

Ultrasonography-guided assessment of surgical margins in oral carcinoma—a study of three cases

Oral squamous cell carcinoma (OSCC) has a very high prevalence in India, and due to low levels of awareness, many cases present at an advanced stage at diagnosis. In our college outpatient facility alone, we treat approximately 150 cases of OSCC per year.

These tumors may invade facial skin and cause considerable induration and swelling of the face over the involved area, making accurate clinical assessment of tumor margins difficult. Recurrence is a fairly common problem, and adequate surgical clearance is mandatory. It is advantageous to know the exact tumor margins when planning surgery to facilitate achievement of appropriate surgical margins and to reduce morbidity. When facial skin is involved, knowing the exact tumor margins also permits reduction of skin loss.

Ultrasonography has been reported to help delineate tumor margins from surrounding edema in tumors invading the facial skin,¹ whereas computed tomography (CT) and magnetic resonance imaging (MRI) currently do not have the resolution to clearly distinguish tumor margins or to determine skin involvement.²⁻⁴ Thus, we have used ultrasonography to assess tumor margins and skin involvement in OSCC involving the buccal mucosa. Similarly, high-resolution ultrasonography is being used to assess tumor thickness in melanoma,^{5,6} and it has been reported to be superior to CT and MRI in determining the tumor thickness in OSCC.⁷

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This finding has prompted us to use ultrasonography to assess tumor depth in OSCC involving the tongue. We report three cases of OSCC in which high-resolution ultrasonography was used to assess the tumor prior to surgery.

Case 1

A 57-year-old woman with a 30-year history of betel chewing presented with a proliferative growth on the left buccal mucosa along with extraoral swelling for the past 3 months. The skin over the swelling was fixed to the underlying tissues, which was erythematous and indurated. The incisional biopsy was suggestive of well-differentiated OSCC. Significant edema at presentation reduced after 3 days of intravenous gentamicin. The CT scan showed an irregular, expansile bony defect (3.5 × 2 cm) in the left body of the mandible, with an adjacent heterodense soft-tissue lesion extending to the left buccal space (Figure 1). However, the extent of skin infiltration could not be determined, and the CT scan could not differentiate between the tumor margins and the surrounding edema.

Ultrasonography was performed with a diagnostic ultrasound machine using a high-resolution linear probe at 7–8.5 MHz. The scanning protocol was adapted to account for the structures at the skin surface. The image showed the tumor mass with an area of necrosis and in some areas distinguished the tumor margins from the surrounding edema. The tumor was seen as a hypoechoic mass infiltrating

the skin (Figure 1). The margins of the tumor were marked on the overlying skin with India ink under ultrasonography, including a standard 1 cm marginal clearance from the tumor periphery. Surgery was performed accordingly and included a radical neck dissection along with excision of the primary tumor. Histopathologic assessment of the tumor margins revealed adequate clearance of all the margins; sampling of three separate sites from each margin indicated marginal clearance of about 5–7 mm. The patient remains tumor free 12 months after surgery and is still under follow-up.

Case 2

A 59-year-old man presented with rapidly growing swelling on the left side of his face for the past 3 weeks. The swelling was tender on palpation. The skin over the swelling was firm and stretched, and skin involvement could not be assessed clinically. Axial and coronal CT scans showed the presence of an expansile lesion in the left mandible (5 × 8 cm) along with destruction of both cortical plates; however, skin involvement could not be distinguished by CT scan.

Ultrasonography showed a hypoechoic tumor mass (5 × 5 cm) involving the left cheek (Figure 2). The tumor was well delineated from the skin, with the thinnest portion of the normal skin being evident over the lower border of the mandible; there was no tumor involvement in the overlying skin. The incisional biopsy was suggestive of well-differentiated OSCC. The surgery was planned accordingly, and adequate exci-

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FIGURE 1 (a) Axial computed tomographic scan could not ascertain the degree of skin involvement and cannot differentiate between the tumor and edema. (b) Ultrasonographic image shows the tumor as a heterogeneous, hypoechoic area infiltrating the skin. (c) India ink marking on the skin represents the tumor periphery as determined by ultrasonography.

sion was performed, sparing the overlying skin. Histopathologic assessment of the margins at multiple sites revealed adequate tumor clearance of more than 5 mm. The patient remains tumor free and is still under regular follow-up.

Case 3

A 60-year-old woman presented with a firm, indurated proliferative growth with surface ulceration on the left lateral border of the tongue for the past 2 months (Figure 3). Ultrasonography was performed to assess the depth and width of the lesion. The tumor mass was seen as a hypoechoic area with margins well delineated from the surrounding tissues. The depth was accurately measured at 18.1 mm, and the width was 10.2 mm. Surgery was planned accordingly, and subsequent histopathology revealed adequate clearance of the margins. The patient is still under follow-up.

Discussion

Tumor thickness and status of resection margins are of prognostic significance in the treatment of OSCC. High-resolution ultrasonographic imaging is a reliable tool in evaluating tumor thickness and clearance of surgical margins, especially in intraoral assessment. Ultrasonographic detection of close surgical margins has a sensitivity of 83% and a specificity of 63%.⁸ In tumors smaller than 5 mm in thickness, CT and MRI could delineate the extent of the tumor with a density difference from normal tissue. High-quality ultrasonographic images can measure



FIGURE 2 Ultrasonogram showing the tumor as a heterogeneous, hypoechoic area. The overlying skin shows a normal, hyperechoic pattern.



