ORIGINAL ARTICLE

DETERMINE DIAGNOSTIC ACCURACY OF MULTISLICE CT SCAN IN DETECTION OF BONY INVASION OF SQUAMOUS CELL CARCINOMA OF ORAL CAVITY

Muhammad Imran Siddiqui, Muhammad Misbah Tahir, Amanullah Khan, Muhammad Ayub Mansoor

Department of Diagnostic Imaging, Liaquat National Hospital (LNH), Karachi, Pakistan.

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ABSTRACT

OBJECTIVE: To determine the diagnostic accuracy of multislice computed tomography in detecting bony invasion of squamous cell carcinoma of the oral cavity. **METHODS:** We enrolled 80 biopsy proven patients of oral squamous cell carcinoma who underwent multislice computed tomography at department of diagnostic radiology, Liaquat National Postgraduate Medical Centre from July 2011 till December 2011. Lesions were assessed for bony involvement of maxilla & mandible. A total of 69 patients underwent surgery after computed tomography. Sensitivity, specificity, positive and negative predictive values were calculated by comparing the computed tomography results with histopathology. Around 11 patients who did not have surgery were excluded from the study. **RESULTS:** Multislice CT correctly identified invasion of the maxilla in 9 out of 9 patients (9/9), invasion of mandible in 30 out of 32 patients (30/32), invasion of maxilla and mandible in 4 out of 4 patients. Thus the sensitivity of the computed tomography was 95.55%. On the other hand, computed tomography correctly detected 24 out of 25 cases without bony invasion making the specificity as 95.85%. **CONCLUSION:** Mulltislice computed tomography is an accurate modality for detecting bony invasion of squamous cell carcinoma of the the oral cavity.
Key words: Bony invasion, CT, squamous cell carcinoma, oral cavity

Introduction

Prevalence and mortality rates of oral carcinoma are rising worldwide. The annual incidence is more than 3,000,000 new cases, globally.[1] For lip and oral cavity cancer only, the incidence rates are lowest in Eastern Asia and highest in South-Central Asia. Its prevalence is estimated to be 40% of all cancers in South East Asia.[1] It is the second commonest cancer in both males and females in Pakistan.[1] Oral car-cinoma is responsible for approximately 200'000 deaths per year world wide.[2] Squamous cell carcino-ma is the most common malignant tumor of the oral cavity[1,3] In a study by Musani et al bony invasion by cheek carcinoma is found to be 53.3% in mandible, 15.5% in maxilla and 4.4% in both.[1]

The important role of imaging for patients with squamous cell carcinoma of oral cavity is the evaluation of presence and extension of bony invasion as it influences surgical planning and prognosis. Different surgical excisions like marginal and seg-mental mandibulectomy, hemimandibulectomy, partial maxillectomy and total maxillectomy can be planned depending upon extension of bone involvement.[1,4] Among various imaging modalities both computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used to evaluate bony invasion of squamous cell carcinoma of oral cavity.[4,5] There

Correspondence : Dr. Muhammad Imran Siddiqui
Department of Diagnostic Imaging,
Liaquat National Hospital (LNH),
Karachi, Pakistan.
Ph: 0300-8943895
Email: drimrandow@gmail.com

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is no Pakistani data available regarding accuracy of computed tomography in detection of bony invasion of squamous cell carcinoma of oral cavity. Best of our knowledge this is the first study evaluating accuracy of CT in detecting involvement of both maxilla and mandible by oral squamous cell carcinoma. Previous studies have evaluated involvement of mandible only.

Computed tomography can identify the location and extent of tumor along with presence or absence of distant metastasis. Ability of multislice computed tomography to scan the head & neck in single breath hold combined with a better resolution and elimination of breathing and miss registration artifacts has made it modality of choice for evaluating bone invasion by oral carcinoma. Properly performed and accurately interpreted imaging study can significantly influence clinical management besides becoming cost effective.

Methods and Material

We enrolled 80 biopsy proven patients of oral squamous cell carcinoma who underwent multislice computed tomography at department of diagnostic radiology, Liaquat National Postgraduate Medical Centre from July 2011 till December 2011 in this study. Sixty-nine of these patients underwent surgery after CT. Eleven patients who did not have surgery were excluded from the study. CT was performed on Toshiba Asteion 16 mulltislice CT scanner. Images were acquired before and after intravenous contrast administration. Informed consent was taken from all patients. Approval from ethical committee of our institution was also obtained. Scanning was performed in axial and coronal planes by a CT technician having at least five year experience in body imaging. Non-ionic iodinated contrast (Iopamiro 370, Bracco s.p.a. Italy) was given at a dose of 1.5 - 2.0 ml per kg with power injector at rate of 2.0 - 3.0 ml per second. Patient's allergy status and creatinine level were taken into account before giving contrast.

