Nair et al. reported root resorption in only 1 of 28 OKC cases on CBCT and panoramic imaging[26].

Moreover, a study involving 132 cases of unicystic ameloblastoma revealed that root resorption along with cortical and soft tissue invasion was significantly correlated with an increased risk of disease recurrence[27].

In this study, root resorption was documented in 27 cases (25.0%), including cystic lesions such as radicular cysts and tumors like ameloblastoma, though exact per-lesion rates were not stratified due to sample size. Initial reports omitted it in 35 cases (32.4%), but re-evaluation identified it in 9 cases (Observer 1) and 3 cases (Observer 2), highlighting interobserver variability that may stem from subjective interpretation influenced by experience and training. This pattern aligns with Sueyoshi et al. (2025), who demonstrated significantly higher root resorption rates in ameloblastomas compared to odontogenic keratocysts, dentigerous cysts, and simple bone cysts on CT imaging[25].

Vital anatomical landmarks are essential not only for maintaining sensory integrity but also for preserving a patient's overall quality of life. Their involvement may significantly affect both the patient's clinical presentation and the complexity of the required treatment. For instance, displacement or compression of the inferior alveolar canal (IAC) can result in paresthesia or anesthesia of the affected area. Invasion of the maxillary sinus or nasal cavity may give rise to oroantral communication, chronic sinusitis, and surgical complications[1].

In this study, most reported cases involved the IAC, followed by the maxillary sinus. Lu Ru et al. described a rare dentigerous cyst encircling the inferior alveolar nerve, underscoring the frequent displacement of the IAC in mandibular odontogenic lesions[28]. Similarly, Shahad A. Waheed et al. conducted a clinicopathological analysis of maxillary odontogenic cysts and tumors, confirming that extension into the maxillary sinus is a common finding[29].

Cortical expansion and cortical perforation reflect the aggressive biological behavior of many intraosseous jaw lesions. In this study, the interpretation of radiographic reports in relation to histological findings revealed that (53.7%) of cases with cortical expansion and (54.6%) with cortical perforations were consistent with odontogenic cysts. These findings are consistent with the study by Meng et al., who reported a high prevalence of cortical expansion in radicular cysts assessed using CBCT and CT imaging[30].

In the present study, the substantial inter-observer agreement regarding lesion density indicates that this parameter is highly reproducible, thereby reinforcing its reliability in diagnostic assessment. Still, both lesion extensions and tooth relations showed substantial agreement; another study by Mao et al. reported substantial agreement in shape, border, cortical thickness, internal density, and tooth displacement. Notably, they found moderate agreement for the extension of the lesions and their relation to the teeth. This difference might be due to differences in sample size, multicenter-based study, imaging modalities, interpretation of the same case with two modalities simultaneously, and the diagnostic expertise of the investigators[5].

In the current study, cystic lesions were the most common diagnosis category, with radicular cysts accounting for nearly a quarter of all cases. This finding was consistent with the work of Nainani and Sidhu, who reported radicular cysts represent 52-68% of jaw cysts[31].

In the current study, odontogenic OKCs accounted for 12% and showed unilocular, well-defined borders, as they are the most prevalent diagnostic category. This is in accordance with the findings of Borghesi et al., who described OKCs (10%) as radiolucent lesions, most commonly unilocular and well-defined[32].

Furthermore, most imaging modalities utilized in this study were CBCT (71.3%), which can serve as an alternative to CT in dental practice, by providing detailed diagnostic information through high-resolution, three-dimensional imaging, while maintaining relatively low radiation exposure and cost for patients[33].

In the current study, CBCT demonstrated superior diagnostic accuracy (81.8% score 3 differential diagnosis), with Observer 2 (87.7%) outperforming Observer 1 (77.9%; interobserver variability noted), likely attributable to differences in observer experience and subjective judgment during image analysis. These findings align with Mao et al., who reported CBCT first-diagnosis accuracy of 78.7% (both observers) compared with (64.4-70.2%) for panoramic radiograph in 225 lesions, attributing superiority to better visualization of borders, density, and structures, consistent with the kappa agreements observed in the present study[5]. Likewise, Kadhim's study emphasized CBCT's precise lesion boundary and anatomical relation in comparison with two-dimensional imaging, which is in agreement with the findings of the present study, despite their focus on radiopaque/mixed lesions versus our predominantly radiolucent (79.6%) sample; minor differences may stem from our larger cohort (108 cases versus 20) and the histopathological gold standard[34].

Conclusion

The highest diagnostic performance was achieved by CBCT, especially in identifying the correct differential diagnosis. Interestingly, benign cystic lesions were predominant. Still, reporting of radiographic features using qualitative categories varied between observers, reflecting the need for standardized reporting, technical, and training improvements for the radiologists.

Declarations

Ethics Approval and Informed Consent (Institutional Review Board) Statement: This research was approved by the Ethics Committee of the College of Dentistry, University of Sulaimani, Iraq, under application No. (COD-EC-24-0022), Issued on 16/12/2024. Informed consent statement: Written informed consent was obtained from all participants prior to their inclusion in the study.

Author Contributions: Conceptualization: AAK and DNM; methodology: AAK and DNM; software: AAK; validation: DNM; formal analysis: AAK; investigation: AAK; resources: DNM; data curation: AAK; writing original draft preparation: AAK; writing—review and editing: DNM; visualization: AAK; supervision: DNM; project administration: DNM; funding acquisition: DNM. All authors have read and agreed to the published version of the manuscript

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