Original Article

A retrospective radiographic analysis of osseous changes in oral malignancy

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ABSTRACT

Introduction: Although oral squamous cell carcinoma mainly occurs in oral soft tissues, involvement of jaw bones occurs in 12–56% of the cases. In these cases, radiographic examination becomes important to observe the pattern of bone involvement. **Objectives:** To analyze the radiographic features of oral malignancy involving jaw bone and to compare it with the available literature. **Materials and Methods:** The clinical and radiographic records of 20 cases of oral malignancy showing bone involvement in panoramic radiographs were analyzed from the archives of the department in the present hospital-based retrospective study. Descriptive statistics were used to compare the findings. **Results:** We observed that the age of the patients presenting with oral malignancy with jaw bone involvement ranged from 35 to 82 years, with a male:female ratio of 1:1. Mandible was involved in 19 cases with preference to the right side (63.2%). In the mandible, the body of the mandible was most commonly involved (89.5%), with ragged margins (80%) and irregular pattern of involvement (75%) being the most common. Pathologic fracture was evident in 6 (30%) cases and floating tooth appearance was present in 10 (50%) cases. Only 3 (15%) cases demonstrated root resorption. **Conclusion:** Panoramic radiographs are valuable aids in diagnosing the involvement of jaw bones in oral malignancy, and thereby help in devising the treatment plan.

Key words: Oral malignancy, panoramic radiograph, pathologic fracture, root resorption

Introduction

Oral cancer is the eighth most common cancer and accounts for 2% cancer deaths worldwide. In the developing world, the incidence of oral cancer is alarmingly high. In India, oral cancer accounts for up to 30–50% of all cancers.[1] The malignancies involving oral cavity can be carcinoma, metastatic lesion from distant malignancies, sarcoma, or malignancy of the hematopoietic system. Squamous cell carcinoma is the most common among all the oral cancers and comprises 90–95% of all oral malignancies.[2]

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The bony involvement in advanced stage oral cancer is common and significantly affects the prognosis of the disease. On radiographs, malignancies present some characteristic, if not diagnostic, appearances. Margins of the malignant lesion on the radiographs are typically ill-defined with lack of cortication. The internal structure is usually radiolucent with occasional presence of residual islands of bone. The involved teeth become loose, migrate or show root resorption. The associated anatomic

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structures show evidence of invasion or infiltration by the lesion. The surrounding bone may show saucer-shaped defects or may show pathologic fracture in extreme cases. The overall radiographic appearance and the effects on the surrounding structures mirror the destructive behavior of the malignant lesion [Figure 1].[3,4]

Owing to easy availability and lower radiation dose, panoramic radiographs combined with routine intraoral radiography play a vital role in the detection of bony changes in the jaws.[5] In a study conducted by Rao *et al.*,[6] it was found that orthopantomograms have 92% sensitivity for the detection of mandibular involvement by malignancies. Therefore, the present study aims to analyze patterns of jaw bone involvement in oral malignancy by using digital panoramic radiographs [Figure 2].

Materials and Methods

A total of 50 patients of oral malignancy reported during the time period from June 2014 to February 2015, of which 20 demonstrated bone involvement in panoramic radiographs. The lesions were present involving both the jaws in different locations, i.e., either side of the jaw or the anterior region. The borders of the lesions were found to be ragged in a majority of the cases while smooth in some cases. The internal structure varied from completely radiolucent to radiolucent with soft tissue shadow or radiolucent with a few flecks of calcification. Saucerization defect was also present in some of the cases.

Regarding surrounding structures, the periodontal membrane and lamina dura of the teeth were found to be destroyed with the teeth having a floating tooth appearance. A few cases demonstrated spike type of root resorption. There was destruction of associated anatomic structures, i.e. inferior alveolar nerve canal and mental foramen. Severe cases demonstrated presence of pathologic fractures with or without displacement.

The details of the cases are described in Tables 1 and 2 and Figures 3-5. Out of the 20 cases, 3 cases underwent head and neck computed tomography (CT). The CT findings were consistent with that of the panoramic radiographs. The CT findings of the three cases were:

Case 10: Severe erosion of angle and ramus of the mandible up to the coronoid process.

Case 17: Erosion of the left mandibular alveolar process with involvement of the mandibular canal.

Case 20: Destruction of the buccal and lingual cortical plates.

