Gauze Padding: A Simple Technique to Delineate Small Oral Cavity Tumors

BACKGROUND AND PURPOSE: Small oral cavity tumors are an imaging challenge. Intimate apposition of vestibular oral mucosa to the alveolar mucosa makes tumor assessment difficult. In CT imaging, the “puffed cheek” method has been used to separate surfaces, though this is not feasible with long MR imaging sequences. We implemented placement of 2 × 2 inch (6.45 cm) gauze into the oral vestibule before the MR imaging examination, to determine whether this might improve tumor visualization.

MATERIALS AND METHODS: MR imaging examinations of all T1 oral malignant tumors treated at University of California, San Francisco, by the Oral and Maxillofacial Department were reviewed by 2 neuroradiologists. Nine patients were included in the final analysis. Six patients were imaged by using a standard protocol. Three patients were imaged with gauze placement. The radiologists evaluated the MR images, assessing whether they could see the tumor and then fully delineate it and its thickness.

RESULTS: Fisher exact analysis was performed on questions 1, 2, and 4 with the following results: P value = .048, Can you see the tumor? P value = .012, Can you fully delineate? P value = .012, How confident are you? MR imaging examinations with gauze clearly delineated the tumor with the tumor thickness measurable. MR imaging examinations without gauze did not clearly show the tumor or its thickness. Confidence of interpretation of the findings was also increased when gauze was used.

CONCLUSIONS: A 2 × 2 inch (6.45 cm) rolled gauze in the oral vestibule significantly improved tumor localization and delineation at MR imaging. This technique is simple and provides superior preoperative imaging evaluation and treatment planning of small oral cavity tumors.

ABBREVIATIONS: FS = fat-saturated; NR1 = neuroradiologist 1; NR2 = neuroradiologist 2; OSCC = oral squamous cell carcinoma; pT1 = pathological stage T1; TNM = tumor-node-metastasis
Materials and Methods

All biopsy-proved clinical T1 buccal or gingival OSCCs treated by the Department of Oral and Maxillofacial Surgery at the University of California, San Francisco, between January 2004 and March 2009 in patients who underwent perioperative MR imaging were reviewed. One gauze procedure was performed in late 2003; 6 nongauze procedures, in 2006–2008; and the other 2 gauze procedures, in 2009. MR imaging was typically performed 2–4 weeks after the biopsy, except in 1 patient in the nongauze group, when the scan was obtained 1 week after biopsy. The study was approved by the institutional review board.

Imaging for 8 patients was performed on a 1.5T scanner (Signa EXCITE; GE Healthcare, Milwaukee, Wisconsin) by using a neurovascular head coil, and 1 of the nongauze procedures was performed on a 3T Signa EXCITE scanner. All scans were obtained with the following protocol: axial T1-weighted images with a section thickness of 5 mm, section spacing of 1 mm; and axial T2 FS images with a section thickness of 4 mm, section spacing of 2 mm, 18-cm FOV. Postcontrast T1-weighted FS images were acquired in the axial and coronal planes, both obtained at 5-mm section thickness with 1-mm spacing. Axial plane T1, T2 FS, and T1+ contrast and FS images were also obtained through the remainder of the neck. Despite a span of several years, the imaging parameters did not vary significantly among patients. No changes were made to the protocol for the gauze patients.

The patients who had imaging performed with the gauze in situ were shown how to roll up the 2 × 2 inch gauze square and place it into the oral vestibule adjacent to the T1 tumor. This procedure was demonstrated by the primary surgical team. Patients were then given a packet of gauze to take with them to the MR imaging scanner with instructions to place the gauze in their mouth just before commencement of the scanning. The MR imaging requisition form informed the neuroradiologist and technician of the gauze placement by the patient. Imaging that was degraded due to quality (ie, motion, artifacts, incomplete studies, and noncontrast examinations) was excluded from the study. This resulted in a total of 9 patients who could be included in the final analysis. Of the 9 patients reviewed, 6 had imaging performed without gauze (ie, the standard protocol in place for evaluation of T1 oral cavity lesions) and 3 had MR imaging with the gauze in place.

Two radiologists, 1 Certificate of Added Qualification–certified neuroradiologist and 1 neuroradiology fellow, blinded to the final staging, were asked to review the MR images independently on a PACS workstation. They were provided with the information that this was a buccal or gingival OSCC and were asked 4 simple questions: Can you see the tumor? Can you fully delineate the tumor? For
these 2 questions, they were asked for a yes/no response. How thick is the tumor? Finally, how confident are you with your findings? These results were recorded on an ordinal scale:

0 = Not confident/unable to see tumor
1 = Slightly confident/possibly able to see tumor
2 = More confident/probably able to see tumor
3 = Fully/very confident/fully able to see tumor.

A Fisher exact test was used to analyze the results.

**Results**

There were a total of 9 patients in the study (Table). Six patients did not have gauze placed. Three patients were not able to be imaged with gauze due to an inability to tolerate anything in the mouth due to severe pain from the lesion (1 patient) and gag reflex (2 patients). All of the procedures attempted with gauze were performed, and there were no increased motion artifacts on the images.

