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Original Research

Evaluation of the Relationship Between Intraosseous Lesions in the Maxillofacial Region and Other Pathologies: A Dental Volumetric Tomography Study

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ABSTRACT

Objective: This study aims to evaluate the relative frequency of intraosseous lesions in the maxillofacial region and their relationship with other pathologies using dental volumetric tomography (DVT).

Methods: A total of 1150 individuals aged 8-86 were examined retrospectively on DVT images. Lesions were evaluated according to their location and relationship with other maxillofacial pathologies. The obtained DVT data were analyzed using descriptive statistics and presented in tables.

Results: Intraosseous lesions were observed as cystic-tumoral in 27.9% of the patients and as periapical granuloma in 41% and were classified according to their location in the jaws. A statistically significant correlation was found between apical lesions in patients with intraosseous lesions. Apical lesions were more frequently observed in DVT images associated with radicular cysts ($p < 0.05$). No statistically significant correlation between maxillary sinus diseases and apical lesions was observed, but a relationship was observed with pathological alveolar bone loss ($p < 0.05$).

Conclusion: DVT provides significant benefits in the diagnosis, treatment, and post-treatment follow-up of intra-bone pathologies in the jaws. The findings obtained from this study showed that different studies should be conducted for each lesion or lesion group to achieve a standard.

Keywords: dental volumetric tomography, intraosseous lesions, maxillofacial region.

INTRODUCTION

The jaws are anatomical regions where odontogenic and non-odontogenic intraosseous lesions are commonly observed. Although the jaws are special regions for cysts and tumors originating from different stages of tooth development, other neoplastic and non-neoplastic bone lesions are also frequently reported in the jaws [1]. Due to the wide variety of these lesions occured in the jaws, detecting bone lesions seen in the jaws is difficult and complex. Many supporting examinations are required for a definitive diagnosis. Imaging devices and methods, which have made substantial progress in recent years in parallel with technological development, are helping diagnose jaw lesions [2].

Lesions developing in the jaws may originate from teeth and different tissues that form the jaws' anatomical structures. Due

to their diversity, lesions in this region have been subjected to different classifications [3]. Some classifications classify tumors according to the cells they originate from, while cysts are classified as inflammatory or developmental according to their etiology. However, since theories of origin may vary, classifications may also change [4].

Imaging methods for jaw lesions may vary depending on the lesion's behavior, size, location and margin. Direct radiographs routinely used in dentistry, such as intraoral and panoramic radiographs, may be sufficient to characterize a small, well-defined lesion. Modern and developed imaging methods such as computerized tomography (CT), magnetic resonance imaging (MRI), ultrasonography (USG) and scintigraphy may be needed to determine the size of a lesion that has reached large dimensions and causes expansion in the jaws or its relationship with adjacent tissues [5].

DVT technology is routinely used in maxillofacial imaging today. Designed to evaluate the bone structures of the maxillofacial region, this method can obtain images in all three planes and create a three-dimensional image, as in spiral and multislice CTs used in the medical field. DVT devices differ from other CT devices due to the different geometric principles used in imaging. In CT devices, X-rays reach the patient in the form of a fan, while in DVT, they reach the patient in conical beams [3]. In CTs, multiple sections taken in the axial plane are stacked on top of each other to obtain a complete image, while in DVT, a volumetric image is obtained by a two-dimensional detector or panel with a gantry containing a circular or rectangular conical X-ray source that can rotate 360 degrees around the patient, around the area to be examined. Using the digital data that forms this volumetric image, images can be obtained from the desired plane, including axial, sagittal, coronal and oblique sections [6].

Main Points

- The jaws are anatomical regions where many odontogenic and non-odontogenic lesions are frequently seen.
- The diagnosis of these lesions, which can originate from very different tissues and have similar clinical-radiological findings, is difficult and complex.
- Similar to studies provides an important database for both oral radiologists to make a differential diagnosis and pathologists to make a diagnosis.
- The relatıonshıp of pathologıes ın the maxıllofacıal regıon ıs ımportant ın dıagnosıs and treatment plannıng.

DVT is a suitable method that can be used in determining the boundaries of jaw lesions, evaluating their relationships with surrounding structures, determining the effects of the lesion on dento-alveolar structures, and making diagnosis-treatment plans due to its ability to obtain images in the desired plane, allowing simultaneous evaluation of images on three planes in the MPR (Multiplanar Rendering Mode) mode and its high resolution [7].

