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Research Article

Conventional Radiography and Computed Tomography in Assessment of Bony Invasion in Oral Cancer-A Comparative Evaluation with Final Histopathological Report

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Abstract

Background and objectives: Pre-treatment evaluation of patients with oral OSCCand identification in presence of extension of bony invasion, this is outstanding method to determine the treatment plan and prognosis. This study was carried out with a purpose to mould the accuracy of panoramic radiography, occipitomental view and computedtomography in diagnosis of bony invasion in patient planned to undergo surgery for histopathologically proven cases of OSCC.

Materials and Method: A Prospective study conducted from June 2020 to August 2020 inthe Department of Oral and Maxillofacial surgery, College of Dental Sciences and hospital, Davangere, Karnataka, India. On 16 patients who are proven cases of OSCC histopathologically and underwent surgical resection of the tumour along with the adjacent hard tissue margins.

Results: As a part of pre-operative workup Panoramic radiographs for patients with oral squamous cell carcinoma of lower jaws, occipitomental radiographs for those of upper jaws and computed tomography scans in all the cases were performed. Consequently, the resected specimens with adjacent hard tissue margins were subjected to histopathological examination. The results concluded that CT is superior technique when compared to other imaging modalities as mentioned above.

Keywords: Oral Squamous Cell Carcinoma (OSCC); Computed Tomography (CT); Magnetic Resonance Imaging (MRI); Bone Scintigraphy (BS); Orthopantomogram (OPG); Single PhotonEmission Computed Tomography (SPECT); Occipitomental View (OMV); Retromolar Trigone (RMT)

Introduction

OSCC is the 6th most common type of cancer seen in oral cavity in South Asian countries like Indian subcontinent among all the varieties of cancers. OSCC in adavanced stages involves close-by structures which are of non- epithelial in origin [1,2].

In advanced stages, the occurrence of invasion of mandible ranges from 12-56% [3,4] and 26-58% for upper jaw [5]. However when the bony infiltration is noted, resection of soft tissue along with the involved hard tissue as marginal/segmental/hemi mandibulectomy or hemi maxillectomy would be the treatment plan. Resection to obtain R_0 status would create poor cosmetic outcome and may also lead to poor quality of life [6,7]. The types of radiographic manifestations of bony resorption are classified as: a) Compression type-Smooth margins surrounded by a radio opaque sclerotic border. b) Permeated type- Unclear margins.c) Moth eaten type-Irregular margins with extensive bony destruction.

Small bony fragments will be scattered throughout the affected bone. The histologic patterns of bony invasion of jaw tumors [8]

are classified as: a) No invasion of jaw bones. b) Preferredspread through the periodontal membrane into the jaws. c) Preferred spread of entry through cortical surface of the bone. d) Preferred invasion along the bone marrow spaces.

As imaging modalities Computed tomography with contrast (CECT) are being at par excellence to know the bony invasion when compared to the conventional radiographic technique Orthopantomography (OPG), Occipito mental view (OMV) each one of them have their own advantages and drawbacks in detecting the accuracy of bony invasion. This study was conducted to gauge the accuracy of conventional radiography and computed tomography for the evaluation of bony margins in biopsy proven cases of oral squamous cell carcinomas by comparing with the histopathological examination of the resected specimen.

Methodology

This study was carried out in patients reported to Department of Maxillofacial surgery, College of Dental Sciences and Hospital, Davanagere, Karnataka, India. Informed consents were obtained from all the patients who took part in this study. Patients were examined clinically; conventional and computed tomography was done following which tumour excision and histopathological examinations were done.

- **Inclusion criteria:** 1) Patients in the age range of 15-70yrs. 2) Patients clinically and histopathologically diagnosed with oral squamous cell carcinomas with bony invasion. 4)General medical condition of the patient permitting for procedure.
- **Exclusion criteria:** 1) Inoperable cases of oral squamous cell carcinomas. 2) Patients with any bony disorders. 3) Severely medically-compromised patients.

A detailed clinical examination of all the patients who fitted into the above-mentioned criteria, detailed history including demographics, habit history (usage of tobacco), clinically involved structures and TNM staging of disease (8^{th} edition) were noted. Trailed along with radiographic investigation with orthopantomogram/occipitomental view, CT scan. All the radiographic images were assessed by a single radiologist and the operating surgeon and determination of the bone invasion was reported.

Operative procedure

All patients who were medically fit for the surgical procedure under general anesthesia underwent surgical resection of the tumor including marginal or segmental bone resection in the primary tumor area within 4 weeks of imaging. After resection, all pathological specimens were fixed in formalin solution and histopathological confirmation of bone invasion was carried out by consultant histopathologist from the Department of Oral Pathology and Microbiology of our institution.

In histopathological examination, serial sections of the bone were placed in different jars and numbered serially according to the corresponding position of the section in the original specimen. Results of histological examination of the surgical specimen were considered to bethe gold standard for bone invasion by oral malignancies.

