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Original Research Article

Retrospective Evaluation of Radiological Findings in Patients with Oral Malignancy

Oral Maligniteye Sahip Hastaların Radyolojik Bulgularının Retrospektif Olarak Değerlendirilmesi

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ABSTRACT

Aim: Oral cancer ranks among the most prevalent cancers worldwide. Imaging methods play a vital role in assessing patients. This study aimed to evaluate the age, sex, and localization distribution as well as panoramic and cone-beam computed tomography (CBCT) image findings in patients with oral malignancy with bone involvement.

Materials and Method: Patients who were histopathologically diagnosed with malignant oral lesions at Gazi University, Faculty of Dentistry, Department of Oral Pathology between 2009 and 2023 were reviewed. Patients with oral malignancies whose panoramic images or CBCT images were available in the radiology archive were included in this study. Age-sex distribution was recorded. Localization of lesions and radiological features such as internal structures, borders, and effects on surrounding tissues were evaluated.

Results: The mean age of the patients was 58.2 years; nine of them were female and thirteen were male. The incidence of malignancies included in this study was higher in men than in women, and the mandible/maxilla ratio was equal. The most common primary tumor was squamous cell carcinoma (SCC) (n=12). SCC lesions caused destruction in the cortical borders of neighboring structures in the region where they were located and showed the potential to spread toward these regions. Mucoepidermoid carcinoma was observed as an unilocular radiolucent lesion with clear borders, and it was determined that it destroyed the cortical bone.

Conclusion: Panoramic radiography and CBCT images are valuable imaging methods in the evaluation of bone involvement of oral malignancies.

Keywords: Cone beam computed tomography; Oral cancer; Panoramic radiography; Squamous cell carcinoma

ÖZET

Amaç: Ağız kanseri dünyada en sık görülen kanserlerden biridir. Hastaların değerlendirilmesinde görüntüleme yöntemleri önemli bir yere sahiptir. Bu çalışmada kemik tutulumu olan oral maligniteli hastalarda yaş, cinsiyet ve lokalizasyon dağılımının yanı sıra panoramik ve konik ışınlı bilgisayarlı tomografi (KIBT) görüntü bulgularının değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Gazi Üniversitesi Diş Hekimliği Fakültesi Oral Patoloji Anabilim Dalı arşivinden 2009-2023 yılları arasında histopatolojik olarak malignite tanısı alan hastalar incelendi. Bu çalışmaya panoramik görüntüleri veya KIBT görüntüleri radyoloji arşivine kayıtlı oral maligniteli hastalar dahil edildi. Yaş-cinsiyet dağılımı kaydedildi. Lezyonların lokalizasyonu ve iç yapıları, sınırları, çevre dokulara etkileri gibi radyolojik özellikleri değerlendirildi.

Bulgular: Hastaların yaş ortalaması 58.2 olup 9'u kadın, 13'ü erkekti. Bu çalışmaya dahil edilen malignitelerin erkeklerde görülme oranı kadınlara göre daha yüksekti ve mandibula/maksilla oranı eşitti. En sık görülen primer tümör skuamöz hücreli karsinomdu (SHK) (n=12). SHK lezyonları bulundukları bölgedeki komşu yapıların kortikal sınırlarında yıkıma neden olmuş ve bu bölgelere doğru yayılma potansiyeli göstermiştir. Mukoepidermoid karsinom uniloküler, radyolusent, sınırları belirgin bir lezyon olarak izlendi ve kortikal kemiği tahrip ettiği belirlendi.

Sonuç: Panoramik radyografi ve KIBT görüntüleri oral malignitelerin kemik tutulumlarının değerlendirilmesinde değerli görüntüleme yöntemleridir.

Anahtar Kelimeler: Ağız kanseri; Konik ışınlı bilgisayarlı tomografi, Panoramik radyografi; Skuamöz hücreli karsinom