Three patients had gauze placed. In the no-gauze group, in only 2 cases did 1 or both of the neuroradiologists report being able to see the primary tumor. With the first case, both radiologists were able to see the tumor, but only NR2 could fully delineate it. When asked how confident they were in their findings, both were only slightly confident with their findings—the ordinal scale reported as 1 by both. In the second case, only NR1 reported seeing the tumor. Neither radiologist could fully delineate it. They were also not confident in their findings—the ordinal scale reported as 0 by both. In the remaining 4 of the 6 cases of no gauze, both neuroradiologists were unable to see the tumor, were not able to fully delineate the tumor, and were not confident with their findings. Both neuroradiologists were also unable to measure the thickness of the tumor.

The neuroradiologists were able to see the tumor in all 3 cases with gauze and were able to fully delineate the tumor. In 2 of the 3 cases, they were fully/very confident of their findings—the ordinal scale reported as 3. In 1 case, they were more confident with their findings—the ordinal scale reported as 2. In these 3 cases, the neuroradiologists were also able to measure the tumor thickness, and they each had similar findings with an interobserver variability of 1–1.5 mm.

With a Fisher exact test to compare the gauze and no gauze groups, the $P$ value was .048 for the first question, Can you see the tumor? The $P$ value was .048 for the questions, Can you fully delineate it, and How confident are you?

**Discussion**

At least 90% of oral malignancy is OSCC. In the United States, it accounts for 2%–4% of the annually diagnosed malignancies with approximately 8000 deaths per year. Despite significant advances in research, surgical oncology, imaging, and postoperative critical care, the overall mortality is unchanged.\(^8\)\(^9\)

The management of OSCC is still primarily surgical, ranging from resection with or without a neck dissection, followed by various combinations of radiation therapy or chemotherapy. Multiple factors have been studied regarding prognosis.\(^7\)\(^10\) Tumors >2- to 4-mm thickness, with close or positive surgical margins, depth of invasion >2–4 mm, and metastasis to locoregional lymph nodes have all been implicated as determinants of prognosis\(^11\); however, tumor thickness seems to be the only factor that has consistently shown promise as an indicator of risk for occult nodal metastasis.\(^12\)\(^14\) Tumors >4 mm have a greater likelihood of metastasizing to the neck.\(^14\)

The status of the cervical lymph nodes is the single most important factor influencing patient survival.\(^15\)\(^16\) The TNM classification and staging, published by the American Joint Committee on Cancer,\(^17\) are an important part of overall assessment, treatment, and follow-up (On-Line Tables 1 and 2). OSCC has an overall 5-year survival rate of 48% for all stages.\(^11\) Lo et al\(^18\) reported the 5-year survival rate for stages I, II, III, and IV disease to be 75%, 65.6%, 49%, and 30% respectively. Sklenicka et al\(^11\) found a significant decrease in the survival for stage IV disease; however, their survival curves were not significantly different between stages I, II, and III. Full-thickness cortical invasion into the marrow by definition is stage IV disease. This invasion may not be easily appreciated on imaging if the overall lesion is small or if there are significant dental artifacts. The image findings, therefore, both have a prognostic implication and may also alter the surgical management.
With modern advances in MR imaging, there has been significant improvement in the quality of images and sensitivity of findings. Section thickness can be as thin as 3 mm. MR imaging is less affected by dental artifacts and has superior soft-tissue contrast compared with CT and is, therefore, more accurate in determining anatomic location and extension of OSCC. Techniques used to distend the oral vestibule, such as the puffed cheek and “water and contrast” techniques, while suitable for CT scans, are not applicable to MR imaging due to the long imaging sequences.

This study shows that gauze, which has similar characteristics to air on MR imaging, can be successfully used to delineate T1 oral cavity tumor involvement of the soft tissue and/or adjacent alveolar bone (Figs 1 and 2). Most often, the person who has seen and biopsied the lesion initially is the surgeon. We found that it was simpler to instruct the patient on how to place the gauze adjacent to the tumor. This eliminated the need for the radiology technician to do this additional step, while also positioning the patient for the scan. Most important, the patient was instructed to place the gauze just before commencement of the scan so that the gauze would not become overly saturated with saliva, which would result in a T2 hyperintense appearance and possibly interfere with the final reading and reporting of the MR imaging (Fig 3).

The 2 × 2 inch size was chosen because it is large enough to distend the oral vestibule yet small enough to avoid soft-tissue distortion. While this is a small study, the puffed cheek technique of oral vestibule distension has been previously shown to be useful for CT imaging of oral cavity tumors. That technique is extremely difficult to use with MR imaging due to significantly longer scanning times. We have shown that cheek distension with gauze significantly improved the confidence of the radiologist when assessing oral cavity T1 lesions and provided a more detailed report, which allows more precise staging and treatment planning for the surgeon.

Conclusions

The placement of a 2 × 2 inch rolled gauze into the oral vestibule before imaging significantly improved identification of the lesion, tumor delineation, and confidence of interpretation of images; thus, it appears to be a useful technique for preoperative evaluation and treatment planning of oral cavity tumors. This method is inexpensive, requires no added imaging time, is typically painless for the patient, and requires minimal patient instruction.

Acknowledgments

We acknowledge Gary Sidhu, MD, for review of scans, Chirag Patel, MD, for figure support, Terry Su, MD, for data gathering, and Brian Christensen for table support.

References