Results

All patients with tumour of the upper jaw had undergone OMV radiography and CT scan. Those with tumour of the lower jaw had undergone OPG radiography and CT scan. 30 bony margins were examined with OPG among 16 patients which revealed evidence of tumor invasion in 11 margins (36.67%) of which 10 margins (90.9%) were confirmed histologically and 1 margin (9.09%) failed to prove it histologically. In remaining 19 margins, OPG did not reveal any radiographic changes in 13, but histologically 6 margins (31.57%) showed bony invasion.

Calculating the quality criteria for detecting bone involvement of oral carcinomas by OPG the following values were found Sensitivity 62.50%, Specificity 92.86%, Positive predictive value 90.91%, Negative predictive value 68.42%, Accuracy 76.67%. 17 bony margins were examined with OMV among 16 patients which revealed evidence of tumour invasion in 8 margins (47.05%) of which 7 margins (87.5%) were confirmed and 1 margin (12.5%) failed to prove it histologically. In remaining 9 margins, OMV did not reveal any radiographic changes in 3, but histologically 6 margins (66.67%) showed bony invasion.

Calculating the quality criteria for detecting bone involvement of oral squamous cell carcinomas by OMV the following values were found Sensitivity 53.85%, Specificity 75.00%, Positive predictive value 87.50%, Negative predictive value 33.33%, Accuracy58.82%.

Out of 16 patients, 47 margins were evaluated using CT scans of 26 margins (55.31%) showed evidence of bone invasion, and all (100%) had histological confirmation. In remaining 21 margins, CT did not reveal any radiographic changes in 18 margins (18.57%), but histologically 3 margins (14.28%) showed bony invasion. Sensitivity 89.66%, Specificity 100%, Positive predictive value 100%, Negative predictive value 85.71%, Accuracy 93.62%.

Discussion

Incidence and Prevalence - Head and neck cancers being most common cancerin developing countries like India. They have high potential to cause osteoclast genesis and resorption of the bone by invading into the surrounding hard tissues [9,10]. When patients present with disease in both upper and lower jaws its incommodious for surgical plan as well counselling the patient in psychological aspects [11]. First evidences of spread of malignancy that spread through neck, periosteum of jaw bone was put forth by Polya and von Navratil [12].

Surgical treatment plan by surgeons to know bony invasion for resection of hard tissue and to know its involvement pre-operatively is much dependent on conventional radiography, computed tomography (CT), magnetic resonance imaging (MRI), single positron emission tomography (SPECT), PET-CT, bone scintigraphy [13,14]. To be more precise and ample many surgeons use multiple imaging technique to surpass the drawback which one imaging modality have over the other [15]. Though many debate do exist among researchers as the expenses of the multiple imaging modality would cause increased pre- operative expenses especially in developing countries like India. Some other negative aspects include delay an time between diagnosis and surgical treatment, also during multiple imaging modality patientcould receive extra radiation and MRI might cause mental distress due to long time of study [16].

Although CT scans are preferred by many surgeons as they can delineate periodontal bony erosion from the erosions or degeneration caused by the primary tumour, patients who were subjected to CT scans were taken 1mm sections as images with 4-5mm sections will not prove with satisfactory result [17]. Drawback of CT scan is that images will be hampered by any kind of hardware present previously or dental prosthesis present in the region of interest.

The results obtained with OPG were accurate to the limited degree, whereas the Occipitomental view (OMV) taken for maxillary region was not accurate due to the overlap multiple structures situated in maxillary region [18]. In the present study, false positive cases for CT scan were nil. But 3 false negative cases were reported which showed the drawback of CT scan that if taken exclusively as an imaging modality to detect bony invasion, it mayresult in inadequate resection of bony margins.

The final results of the present study shows the accuracy of CT scan (93.62%) is far better than the accuracy with panoramic radiography (76.67%) and occipitomental radiography (52.85%). Some other imaging modalities as MRI, PET, CT and cone beam CT were used to detect hard tissue invasion. MRI has a good accuracy rate on soft tissues, but the efficacy is not that good for hard tissues. PET-CT could reveal the hard tissue invasion using functional methods, but a slight difference in integration of CT and PET images can cause a misdiagnosis. CBCT can take jaw bones more efficiently according to the area of interest so that accurate detailing of bone is revealed, but its ability to detect soft tissue not at all satisfactory.

The mean age of the patients included in this study was 50.44 years. Out of 16 patients, 13 were associated with some adverse habits like tobacco chewing (n = 8), smoking (n = 2) or both(n = 3). Of the total 16 patients included in this study, histopathological diagnosis include early invasive SCC (n = 4), moderately differentiated SCC (n = 9), well differentiated SCC (n = 3). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy for OPG were 62.50%, 92.86%, 90.91%, 68.42%, 76.67%; for OMV were 53.85%, 75.00%, 87.50%, 33.33%, 58.82% and for CT scan were 89.66%, 100%, 100%, 85.71%, 93.62% respectively. In conclusion, the findings of our investigation have shown that radiographic examination (OPG, OMV and CT) is a reliable technique for predicting bone invasion, however CT has a superior accuracy and can be helpful when considering hard tissue conservation procedures for oral cavity malignancies.