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INTRODUCTION

Oral cancers are the eighth most common type of cancer in the world, and they are responsible for 2% of cancer deaths. Although the incidence of oral cancers increase with age, 95% of cases are over 40 years of age.[1-3] The main risk factors for the development of oral cancers are smoking and alcohol consumption. However, human papillomavirus (HPV), poor oral hygiene, chronic mechanical irritation, and genetics also contribute to the risk. Malignant lesions in the oral cavity may be primary malignancies or metastatic lesions. Squamous cell carcinoma (SCC) is a primary tumor that constitutes approximately 90% of oral cancers[4] , other tumors of the oral cavity include those of the salivary minor glands, melanomas, and lymphomas.[5] Metastatic tumors constitute 1-3% of malignant lesions seen in the oral cavity. Metastatic lesions may occur in soft tissue, hard tissue, or both. The most common place for metastases is the mandible.[6-8] Various primary malignancies, especially breast, prostate, lung, and kidney cancers, prefer bone for metastasis. Within the skeleton, bones with red marrow are preferred sites for metastasis. In contrast, especially in older individuals, there is little active bone marrow in the jaw bones, but remnants of active bone marrow can be detected in the posterior regions of the mandible, and hematopoietically active areas attract metastatic tumor cells.[9]

The size of the tumor, the depth of invasion, and the presence of regional metastasis affect the prognosis, but the involvement of the lymph nodes is the most important determinant of the outcome.[10] Therefore, early diagnosis of oral cancers is very important for the prognosis of patients.

Oral cancers originating in the gingiva, retromolar region, hard palate, or buccal mucosa may frequently invade the maxillary and/or mandibular bone.[11] These involvements can be detected with different diagnostic imaging methods. These imaging modalities are panoramic radiography, bone scintigraphy, magnetic resonance imaging, computed tomography (CT), and positron emission tomography (PET-CT).[10] Panoramic radiography is often used to detect suspected bone invasion in the initial diagnosis of oral carcinomas. Recently, studies investigating the accuracy of cone beam computed tomography (CBCT) images in the determination of bone invasion have been published.[11-13]

Radiographic images of oral cancers show different characteristic findings. Generally, the internal structures of the lesions are radiolucent, their boundaries are unclear, and they cause destruction in the surrounding tissues.[14] It is vital that dentists can diagnose oral cancers early with a good history and clinical examination. In this study, the aim was to examine the effects of oral cancers with bone involvement on the surrounding tissues by evaluating panoramic and CBCT images.

MATERIALS AND METHOD

This study was conducted on 04.02.2020 with the approval of the Gazi University Ethics Committee numbered 91610558-604.01.02.

Patients diagnosed as having a histopathologically malignant lesion from the archives of the Department of Oral Pathology, Faculty of Dentistry, Gazi University between 2009 and 2023 were reviewed retrospectively. The records of 127 patients were accessed. Patients with oral malignancies whose panoramic images or CBCT images were registered in the radiology archive were included in this study. All images were from the radiography archive of the Oral and Maxillofacial Radiology Department, and no additional radiographs were acquired for the study. Twenty-two of these 127 patients had panoramic radiographs or CBCT images, and included in the study.

The digital panoramic images were obtained with a machine (Sirona Dental Systems, Bensheim, Germany), operating at 66 kV, 8 mA, with a 0.5 mm focal spot and an exposure time of 14 seconds. CBCT images were acquired with a Planmeca Promax 3D unit (Helsinki, Finland). They were obtained with imaging protocol 90 kV, 8-12 mA, and 0.4 mm voxel size. All evaluations were made by an oral radiologist.

Lesions were divided into two groups as primary neoplasms and metastases. Internal structures and borders of the lesions and their effects on the surrounding anatomical structures were evaluated in radiological images.

Statistical analysis

The data obtained in the research were analyzed using SPSS 28.0 (Statistical Package for Social Sciences) program. Descriptive statistical methods (number, percentage, median, minimum, maximum, mean and standard deviation) were used when evaluating the data. Variables in the study were analyzed with the Fisher's Exact test. For all analyses, the threshold probability of type I error was determined as α=0.05.

RESULTS

The distributions of participants' gender and lesion variables are presented in Table 1; 40.9% of participants were women and 59.1% were men; and 86.4% were primary tumors and 13.6% were secondary tumors. Histopathologically, 54.5% lesions were classified as SCC, 9.1% as high-grade malignant tumor, because the definitive classification could not be made, 9.1% as mucoepidermoid carcinoma, 9.1% as osteosarcoma, 4.5% as clear cell adenocarcinoma, 4.5% as small cell lung cancer metastases, 4.5% as lymphoma metastases and 4.5% as rhabdomyosarcoma metastases. Of the primary tumors, 63.2% were SCC and this value was statistically significant ($p<0.05$).

While 50% of the lesions were observed in the maxilla and 50% in the mandible, 86.4% were in the posterior region and 13.6% in the anterior region. When the distribution of lesions observed in the posterior region was examined, it was determined that 47.4% were observed on the right side and 52.6% were observed on the left side.

