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Invasion of the mandible in gingivobuccal complex cancers: Histopathological analysis of routes of tumour entry and correlation with preoperative assessment

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ABSTRACT

Objectives: To determine the most accurate imaging modality predicting mandibular invasion in gingivobuccal (GB) complex cancers. To determine patterns of invasion and routes of tumour entry into the mandible by detailed histopathologic analysis.

Material and methods: Prospective observational study of GB Complex cancers juxtaposed with the mandible clinically necessitating some form of mandibular resection. Orthopantomogram (OPG), Multi Detector Computed Tomography (MDCT), DENTA scan and Single Photon Emission Computed Tomography scan (SPECT) were performed after which the patient was subjected to surgery. Histopathological assessment was systematically performed with serial cuts of the mandibular segment.

Results: Of 70 patients, MDCT was the most accurate with area under curve (AUC) of 0.833. OPG, DENTA and SPECT had AUC of 0.714, 0.786 and 0.738 respectively. Mean calculated difference of involved height was −0.025 cm by MDCT (p value 0.87), −0.2 cm by OPG (p value 0.09) and 0.12 by DENTA scan (p value 0.41). Mean difference of involved length was −0.51 cm (p value 0.08) and −1.02 cm (p value 0.04) for MDCT and OPG respectively. 50% of tumour invasion was through the occlusal route while large tumours demonstrated multiple routes of entry.

Conclusion: -Gingivobuccal complex cancers are homogenous with respect to mandibular invasion, preferred route of tumour entry being the occlusal surface.

-Multidetector CT scan is fairly accurate in detecting mandibular involvement and predicting extent of involvement.

-Oncological safety can be achieved by positioning the bone cuts corresponding to the adjacent soft tissue margins in segmental mandibulectomy.

Introduction

Gingivobuccal (GB) complex cancers being juxtaposed with the mandible pose a significant challenge for decision regarding mandibular resection. Maintaining mandibular continuity is vital for a good functional and cosmetic outcome and obviates the need for elaborate reconstruction. While gross mandibular invasion or significant paramandibular disease merits segmental mandibulectomy, mandibular conservation surgery is considered an oncologically safe option for others. An informed decision on mandibular conservation requires not just astute clinical judgement but also accurate imaging and a thorough knowledge of pathophysiology of routes of tumour spread. Studies have compared the accuracy of various imaging modalities in detecting mandibular invasion. Researchers have also attempted to establish the preferred mode of tumour entry in the mandible. Most of these however have been studied for cancers of the floor of mouth and tongue Table 1, [1–20].

We designed a study on a cohort of patients with GB complex cancer to establish most feasible preoperative imaging modality as well as the most preferred route of tumour entry into the mandible.

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Table 1
Studies on Pathological analysis evaluating pattern of invasion/route of tumour entry into mandible.

Author/Year	Sample size	Objective	Subsite
Ward and Robben 1951 [24]	45	Route of entry	Tongue, floor of mouth, tonsil, gingiva
Marchetta 1971 [23]	80	Route of entry	58 tongue, Floor of mouth
Carter 1980 [25]	150	Route of entry	Head and neck
O'Brien 1986 [26]	111	Route of entry	Oral cavity and oropharynx
Mc Gregor and Mac Donald 1988 [27]	46	Route of entry	26 tongue and floor of mouth
Slootweg 1989 [28]	45	Route of entry	Oral cavity
Totsuka 1991 [29]	48	Pattern of invasion	Lower alveolus
Nomura 2005 [30]	176	Pattern of invasion	Gingiva
Brown 2002 [31]	100	Route of entry	54 Tongue and floor of mouth

Material and methods

This prospective, observational study was embarked upon with the aim to determine the most accurate imaging modality predicting mandibular invasion in GB complex cancers as well as patterns of invasion and routes of tumour entry on histopathological analysis. Approval was obtained from the Institutional Review Board.

Treatment naive patients with biopsy proven squamous cell carcinoma of the GB complex were screened for the study after examination by the lead author. Patients with tumours abutting the mandible or with suspicious mandibular invasion clinically necessitating some form of mandibular resection were included. Those with evident mandibular invasion were not considered.

Patients who fulfilled the inclusion criteria and consented to participate were accrued to the study. Demographic data such as gender, age, dentition and site of primary disease viz. buccal mucosa, alveolus, GB sulcus or retromolar trigone was recorded. All those patients with recent loss of teeth but an intact socket and mandibular ridge at the tumour site were labelled as partially dentate. Those mandibles with reduced vertical height due to resorption were labelled as edentulous (pipestem mandibles). Each patient was subjected to an Orthopantomogram (OPG), Multi Detector Computed Tomography (MDCT), DENTA scan and Single Photon Emission Computed Tomography scan (SPECT). Each investigation was interpreted by an independent specialist and blinded to the findings of the other. Mandibular involvement was assessed by the specialist and if involved, the extent of involvement was documented on a predesigned proforma.