Scanning protocol was 3 mm section thickness, collimation 3 mm, reconstruction interval 3mm, scan delay 80 seconds, 450 mA and 100 to 150 Kv. Scanned field was from base of skull to thoracic inlet. Images were reviewed by a radiologist who had more than five year experience of cross sectional body imaging. Images were reviewed on diagnostic monitor in soft tissue and bone algorithm and in axial, sagittal and coronal planes. The criterion for bony invasion was erosion, lysis or destruction of the cortex of the adjacent bone. Per-operatively, representative sections of the tumor-bone interface and the bony margins were submitted. Pathologist with more than five year experience in oncology reviewed the specimens.

Data was initially collected on performa which was then entered into SPSS software. All analysis were done using SPSS version 15. Mean and Standard deviations were calculated for continuous variables like age. Frequencies with percentages were calculated for categorical variables like sex, final diagnosis on biopsy and computed tomography. The binary variables of diagnosis of bony invasion on histopathology and computed tomography were cross tabulated to construct a 2 x 2 table. The 2 x 2 table was used to calculate, sensitivity, specificity, positive predictive value, negative predictive value and accuracy.

Results

A total of 69 patients were included in this study. Age ranged from 32 to 73 years (mean age 53.84 years, SD ± 10.208). There were 38 (55.0%) males and 31 (45.0%) females. Distribution of squamous cell carcinoma of oral cavity was as follows: 45(65.21%) lesions in buccal mucosa; 7 (10.14%) in alveolar ridge; 7(10.14%) in tongue; 5 (7.24%) in floor of mouth; 5 (7.24%) in hard palate. Forty-four out of 69 patients showed evidence of bony invasion on multislice CT. Nine and 31 patients exhibited invasion of maxilla and mandible respectively, while 4 had involvement of both. Bony invasion of the squamous cell carcinoma was found in 45 patients on histopathology. Multislice CT correctly identified 9/9 invasions of the maxilla, 30/32 of the mandibular invasions and 4 out of 4 lesions involving both maxilla and mandible. Thus the sensitivity of the computed tomography was 95.55%. On the other hand, computed tomography truly identified 23/24 cases without bony invasion making the specificity as 95.85%. The Overall diagnostic accuracy of the multislice Computed

Tomography was 95.65%. Positive and negative predicative values for a diagnosis of SCC with bony invasion on CT were 97.7% and 92.0% respectively. Correlation of CT findings with histopathology is given in the (Tab. 1).

	Histopathology +ve	Histopathology -ve	
CT+ve	43	01	Total CT+ve (44)
CT-ve	02	23	Total CT-ve (25)
	Total Histopathology +ve 45	Total Histopathology -ve 24	Total Patient 69

True Positive, n = 43
False Positive, n = 01
True Negative, n = 23
False Negative, n = 02

Table 1: Correlation of histopathology & computed tomography

Discussion

The development of modern imaging techniques has significantly altered the treatment and management of malignancies of oral cavity and other sites in head and neck region. Decisions which were once made intraoperatively are now made in advance by using information from cross sectional imaging techniques.[6] The goal of imaging is to correctly determine the stage of tumor. Involvement of mandible or maxilla significantly affects the prognosis, morbidity and treatment planning. It is vital to detect the bone involvement before planning surgery as it changes the surgical approach. The imaging modality for evaluation of oral cancers has been a subject of debate and opinions and results vary with various authors.[7,8] Some believe that use of MRI is superior to CT in evaluation of tumors especially when lesions are small, while many authors believe that CT and MRI are equally valuable in determining the extent of tumor.[7,8,9] MRI may not be performed in patients with metallic implants and pacemakers. Swallowing, breathing artifacts and claustrophobia may hamper the examination. CT has the advantage of reduced examination time interval which also decreases the chances of motion artifacts. Tooth implants may produce artifacts obscuring the imaging details. Keeping the scanning plane parallel to the mandibular plane helps to eliminate artifacts caused by metallic dental restorations.[10] The choice largely depends on the local availability and expertise.

In early 1980s Larson et al[11] and Muraki et al[12,13] described the radiological and sectional anatomy of the oral cavity. Lenz et al[14] and Sigal et al[15] discussed the role and usefulness of CT scanning in pathologies of oral cavity particularly carcinomas.

CT protocol for head and neck imaging with multislice spiral scanners has been described in detail by Baum et al.[16] Thin-sections acquired with spiral multislice scanners after administration of IV contrast have shown to significantly improve the ability to evaluate oral cancers.Our protocol matches with the protocol described by Baum et al.[16]

Preoperative assessment of mandibular involvement provides crucial information to head and neck surgeons. Accurate information on status of mandible is necessary for proper patient counseling.[17,18] Mandibular involvement has been widely studied and various imaging modalities have been used to determine whether patients are candidates for mandibular sparing procedures. Technical advances have made CT scan the examination most commonly used to detect mandibular involvement. Results have been variable regarding diagnostic accuracy of preoperative CT in this context. In 1986 Close et al[19] reported a sensitivity of 100% specificity of 97% positive predictive value of 92% and negative predictive value of 100%.