The age distribution had a range of 23 to 97, with the median 60.5 and the mean 58.2±17.4 yr. (Table 2).

Whether there was a statistically significant relationship between gender and lesions was assessed with the Fisher's Exact test. Accordingly, the number of men diagnosed with SCC was significantly higher than women, and all metastatic lesions were detected in male patients (Table 3).

Although all patients had panoramic radiography images, only ten patients had CBCT images. Panoramic radiographs of twelve patients diagnosed

Table 1. Characteristics of participants and their lesions

		n	%
Gender	Woman	9	40.9
	Male	13	59.1
Lesion side	Right	9	47.4
	Left	10	52.6
	Sum	19	100.0
Lesion site	Posterior	19	86.4
	Anterior	3	13.6
Lesion localization	Maxilla	11	50.0
	Mandible	11	50.0
Lesion	High grade malignant tumor	2	9.1
	Small cell ac ca metastasis	1	4.5
	Lymphoma metastasis	1	4.5
	Mucoepidermoid carcinoma	2	9.1
	Osteosarcoma	2	9.1
	Rhabdomyosarcoma metastasis	1	4.5
	Scc	12	54.5
	Clear cell adenocarcinoma	1	4.5
Lesion type	Primary tumor	19	86.4
	Secondary tumor/metastasis	3	13.6
	Sum	22	100.0

Table 2. Descriptive statistics of participants' ages

	n	Median (Min-Max.)	Avg±SS
Age	22	60.5 (23-97)	58.2±17.4

with SCC showed loss of lamina dura and enlargement of the periodontal space of the teeth associated with the lesion. Irregular destruction areas and crater-like destruction were detected in the alveolar bone where the lesion was located, and destruction in the cortical bone associated with the lesion (Figure 1a, b).

When the CBCT images of 4 patients diagnosed with maxillary SCC were examined, the lesions showed radiolucent internal structure, their boundaries were unclear, they caused destruction in the cortical borders of the neighboring structures in the region and showed the potential to spread towards these regions (Figure 1c, d).

Maxillary CBCT images of a patient diagnosed with osteosarcoma showed that the lesion had a radiolucent-radiopaque internal structure, causing deterioration in trabeculation and expansion in the alveolar bone. Sunray periosteum reaction with spicules bone was noted in the maxilla (Figure 1e, f).

Table 3. Distributions of lesions by gender

Gender	Lesion	Lesion type		Sum	p
		Primary tumor	Secondary tumor/metastasis		
		n (%)	n (%)	n (%)	
Woman	HIGH GRADE MALIGNANT TUMOR	1 (11.1)	-	1 (11.1)	-
	MUCOEPIDERMOID CARCINOMA	1 (11.1)	-	1 (11.1)	
	OSTEOSARCOMA	1 (11.1)	-	1 (11.1)	
	SCC	5 (55.6)	-	5 (55.6)	
	CLEAR CELL ADENOCARCINOMA	1 (11.1)	-	1 (11.1)	
	Sum	9 (100.0)	-	9 (100.0)	
Male	HIGH GRADE MALIGNANT TUMOR	1 (10.0)	0 (0.0)	1 (7.7)	
	SMALL CELL AC CA METASTASIS	0 (0.0)	1 (33.3)	1 (7.7)	0.029
	LYMPHOMA METASTASIS	0 (0.0)	1 (33.3)	1 (7.7)	
	MUCOEPIDERMOID CARCINOMA	1 (10.0)	0 (0.0)	1 (7.7)	
	OSTEOSARCOMA	1 (10.0)	0 (0.0)	1 (7.7)	
	RHABDOMYOSARCOMA METASTASIS	0 (0.0)	1 (33.3)	1 (7.7)	
	SCC	7 (70.0)	0 (0.0)	7 (53.8)	
	Sum	10 (100.0)	3 (100.0)	13 (100)	