Since dental volumetric tomography (DVT) is superior to other imaging methods in visualizing bone structures, it is frequently used to detect intraosseous lesions. However, limited study has examined the relationship between intraosseous lesions in the maxillofacial region and conditions such as maxillary sinus diseases, alveolar bone loss, and apical lesions. Therefore, this study aims to evaluate intraosseous lesions in the maxillofacial region in relation to age, gender, maxillary sinus diseases, alveolar bone loss, and apical lesions using DVT in a selected population.

MATERIALS AND METHODS

The study was approved by the Kahramanmaraş Sütçü İmam University Medical Research Ethical Committee (Decision No: 2025/10-03). The 1150 DVT images were appraised from the archive of Dentomaxillofacial Radiology Department of Kahramanmaraş Sütçü İmam University, Faculty of Dentistry. This retrospective and comprehensive study evaluated maxillofacial pathologies in 1150 DVT images obtained between 2022-2025. DVT images included 16x9 and 16x16 cm within the field of view (FOV). All DVT images were obtained by Planmeca Promax 3D (Planmeca, Helsinki, Finland) and Romexis software version 3.2.0 scanner in standard resolution mode with voxel size 0.4 mm^3. For each case, descriptive data such as sex, age, type of lesion, and location were acquired. While sexuality is classified as male or female, age was categorized into four groups such as children and young adults (<21 years), adults (21–40 years), middle age (41–60 years), and old age (>60 years). In addition, apical lesions, maxillary sinus diseases, and pathological alveolar bone loss were evaluated in DVT images. Maxillary sinus diseases were grouped as mucosal thickening, partial opacification and total opacification in the right and left maxillary sinuses. Cases containing artifacts

without a preliminary or definitive diagnosis were excluded.

Two oral radiologists, one with six years of experience (A,E) and the other with three years of experience (K, MN), evaluated radiological images independently in a dark room using a 24-inch Planmeca monitor (Helsinki, Finland). In case of disagreement among observers, 100 randomly selected images were re-evaluated after 20 days and consensus was reached.

Statistical Analysis

Interobserver and intraobserver reliability was appraised using kappa statistics. SPSS software (IBM, Version 23.) was used to analyze the obtained data. The conformity of numerical variables for normal distribution was tested with the Shapiro-Wilk test. Mann Whitney U test was used to compare the variability of groups that did not show a normal distribution. The relationships between categorical variables were analyzed with the Chi-square test. P value $p < 0.05$ was noted as significant.

RESULTS

Intraobserver and interobserver agreements were stated to be perfect for the evaluation (0.85 and 0.82, respectively). The 1150 patients included in this study, 55.6% were female and 44.4% were male and the mean age was 37.43±18.01 years.

Intraosseous lesions were observed cystic-tumoral in 27.9% of the patients and periapical granuloma in 41% and were classified according to their location in the jaws. These lesions were most frequently observed in the maxillary anterior region, while the least were in the right-left maxillary posterior region and 13.5% of the intraosseous lesions were radicular cysts. 41% of the patients had at least one apical lesion, and it was most frequently detected in the left mandibular posterior. When maxillary sinus diseases were evaluated, sinus pathology was observed in 43.3% of the patients. Mucosal thickening was most frequently observed in the right-left maxillary sinus (21.1%), and pathological alveolar bone loss was observed in 18.5% of the images (Table 1).

In this study, the average age of men was remarkably higher than women ($p < 0.05$). While there was no statistically important difference between the intra-bone lesions and the regions where they were located, the correlation between these lesions and gender was statistically significant ($p = 0.007$). No relationship was observed between gender and apical lesions and localizations. Maxillary sinus diseases were significantly higher in males ($p < 0.05$).

When intrabone lesions and their locations were examined according to age groups intraosseous lesions were observed more frequently in the maxillary anterior and under the age of 20 ($p < 0.05$). When the relationship between age groups and apical lesions and their locations was examined, apical lesions were most frequently observed in the left maxillary posterior between the ages of 21-40 ($p < 0.05$). Maxillary sinus diseases were most frequently observed in both the right and left maxillary sinuses and in the 41-60 age range ($p < 0.05$). Pathological alveolar bone losses were observed more frequently in patients over 60 ($p < 0.05$).

As observed in Table 2, a statistically significant relationship was found between apical lesions and intraosseous lesions. Apical lesions were observed more frequently in patients with radicular cysts ($p < 0.05$). While no statistically significant relationship was observed between maxillary sinus diseases and apical lesions, a negative correlation was observed with pathological alveolar bone loss. Fewer apical lesions were detected in images with pathological alveolar bone loss. In patients with pathological alveolar bone loss, a statistically significant correlation was found between intraosseous lesions and the regions where they were located ($p < 0.05$).