FIGURE 3 (a) Clinical photograph showing a well-circumscribed, proliferative growth on the left lateral border of the tongue. (b) Ultrasonographic image showing the tumor as a hypoechoic mass with well-delineated margins.

the tumor thickness within 1 mm.⁷

In case 1, the skin was clearly infiltrated by OSCC and fixed to underlying tissues. Ultrasonography helped to delineate the periphery of the tumor and distinguished the areas of edema, thus permitting the surgery to be planned with precision. In case 2, in which the extent of skin involvement could not be determined, ultrasonography showed that although the tumor was close to the skin in some areas, it did not involve the skin at any point. Ultrasonographic imaging also showed the noninvolvement of the overlying skin by an adequate thickness of normal tissue, seen as a hyperechoic pattern between the tumor mass and the facial skin. In case 3, ultrasonography provided accurate measurement of the depth and width of the tongue lesion, permitting achievement of appropriate surgical margins.

The appearance of tumors as hypoechoic areas and the corresponding clarity of demarcation from normal

structures on ultrasonograms may be attributable to vascular impedance, as suggested in lymph node assessment using Doppler sonography.⁹ In this setting, sharp borders in malignant nodes due to tumor infiltration and reduced fatty deposition result in increased acoustic impedance, and it also helps to differentiate the node and other surrounding tissues. In most metastatic nodes, the peripheral vasculature has higher vascular resistance.¹⁰

In summary, high-resolution ultrasonography is a valuable, noninvasive tool in assessing OSCC tumor margins and skin involvement and in determining the depth of lesions in the tongue. The consequent ability to perform more conservative surgery reduces postoperative morbidity and can spare facial skin. Ultrasonography serves as a commendable adjunct to clinical examination in OSCC, especially in developing nations, since it is more economical than CT and MRI.

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Commentary

Ultrasonography may hold promise for pre- and intraoperative evaluation of head and neck cancers

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In 2007, an estimated 45,660 new cases of head and neck cancer (HNC) were diagnosed in the United States alone.¹ HNC accounts for approximately 3% of all cancer cases in the United States annually. Worldwide, however, HNC is an even more pressing public health problem.² With the advent of multidisciplinary care, treatment op-

tions for HNC have expanded greatly over the past 30 years, yet the prognosis and progression-free survival for patients with locally advanced HNC have not improved significantly.

For locally advanced HNC, especially tumors arising in the oral cavity, a precise knowledge of disease spread is necessary for optimal surgical decision-making. Detailed tumor map-

ping determines the extent of the ablative procedure required—and thus the need for simple or complex reconstruction. Most important, tumor staging is needed to inform patients and provide reasonable expectations about their prognosis.

Typically, assessment of tumor burden begins with clinical examination and is then complemented by computed

tomography or magnetic resonance imaging. Although effective, these imaging modalities cannot always accurately delineate mucosal tumor thickness or the extent of skin involvement. Thus, high-resolution ultrasound imaging has emerged as a promising tool for preoperative evaluation of HNC and to assess surgical margins intraoperatively. Ultrasound imaging is used extensively in the assessment of the cervical lymphatics for regional metastasis. However, its role in evaluating the primary tumor has not been well investigated. Prabhakaran and colleagues present a fascinating report, demonstrating the efficacy of ultrasonography for assessing skin involvement for buccal carcinomas and the depth of invasion for tongue cancer. These authors show the feasibility and accuracy of ultrasonography with three case presentations.

Assessing skin involvement

The proximity of the buccal mucosa to the skin of the overlying cheek creates a significant clinical problem, especially for patients with advanced-stage disease. Preoperatively, it is often difficult to determine whether this skin will need to be resected. If the skin of

the outer cheek must be resected, a microvascular free-tissue transfer is required, adding hours to the procedure and resulting in significant postoperative deformity. If the skin can be saved, reconstruction with a skin graft will suffice. Thus, any technique that can reliably predict skin involvement prior to surgery would be of great benefit to clinicians and patients alike. Preoperative ultrasonography may be particularly helpful in the treatment of carcinomas arising in the buccal mucosa or the inner cheek. Optimal probe design and frequencies should be further studied. Ultrasonography also might be able to identify patients who have lymphangitic or intradermal spread after recurrence, but this possibility remains to be studied.

Evaluating depth of invasion

Regardless of subsite within the oral cavity, depth of tumor invasion is the most reliable indicator for predicting cervical metastases. Since neck metastasis may shorten survival by half, precise assessment is of utmost importance.³ Analysis of frozen sections must be performed intraoperatively, and the decision for neck dissection must be made

then. Although not a substitute for frozen-section assessment of pathologic margins in delineating surgical margins or the extent of tumor spread, ultrasonography appears to be a promising modality to aid surgeons in their preoperative planning and intraoperative decision-making. Future prospective trials are needed to compare ultrasonographic evaluation of tumor spread with pathologic assessment of standard, hematoxylin and eosin-stained sections to determine the sensitivity and specificity of high-resolution ultrasonography, as well as to correlate ultrasonographic and pathologic findings in HNC.

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