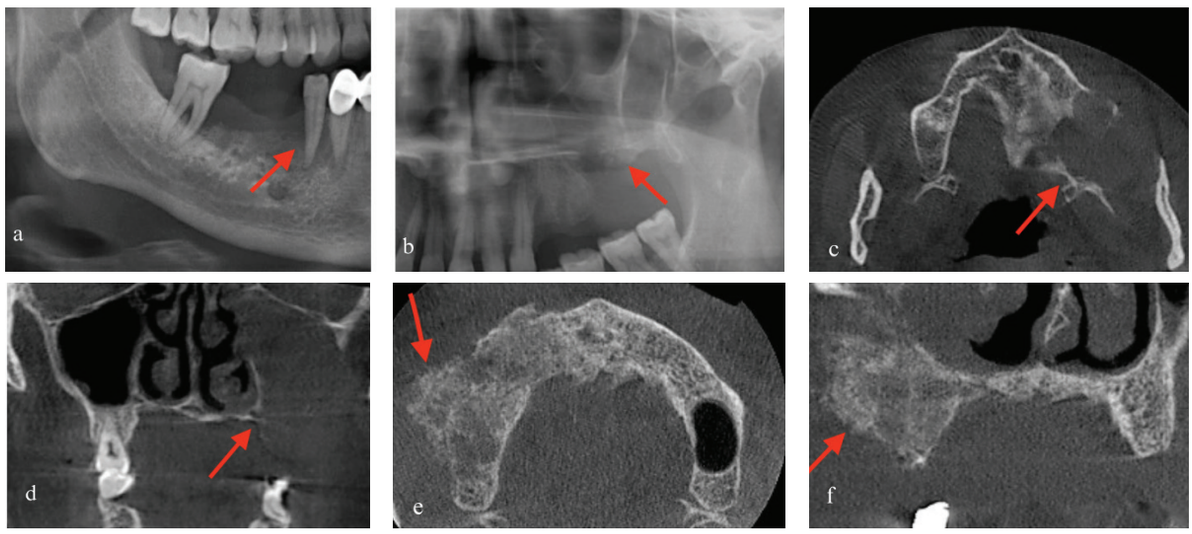

Figure 1. Panoramic and CBCT images in patients diagnosed with SCC and osteosarcoma.
Cropped panoramic radiograph image of the patient diagnosed with SCC, loss of the lamina dura of the teeth associated with the lesion posterior to the right mandible (a) (red arrow), the maxillary sinus floor is not clearly visible with the destruction area posterior to the left maxilla (b) (red arrow) CBCT axial (c) and coronal section (d) images of the patient diagnosed with SCC; the lesion appears to have caused destruction of the alveolar bone, maxillary sinus, and lateral wall of the nasal cavity. CBCT axial (e) and coronal (f) section images of the patient diagnosed with osteosarcoma. Expansion and periosteal reaction in the alveolar bone posterior to the right maxilla (red arrows).

Panoramic and CBCT images of one of the mucoepidermoid carcinoma cases were examined; the lesion was identified with clear borders, unilocular radiolucency, and cortical bone destruction (Figure 2a, b, c).

In the CBCT of the patient with metastatic tumor (small cell lung carcinoma), a pathological fracture in the mandibular angulus, which was not observed in the panoramic radiograph, was noted (Figure 2d, e).

The panoramic radiograph of the patient whose tumor was consistent with hyalinize clear cell adenocarcinoma showed an area of irregular destruction in the right maxilla posterior. There was loss of the lamina dura in the tooth associated with the lesion (Figure 2f).

When the panoramic radiographs of two lesions, defined as high grade malignant tumors and histopathologically unclassifiable, were examined, large areas of destruction in the alveolar bone and trabeculation disorder were observed. Also, loss of lamina dura and floating tooth appearance in the teeth associated with the lesion were observed. Their CBCT images revealed destruction of the nasal cavity borders in one, and superior displacement of the floor of the maxillary sinus in the other patient. In Table 4, the radiological findings of the patients are presented in detail.