Results

Out of the 50 patients who presented during the study period, jaw bone involvement in oral malignancy was present in 20 cases. The panoramic radiographs of these 20 cases were studied in detail. In the present study, the age of the patients ranged from 35 to

Table 1: Radiographic presentation of oral malignancy

Case No.	Border		Shape	Internal structure			Saucerization
	Ragged	Smooth	Irregular	Radiolucent	Radiolucent with soft tissue shadow	Radiolucent with a few flecks of calcification	
1	+		+			+	
2		+	+	+			+
3	+		+		+		
4	+		+	+			
5	+		+	+			+
6	+		+			+	
7	+		+	+			+
8	+		+	+			+
9	+		+	+			
10		+	+	+			+
11	+		+	+			
12	+		+	+			+
13	+		+	+			+
14	+		+	+			
15	+		+	+			+
16	+		+	+			
17		+	+	+			+
18	+		+	+			
19	+		+		+		
20	+		+		+		

+: Present

Table 2: Effect of lesion on surrounding structures

S. No.	Tooth				Destruction of inferior alveolar nerve canal	Destruction of mental foramen	Pathologic Fracture	
	Destruction of PDL Space	Loss of lamina dura	Spike type of root resorption	Floating tooth			With displacement	Without displacement
1	34,35	34,35	34	35	+	+	+	
2	46,47	46,47		47	+			
3	35,42	35,42		42				
4	47,48	47,48		48				
5	45,46	45,46	45,46	45	+	+		
6	45,46	45,46			+		+	
7	45	45		45	+			+
8	36	36			+			+
9	47	47			+	+		
10	47	47		47	+			
11					+			
12	34,35	34,35		35	+	+	+	
13					+		+	
14	46,47,48	46,47,48			+			
15					+			
16	33,34,35,36	33,34,35,36		35,36	+	+		
17					+			
18	44,45,47	44,45,47			+	+		
19	27,28	27,28		27				
20	31,34,41,42,43	31,34,41,42,43						

+: Present

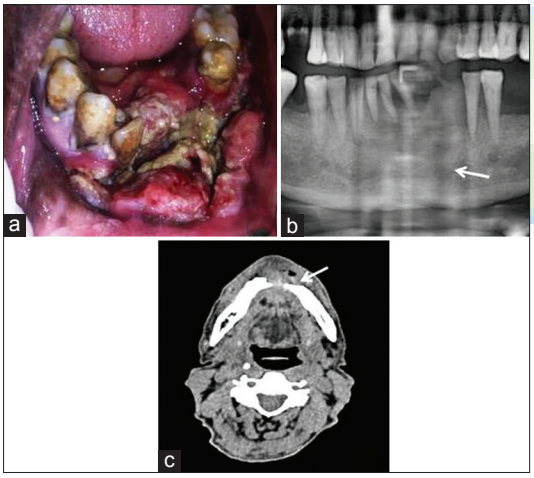

Figure 1: (a) An ulceroproliferative lesion in lower anterior region. (b) A panoramic radiograph showing the malignant lesion involving symphysis and parasymphysis region. (c) Axial view of CT scan showing destruction of buccal and lingual cortical plates

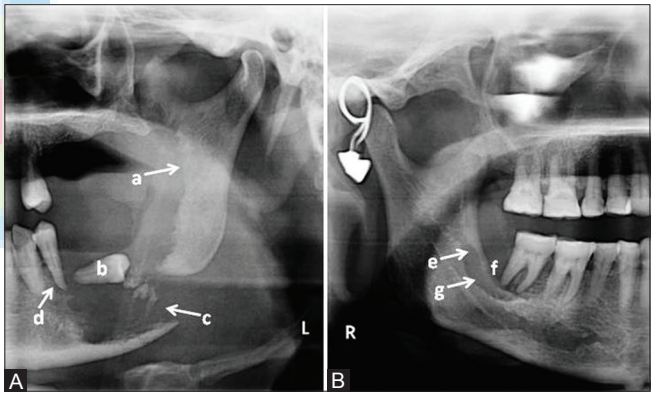

Figure 2: (A and B) Panoramic radiograph showing (a) ragged margins; (b) floating tooth; (c) pathologic fracture; (d) spiking of the root; (e) smooth margins; (f) saucerization; (g) invasion of inferior alveolar nerve canal

82 years. Maximum number of patients (n = 5, 26%) were in the 40–49-year age group, and the minimum number of patients were (n = 1, 5%) in the 80-89-year age group. Regarding gender distribution, out of the 20 patients, there were 10 (50%) males and 10 (50%) females with a gender ratio of 1:1 [Figure 3]. Out of the 20 radiographs, involvement of maxilla was seen in only one (5%) case, whereas the mandible was involved in 19 (95%) cases. Out of the 19 cases involving the mandible, 12 (63.2%) cases were involving the right side of the mandible, 5 (26.3%) cases were involving the left side of the mandible, and 2 (10.5%) cases were involving the anterior region of the mandible [Figure 4].