Table 1. Distribution of dependent and independent variables

Dependent and independent variables		n	%
Age Group	<=20	251	21.8
	21-40	419	36.4
	41-60	323	28.1
	>60	157	13.7
Sex	Male	511	44.4
	Female	639	55.6

Intraosseous lesion site	Anterior mandible	28	2.4
	Anterior maxilla	89	7.7
	Right mandibular posterior region	72	6.3
	Right maxillar posterior region	18	1.6
	Right maxillar left mandibular posterior region	3	0.3
	Right-left maxillar mandibular posterior region	6	0.5
	Right-left mandibular posterior region	3	0.3
	Right-left maxillar posterior region	2	0.2
	Left mandibular posterior region	66	5.7
	Left maxillar posterior region	22	1.9
	Absence	841	73.1
Intraosseous lesion	Ameloblastoma	4	0.3
	Simple bone cyst	14	1.2
	Dentigerous cyst	45	3.9
	Giant cell granuloma	2	0.2
	Enostosis	11	1.0
	Periapical and florid cement osseous dysplasia	12	1.0
	Nasopalatin duct cyst	2	0.2
	Odontoma	9	0.8
	Odontogenic keratocys	15	1.3
	Ossifying fibroma	5	0.4
	Osteomyelitis	9	0.8
	Radicular cyst	155	13.5
	Residual cyst	23	2.0
	Sementoblastoma	2	0.2
	Stafne Bone Cyst	2	0.2
	Absence	840	73.0
Periapical inflammatory lesion	Presence	471	41.0
	Absence	679	59.0
Maxillary sinus diseases	Right mucosal thickening	110	9.6
	Right- left mucosal thickening	243	21.1
	Right- left partial opacification	17	1.5
	Right- left total opacification	4	0.3
	Right total opacification	9	0.8
	Left mucosal thickening	90	7.8
	Left partial opacification	4	0.3
	Left total opacification	10	0.9
	Healty	663	57.7
Pathological Bone Loss	Presence	213	18.5
	Absence	937	81.5

Table 2. Relationship between intraosseous lesions and their location with age, gender and other pathologies

	Sex	Age Group	Periapical inflammatory lesion	Maxillary sinus diseases	Pathological Bone Loss
Intraosseous lesion	0.007*	0.001*	0.001*	0.184	0.001*
Intraosseous lesion site	0.518	0.001*	0.911	0.093	0.001*

*Level of significance set at $p \leq 0.05$

DISCUSSION

Jaws are anatomical regions where many lesions of odontogenic and non-odontogenic origin are commonly seen. Diagnosing these lesions, which can originate from very different tissues and have similar clinical-radiological findings, is difficult and complex [8]. DVT provides significant benefits in the detection, treatment, and post-treatment pursuit of intra-bony pathologies seen in the jaws, as it provides three-dimensional imaging and allows sectioning in the desired plane. DVT offers an opportunity to evaluate three dimensions: location, size, peripheral margins, relationship with surrounding structures, internal structure and lesion density [9].

DVT is a suitable method that can be used in determining the boundaries of jaw lesions, evaluating their relationships with surrounding structures, determining the effects of the lesion on dento-alveolar structures, and making diagnosis-treatment plans due to its ability to obtain images in the desired plane, allowing simultaneous evaluation of images on three planes in MPR (Multiplanar Rendering Mode) mode and its high hard tissue resolution [10]. There are studies in the literature to determine the diagnostic value of DVT in the differential diagnosis of intraosseous lesions. In the study accomplished by Rosenborg et al. [11], it was stated that DVT is an inappropriate method for differentiating radicular cysts and granulomas, while in the study conducted by Guo et al. [12], it was shown that DVT can provide a moderately accurate diagnosis in distinguishing cysts from granulomas in apical lesions with a minimum size of 5 mm. DVT is currently the superior method for evaluating lesion boundaries and internal structure [13]. Due to these advantages, this study presented cyst-tumor and similar lesions, apical lesions, intraosseous pathologies, maxillary sinus diseases, pathological alveolar bone loss, and DVT findings.

While some previous studies focused on particular study groups of lesions, such as odontogenic and non-odontogenic cysts and odontogenic and non-odontogenic tumors [14-17], others have evaluated more diverse study groups, such as pediatric patients or participants in certain geographical regions [18-22]. In this study, all intraosseous pathologies and all age ranges were retrospectively reviewed, and their relationship with incidental pathologies was evaluated.