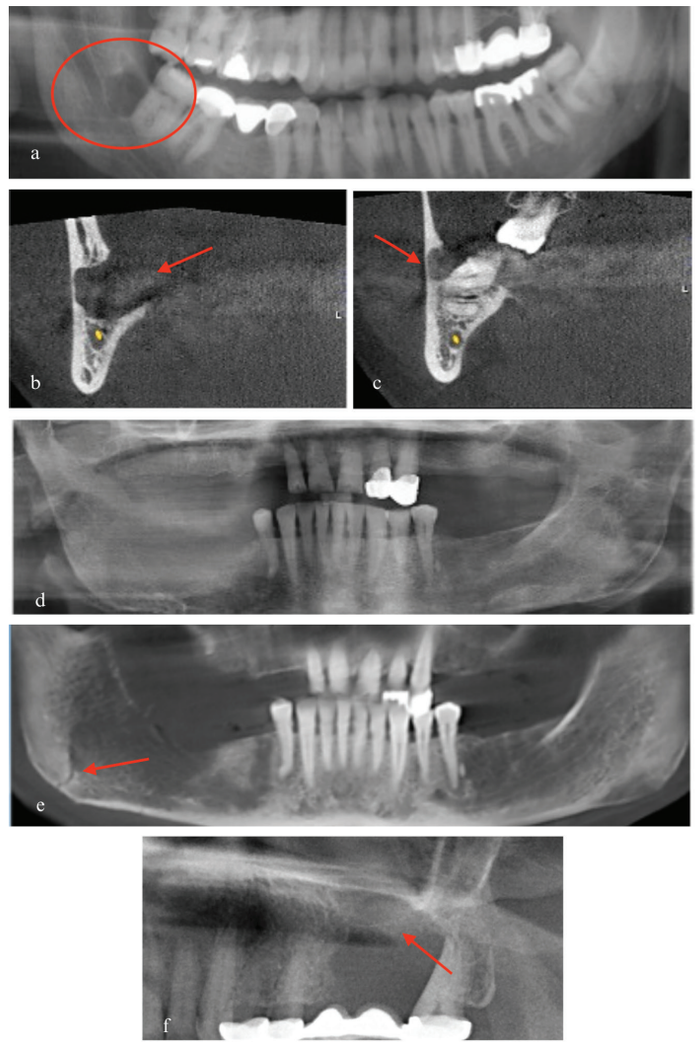

Figure 2. Panoramic and CBCT images of the patients with mucoepidermoid carcinoma, small cell lung cancer metastasis and clear cell adenocarcinoma. Panoramic radiograph (a) and CBCT coronal sections (b,c) images of a patient diagnosed with mucoepidermoid carcinoma. Clear borders of the radiolucent lesion located distal to the second molar. CBCT reformat panoramic radiography image (e) of a patient with small cell lung cancer metastasis shows a fracture in the right mandible angulus (red arrow) that is not observed on the panoramic radiograph (d). Cropped panoramic radiograph image of the patient with clear cell adenocarcinoma (f).

Table 4. Radiological findings of malignant lesions seen in panoramic radiography and CBCT

Localization	Internal Structure	Lesion Boundaries	Impact on Surrounding Tissues
Squamas Cell Carcinoma			
Maxilla			
1. Maxilla Anterior	RL	Irregular	destruction in the nasal cavity and alveoler bone
2. Right Maxilla Posterior	RL	Irregular	destruction in the alveoler bone, nasal cavity, maxillary sinus and orbita
3. Left Maxilla Posterior	RL	Irregular	loss of lamina dura
4. Left Maxilla Posterior	RL	Irregular	destruction of the alveolar bone, maxillary sinus, and lateral wall of the nasal cavity
5. Left Maxilla Posterior	RL	Irregular	destruction in the alveoler bone, maxillary sinus, thinning of the orbital floor
6. Left Maxilla Posterior	RL	Irregular	crater-like destruction in the alveolar bone, loss of lamina dura
7. Left Maxilla Posterior	RL	Irregular	destruction in the alveolar bone
Mandible			
1. Right Mandible Posterior	RL	Irregular	loss of lamina dura and enlargement of the periodontal space, destruction in the alveolar bone
2. Left Mandible Posterior	RL	Irregular	destruction in the alveolar bone, involvement of mandibular canal and mental foramen
3. Left Mandible Posterior	RL	Irregular	irregular destruction areas in the alveolar bone
4. Right Mandible Posterior	RL	Irregular	irregular destruction areas in the alveolar bone
5. Mandible Anterior	RL	Irregular	floating tooth, irregular destruction areas in the alveolar bone
High Grade Malignant Tumor			
Maxilla			
1. Left Maxilla Posterior	RL	Irregular	floating tooth, destruction of the alveolar bone and maxillary sinus
2. Left Maxilla Posterior	RL/RO	Irregular	deterioration in trabeculation, irregular destruction areas in the alveolar bone
Mucoepidermoid Carcinoma			
Mandible			
1. Right Mandible Posterior	RL	Regular	cortical bone destruction
2. Right Mandible Posterior	RL	Regular	cortical bone destruction
Osteosarcoma			
Mandible			
1. Right Mandible Posterior	RL	Irregular	destruction in the alveolar bone,loss of lamina dura
Maxilla			
1. Right Maxilla Posterior	RL/RO	Irregular	deterioration in trabeculation and expansion in the alveolar bone, sunray periosteum reaction
Hyalinizing Clear Cell Adenocarcinoma			
1. Left Maxilla Posterior	RL	Irregular	loss of lamina dura, destruction in the alveolar bone
Metastatic Tumors			
Mandible			
1. Right Mandible Posterior	RL	Irregular	fracture in the angulus mandible, involment of mandibular canal
2. Right Mandibular Ramus	RL	Regular	cortical bone destruction, crater-like destruction in the ramus mandible
3. Mandible Anterior	RL	Irregular	irregular destruction areas in the alveolar bone, loss of lamina dura