The symphysis and parasymphysis of the mandible were involved in 1 case (5.2%), parasymphysis and body of the mandible were involved in 1 case (5.2%), the body of the mandible was involved in 5 cases (26.3%), the body, angle and ramus were involved in 4 cases (21.05%), the body and ramus of the mandible were involved in 5 cases (26.3%), the body, ramus, and coronoid process were involved in 1 case (5.2%), and the entire left side of the mandible was involved in 1 case (5.2%) [Figure 5].

When margins of the lesions were evaluated, 17 (85%) cases showed ragged margins whereas 3 (15%) cases

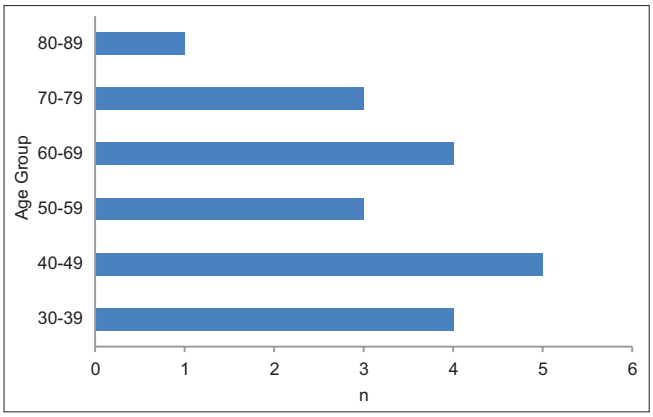

Figure 3: Graph showing age-wise distribution

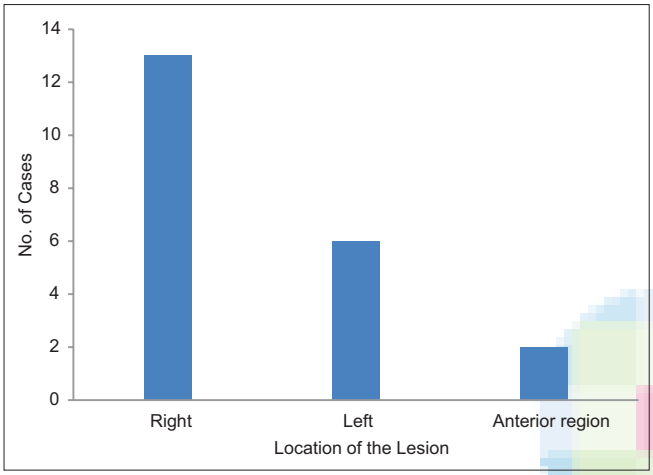

Figure 4: Graph showing area of involvement

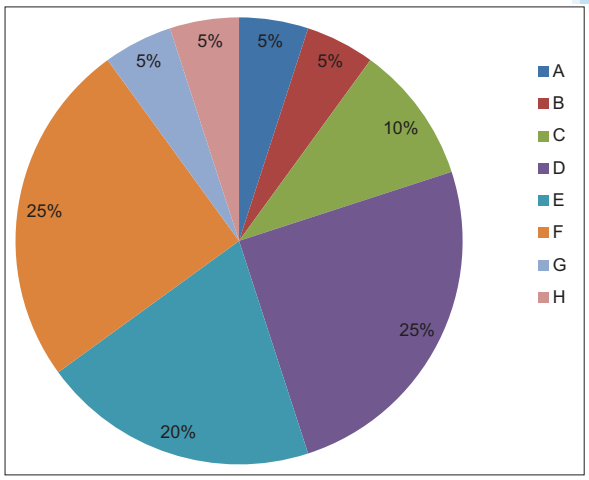

Figure 5: Location-wise distribution [(A) Posterior alveolar bone of maxilla, (B) symphysis and parasymphysis, (C) parasymphysis and body, (D) body, (E) body, angle, and ramus, (F) body and ramus, (G) body, ramus, and coronoid Process, (H) symphysis, parasymphysis, body, angle, ramus, coronoid process, and condyle]

demonstrated smooth margins. In evaluation of the shape of the lesion, all the 20 (100%) cases were present with irregular shape. Assessment of the internal structure of the lesion revealed that all 20 (100%) cases had radiolucent internal structure. Three (15%) radiolucent lesions demonstrated superimposition of soft tissue shadow, and 2 (10%) radiolucent lesions demonstrated a few islands of residual trabecular bone within the lesion [Table 1].

Regarding surrounding structures, in all the cases the affected teeth showed destruction of their periodontal membrane and the lamina dura was lost. Spiking of the roots was noticed in 2 (10%) cases and floating tooth appearance was present in 9 (45%) cases. Out of the 17 cases involving the posterior mandible, majority of the cases (n = 16 cases, 94.11%) showed involvement of the inferior alveolar nerve canal. Only 1 (5.88%) case did not show involvement of the nerve canal. Mental foramen was involved by the lesion in 7 (35%) cases. Saucerization was present in 9 (45%) cases and pathologic fracture of the jaw was evident in 6 (30%) cases [Table 2].