Technique and interpretation for bone invasion

OPG was performed by standard technique. Erosion/scalloping of the alveolar margins was looked for and measured.

MDCT: CT scanning was performed on a 16 section multidetector CT (MDCT) scanner (GE Lightspeed GE Healthcare) from above base skull to the top of the manubrium sterni. Images were acquired with 2.5 mm collimation with a scan delay of 35 s after injecting 80 ml of non-iodine containing contrast (300 mg/ml) at 2.5 ml/second. Puffed cheek technique was used. 0.625 mm retro-reconstructed images were also generated and archived on the GE PACS. Multiplanar reformations were studied interactively with triangulation in soft tissue algorithm and in bone window as well as bone algorithm images. Bone invasion was considered positive if the well-visualized cortex using multiplanar reformations was eroded adjacent to abnormal soft tissue mass.

DENTA scan: Scans were performed on a 16 slice CT scanner (Discovery ST, GE healthcare, Milwaukee, USA). Images were viewed on an Advantage 4.2 workstation after multiplanar panoramic and orthoradial reconstructions. Erosion of buccal plate/lingual plate, infiltration of the marrow adjacent to the tumor or pathological fracture of the mandible was considered as positive for mandibular involvement.

Since the strength of the Dentascan is to obtain cross sectional view of the mandible with its lingual and buccal plates, it was used only to detect mandibular invasion and its depth and not to evaluate the length of involvement as done in MDCT and OPG.

SPECT scan: Aquisition was performed using on a Infinia Hawkeye SPECT-CT system. Post intravenous injection of 25 mCi of 99 mTc MDP, imaging was performed immediately and delay of 3 h with planar and tomographic views of the mandible. Images were processed and viewed on Xeleris workstation (GE healthcare, Milwaukee, USA). Focal tracer concentration in the mandible adjacent to the site of tumor which persisted on delayed imaging after 3 h was considered as positive for mandibular involvement.

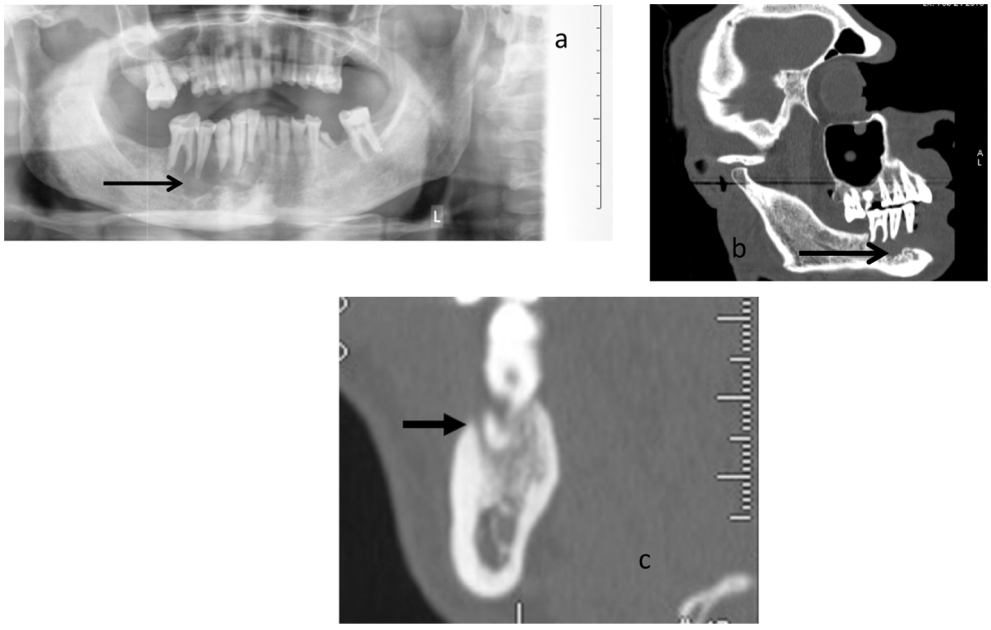

Fig. 1. Mandibular invasion depicted by arrow in various imaging modalities (a) OPG; (b) Reformatted CT scan; (c) DENTA scan.