In subsequent studies Shaha et al[20] reported diagnostic accuracy of 68% and Brown et al[21] claimed a false negative rate of 28% arguing that the predictability and reliability of CT was disappointing. Later Lane et al[22] reported sensitivity of 50% with negative predictive value of 61% suggesting that CT scan was inaccurate method for evaluating status of mandible.

In 2001 the study of Mukherji et al[23] showed promising results in this regard, they reported sensitivity of 96% specificity of 87% positive predictive value of 89% and negative predictive value of 95%.

In 2006 Imaizumi et al[7] had also shown excellent result in a comparative study for mandibular invasion in CT Vs MRI. He reported sensitivity of CT 100%and specificity 88%, PPV 89% as well as NPV 100%. These accuracy measures are higher than any other study. It is chiefly because of Imaizumi et al had taken 5 mm and 1 mm thickness in axial section along with soft tissue and bone algorithm images.

He had also added dental CT, or dental scan, CT software program specifically developed to evaluate multiple panoramic and cross sectional images of the jaw bone.

This variability in results of different studies is most probably due to inconsistent imaging technique that was not optimal. Review of multiple previous studies using various imaging modalities for detecting bone invasion by squamous cell oral carcinoma has been given in (Tab. 2).

Study	Publication year	No. of patients	Slice thickness	Imaging modality	Sensivity (%)	Specificity (%)	Accuracy (%)
Brown et al[21]	1994	35 35	4-5mm 5mm	CT MRI	53.3 91.7	100 100	72 93.8
Lane et al[22]	2000	26	5mm	CT	50	91.7	69.2
Mukerji et al[23]	2001	49	3mm	CT	96.2	87	91.8
Imaizumi et al[4]	2006	51 51	5-1mm 3-4mm	CT MRI	100 96	88 54	94 74

Table 2: Review of studies using CT, MRI or both for detecting bone invasion by squamous cell oral carcinoma.

Figure 1: Axial section of CT scan (bone window) revealing oral carcinoma eroding adjacent mandible on right side.

The results of this study for evaluation of bony involvement (sensitivity 95.55%, specificity 95.85%, positive predictive value 97.7%, and negative predictive value 92%) are superior to studies of Brown et al,[21] Shaha et al[20] and Lane et al.[22] This in our belief is because of better imaging technique.

Brown et al[21] and Lane et al[22] acquired images by using 5 mm thick sections and did not routinely evaluate mandible with bone algorithms. Shaha et al[20] did not describe their CT technique. Close et al also obtained 5 mm thick contiguous sections, however if there was suspicion of bony involvement 3 mm sections were again obtained. Mukherji et al[23] acquired contiguous 3 mm images of all patients. Both Close et al[19] and Mukherji et al[23] evaluated images on soft tissue and bone window settings.

The relatively higher sensitivities of CT noted in studies of Mukherji et al[23] and Imaizumi et al[7] is most likely due to the fact that Mukherji et al[23] included only those patients who had carcinomas fixed to mandible on clinical examination and Imaizumi et al[7] used an additional soft ware, Dental CT, or Denta scan that was not used in our study .There are some limitations of CT in diagnosing superficial lesion only abutting adjacent bone, hence full staging process should include clinical examination and imaging. And there is always a need for refinement in imaging techniques and modalities that can provide accurate information approaching gold standard. Further studies can be done in this regard. In selected cases use of another imaging modality like MRI in small lesions or Fused PET/CT may be useful.

On the other hand besides mandibular invasion we have also assessed the invasion of maxilla which was not done in previous studies. Although the cases of maxillary invasion are less than mandibular invasion but accuracy of CT for detecting maxillary invasion in our study is found to be higher than mandibular invasion. This is probably due to anatomic site of involvement of oral carcinoma and late presentation of patient for treatment.

Conclusion

Computed tomography is an imaging modality with high diagnostic accuracy, sensitivity and specificity in detecting bony invasion in oral squamous cell carcinoma. Use of this rapid, non operator dependent & highly accurate examination decreases delays in appropriate management and also guides in defining the disease extent and surgical approach.

The results of our study showed that CT is reliable technique for predicting bony invasion and may be

a helpful adjunct when considering mandibular or maxillary sparing procedures for carcinoma of the oral cavity. We believe that high diagnostic accuracy of CT can be consistently obtained only with high quality studies consisting of thin-section imaging, reconstruction and reformation of images in multiple planes, using both soft tissue and bone algorithm.

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