Discussion

Primary carcinomatous lesion can involve jaws by two different types. The first and the most common one is involvement of the bone through infiltration of bone by the mucosal lesion. Mandible is more commonly involved than the maxilla, with the most common site being the junction of the anterior margin of ramus and the body of the mandible. The other type of jaw involvement by the malignant lesion is very rare and it is through primary intraosseous carcinoma. The treatment results of such cases are poor and quality of life is significantly affected.[4,6] The incidence of bone invasion by oral malignancies ranges from 12 to 56%.[6] In our study, out of 50 patients, 20 i.e., 40% of the patients demonstrated involvement of the jaw bone. This finding falls within the range of bone involvement reported in literature. The findings of these 20 cases are evaluated and discussed in detail.

Ninety-five percent of oral cancers occur in individuals over 40 years of age. In the present study, oral malignancy was found to occur between the ages of 35 to 82 years, with a mean age of 53.3 years. This finding was analogous to the studies of Rao *et al.*[7] and Grosky *et al.*[8] in which the means of patient age were 61.1 years and 53.4 years, respectively. Studies have demonstrated male predominance for oral malignancy with M: F ratio ranging from 6:1 to 2:1.[9,10] These findings are not in concordance with our study results, which shows an equal sex predilection.

Similar to available literature, mandible was the most commonly involved jaw (95%) in this study with the most common area of involvement being the mandibular body (89.5%) and ramus (52.6%). When the pattern of jaw involvement was assessed, it was found that the

right side (63.2%) of the mandible was more commonly affected than the left side. This observation was not similar to the study conducted by Pandey *et al.*,[6] in which the left side of the jaw was involved in 64% of the cases.

The margins of the malignant lesion show wide zone of transition, i.e., they lack sharp or clear demarcation from the adjacent normal bone. The outlines of the malignant lesion may be irregular suggestive of invasive nature of tumor or smooth suggestive of erosive nature.[11] In our study, the bony involvement was more of the invasive type (85%) rather than the erosive (15%) type. This finding was similar to the study of Pandey *et al.*[6]

The internal structure of most oral carcinomas is presence of an area of bone destruction without any evidence of the bone formation within the lesion. Thus, the nature of these lesions is osteolytic, which is demonstrated by radiolucent internal structure with or without the presence of a few radiopaque flecks suggestive of residual trabecular bone. In all our study cases, the nature of the lesion was osteolytic, with 2 (10%) cases showing few radiopaque flecks within the lesion. A soft tissue mass is often present with carcinoma of the jaw, which may be present as a faintly increased density in the radiographs, standing above the general level of the bone.[4] In our study, 3 (15%) cases demonstrated presence of soft tissue shadow.

The most frequent feature of malignancies is destruction of the bone. Most carcinomas of the jaws start near the surface of the bone, leading to the osseous defect involving one of the margins of the bone. If it occurs on alveolar crest, it leads to roughly semicircular or saucer-shaped erosion into the bony surface with uneven osteolytic invasion.[11,12] In our study, saucerization was seen in 45% of cases. In the advanced cases of oral malignancy, owing to large amount of bone destruction, pathologic fracture of the jaw occurs. In our study, 30% of the cases demonstrated pathologic fracture. In a study of pathologic fracture of mandible,[13] 30% of the pathologic fractures were due to malignant tumors.

In most cases, malignant tumors do not cause root resorption of the adjacent teeth owing to their rapidly invasive character. However, in some cases, spiking type of the root resorption occurs. In our study, 10% of the cases showed spiking of the roots. This finding was similar to the study of Kawai *et al.*,[14] in which 37% of the cases demonstrated spiking of the roots. The rapidly growing malignant lesion destroys the supporting alveolar bone around the teeth. Hence, the teeth may appear to be floating in the space. In our study, floating tooth appearance was seen in 45% of the cases. Destruction of the neurovascular bundle is a common finding of malignant lesions of the jaws.[3,11] In our study, involvement of neurovascular bundle was observed in 80% of the cases.

Conclusion

To conclude, the clinicohistological examination of a malignant lesion present in the vicinity of the jaws should be accompanied by radiographic examination to detect bone invasion. Panoramic radiographs are useful in detecting the bone involvement and thereby aid in formulating the treatment plan. They also demonstrate various significant radiographic features of malignancy. However, further examination by advanced imaging modalities, such as computed tomography, is advisable before planning the surgery to determine the extent of surgical removal of the involved jaw bone.

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Conflicts of interest

There are no conflicts of interest.

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