DISCUSSION

Primary malignancies of the oral cavity often begin in the soft tissue and then invade the bone locally. The most common histological type of oral cancer is squamous cell carcinoma. Consistent with the literature, 12 of 19 primary malignancies included in our study were SCC.

Mandible involvement is more common than the maxilla and is more common in males than in females.[15-18] In our study, consistent with the literature, the number of men with malignancies was higher than women, but the mandible/maxilla ratio was equal.

The age range of the twenty-two patients examined in our study was 23-97 years and the mean age was 58.2 years. These findings are consistent with the literature.[15,16]

Metastatic lesions of the jaw bones are rare.[19] In their study of metastatic lesions seen in 114 jaw bones, Nisha *et al*.[20] reported that such lesions were seen in males and more often in the mandible. In our study, in accordance with this, all metastasis were male, and the affected bone mandible.

Seoane *et al*.[21] analyzed 39 oral metastases and found that 25% (10/39 cases) of the metastatic tumors had been found before the primary tumors. In the literature, the most commonly reported primary metastatis site is the lung for males and the breast for females.[22,23] Unfortunately, since our study was conducted retrospectively, we did not have such information.

CBCT has been reported to have the potential to be a new diagnostic tool in the oral squamous cell carcinoma (OSCC) screening procedure to predict mandibular invasion or erosion.[11] Slieker *et al.*[24] also reported that CBCT can accurately detect bone invasion of the maxilla, which might be beneficial during preoperative assessment of OSCC of the maxilla. In this study, in OSCC patients with bone involvement, panoramic and CBCT images were examined and radiolucent internal structure, expansion of the periodontal space of the teeth in the relevant region, and loss of lamina dura, and destruction of the cortical boundaries of the surrounding tissues were observed. These findings are consistent with the work of Shah *et al*.[18]

Mucoepidermoid carcinoma; is the most common malignant salivary gland tumor. It is twice as common in women as in men and the mandible is more commonly affected than the maxilla.[25] These tumors are most common in the 3rd and 4th decade.[26] In our study, both patients examined in accordance with the literature have mandible involvement, but the female/male ratio is equal. Again, when the radiographic images of the patients examined, the internal structure was radiolucent, and cortical borders were clear. These findings are consistent with those in the literature.

Osteosarcoma is the most common malignant tumor of the bones but rarely seen in the jawbone. In the study conducted by Weber *et al*.[27] , the radiological findings of osteosarcoma seen in the jaw bones may vary, but in the most common osteoblastic form in the jaws; they stated that a periosteal reaction in the form of sclerotic bone and sunlight was observed. The panoramic and CBCT images of the patients examined in our study were consistent with these findings.

Hyalinizing clear cell carcinoma (HCCC) predominantly affects the minor salivary gland of the oral cavity and is more common in women than in men.[28] Zhi-Jun Sun *et al*.[29] reported a case of hyalinized clear cell carcinoma localized in the palatal mucosa of a 48-year-old female patient and caused destruction of the alveolar bone in radiological examinations. Similarly, destruction was observed in the left maxilla alveolar bone in the images included in our study.

CONCLUSION

Our study aimed to investigate the radiological findings of malignant lesions seen in the oral cavity. According to the study results, 63.2% of the primary tumors observed in the oral cavity were SCC. The incidence of oral malignancies was higher in men than in women. Irregular borders were observed in the radiological images of all pathologies except mucoepidermoid carcinoma. All metastases were seen in the mandible.

Timely detection of oral cancers is crucial for prognosis and improving survival rates. Careful clinical and radiographic examination by dentists can be lifesaving for patients. Panoramic radiography and

cone beam computed tomography images are effective in the diagnosis of these malignancies. In cases of suspicion, advanced imaging methods should be prioritized to expedite diagnosis.

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