The mean age of patients in the current study was 37.43 ± 18.01 years, comparable to previous studies [18, 23, 24]. In a similar study by Farias et al. [25], lesions were most frequently observed between the ages of 31 and 40, while in our study, they were observed more frequently under the age of 20.

While most studies on intra-osseous lesions report an almost equal gender distribution with a male predominance [14, 18, 26, 27], our study showed a female predominance. This study found a significant relationship between gender and intra-bone lesions.

In the study of Langaroodi et al. [28] on panoramic radiography, 18% of lesions were detected, and the most common were odontogenic cysts. In the epidemiological study of Farias et al. [25], including pathology records, a radicular cyst was the most common of the 14% cases with intra-bony lesions. In the study of Dhanuthai et al. [23], based on 25 years of experience, 31.62% of the patients were detected with intra-bony lesions, and the most common was radicular cyst, followed by dentigerous cyst and ameloblastoma. In this study, the intra-bony lesion rate in DVT images with pathological records and clinical pre-diagnosis was 27.9% cyst and tumor and 41% periapical inflammatory lesions. While many publications do not include periapical lesions among intra-bony lesions, they were included in this study, as in the study by Farias et al. [25]. Additionally, no malignant lesions were found in this study.

In the study of Jaafari-Ashkavandi et al. [29], intraosseous maxillofacial lesions were more often located in the posterior part of the mandible, followed by the anterior maxilla. This study observed it in the maxillary anterior and right mandibular

posterior regions. In a study in which anatomical changes and pathological findings in maxillary sinuses with DVT were analyzed, the prevalence of maxillary sinus disease ranged from 7.5% to 66%, and the most common conditions were mucosal thickening and opacification or sinusitis [30]. In this study, the prevalence was 43.3%, and low mucosal thickening was observed. Previous DVT studies have found a correlation between periapical inflammatory lesions and maxillary sinus diseases. The severity and incidence of maxillary sinus diseases were positively correlated with apical lesions [31, 32]. While a statistically important relationship was observed between maxillary sinus diseases and apical lesions in the study by Melo et al. [33], that was not observed in this study.

Apical lesions and some intraosseous lesions are associated with increased expression of alveolar bone loss parameters. Increased intraosseous inflammation may advance the formation of radicular cysts and more marked bone loss [34]. A statistically significant relationship was found between intraosseous lesions and the areas where the lesions were located in patients with pathological alveolar bone loss ($p < 0.05$). Fewer apical lesions were detected in patients with pathological alveolar bone loss.

There are numerous studies in the field of dentistry on intraosseous lesions, apical lesions, maxillary sinus diseases, and pathological alveolar bone loss However, similar to our study on intraosseous lesions, there are limited recent studies in the literature examining the relationship between DVT findings and maxillary sinus diseases, apical lesions, and pathological alveolar bone loss. Most researchers have found a significant relationship between the presence of periapical lesions in maxillary posterior teeth and maxillary sinus inflammatory reaction [35-37]. In the study by Gomes et al. [37], periapical pathology of maxillary teeth, especially those in close contact with the maxillary sinus floor, was reported to be associated with a higher probability of having odontogenic maxillary sinus mucosal thickening. Huang et al. [38] demonstrated that thickening of the maxillary sinus membrane was significantly associated with periapical lesions and periodontal bone loss. In our study, while no statistically significant relationship was observed between maxillary sinus diseases and apical lesions, a relationship was observed with pathological alveolar bone loss. This study's limitation is that, since it is a retrospective archive study, the patient's clinical symptoms and medical history cannot be accessed. Further studies are needed to explore such an association in different populations and with a much larger sample. In addition, these lesions can be evaluated with advanced imaging studies.

CONCLUSIONS

The study is a regional study on the relationship of intraosseous jaw lesions with other pathologies in the maxillofacial region. Other incidental pathological findings should not be ignored while evaluating any intraosseous lesion in the maxillofacial region. That provides an important database for both oral radiologists and pathologists to make a differential diagnosis. However, a more comprehensive study similar to this study examining the relationship with maxillofacial pathologies is needed.

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Informed Consent: Informed consent was obtained from all patients for being included in the study.

Ethical Approval: The study was approved by the Kahramanmaraş Sütçü İmam University Medical Research Ethical Committee (Decision No: 2025/10-03). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions

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