Statistical analysis

Case sample

A 69-year-old female patient diagnosed with squamous cell carcinoma of right lower alveolus involving GB sulcus, floor of mouth and retromolar trigone.

Sl. No.	Age	HistopathologicalDiagnosis	Site of the tumour	Hard tissue involvement		
				Digital radiograph (OPG/ OMV)	CT scan	Histopathological asesment of bony invasion
1	58 years	Moderately differentiatedSCC	Left body of the mandible distal to 35	Present	Present	Present
			Midsymphysis of mandible	Absent	Absent	Absent
2	55 years	Moderately differentiatedSCC	Left body of the mandible distal to 36	Present	Present	Present
			Parasymphysis of mandible	Absent	Absent	Absent
3	40years	Moderately differentiatedSCC	Left body of mandible distal from 36 to RMT	Present	Present	Present
			Paraymphysis of mandible	Absent	Absent	Absent
4	45 years	Moderately differentiatedSCC	Left body of mandible wrt 34, 35	Present	Present	Present
			Midsymphysis of mandible	Absent	Absent	Absent
5	44 years	Moderately differentiatedSCC	Right mandible wrt42, 43	Present	Present	Present
			Anterior right mandible lingualcortex	Absent	Present	Present
			Right RMT	Absent	Absent	Absent
6	55 years	Moderately differentiatedSCC	Left parasymphysisbody of mandible wrt 33, 34, 35	Present	Present	Present
			Left midsymphysisof mandible	Absent	Absent	Absent
7	69 years	Well differentiatedSCC	Left maxillary sinusfloor	Present	Present	Present
			Left retromolartrigone	Absent	Present	Present
			Left pterygoid plate	Absent	Absent	Present
			Left Condyle	Absent	Absent	Absent
			Left Zygoma	Absent	Absent	Absent
8	70 years	Moderately differentiatedSCC	Right retromolar trigone	Absent	Present	Present
			Right mandibularalveolus	Absent	Present	Present
9	65 years	Early invasiveSCC	Right body of mandible wrt 45, 46, 47 region	Present	Present	Present
			Right midsymphysis of mandible	Positive	Absent	Absent
			Right angle ofmandible	Absent	Present	Present

10	39 years	Well differentiatedSCC	Left Zygomatic arch	Present	Present	Present
			Floor of left maxillary sinus	Present	Present	Present
			Left lateral wall oforbit	Absent	Present	Present
			Left infraorbital rim	Absent	Absent	Absent
			Left Infratemporalfossa proper	Absent	Absent	Present
11	59 years	Moderately differentiatedSCC	Left maxillary posterior alveolus	Present	Present	Present
			Floor of left maxillary sinus	Present	Present	Present
			Left hard palate	Absent	Absent	Absent
12	55 years	Early invasiveSCC	Right Mandibular alveolus wrt 45, 46	Present	Present	Present
			Right mandibularalveolus wrt 43	Absent	Absent	Absent
			Right mandibularalveolus wrt 48	Absent	Absent	Absent
13	34 years	Early invasiveSCC	Left maxillary alveolus wrt 37,38	Present	Present	Present
			Left hard palate	Present	Present	Present
			Posterolateral wallof left maxillary sinus	Absent	Present	Present
			Left pterygoid plate	Absent	Present	Present
14	39 years	Well differentiatedSCC	Right mandibular body wrt 47, 48 extending to angle and anterior ramus.	Present	Present	Present
			Right Mandibularlingual cortex	Absent	Present	Present
			Right parasymphysis region of mandible	Absent	Absent	Absent
15	42 years	Moderately differentiatedSCC	Right mandibular body (Peri resectedregion)	Present	Present	Present
			Right Condyle	Absent	Absent	Absent
			Right parasymphysis region of mandible	Absent	Absent	Absent
16	38 years	Early invasiveSCC	Right mandibular alveolus wrt 35, 36	Absent	Present	Present
			Right parasymphysis region of mandible	Absent	Absent	Absent
			Inferior border of mandible	Absent	Absent	Absent

Table 1

Figure 1: Frontal profile.

Figure 2: Intra oral examination.

Figure 3: OPG showing bony invasion of right body of mandible.

Figure 4: CT scan showing bony invasion of right body of mandible.

Conclusion

In conclusion, the results of the present study shows that radiographic investigation (CT, OPG and OMV) can be used as reliable technique for the detection of bony invasion in oral squamous cell carcinomas and in turn helps in conservation of hard tissue. The accuracy of CT is very superior to that of plain radiography for upper and lower jaw that is, OMV and OPG respectively. High quality results can be achieved by thin 1mm sections and reconstruction of the tissues using bone algorithm. SPECT is another confirmatory imaging modality done when CT and MRI does not show signs of bony invasion. To conclude, histopathological examination is considered as a gold standard and CT scan has a superior sensitivity and specificity which is exceptionally useful in accurate prediction of bony invasion in oral squamous cell carcinomas.

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