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Computed Tomography–Directed Fine Needle Aspiration of Skull Base Parapharyngeal and Infratemporal Fossa Masses

Abstract—Suspicious findings in the parapharyngeal region on computed tomographic (CT) or magnetic resonance imaging studies can be a diagnostic problem. Blind biopsy through the mucosa can be inadequate, since the abnormality is not directly visible. With CT guidance, fine needle aspiration (FNA) of parapharyngeal masses can be performed with a needle confidently placed within the lesion. Vital structures such as the carotid artery are avoided. We present a series of 33 CT-guided FNA on 30 patients to evaluate the safety and the degree of accuracy of the procedure. Most of the patients had been treated previously for local malignancy. All patients had surgical pathologic study, autopsy, or clinical and imaging follow-up to confirm the FNA cytology results. Twenty of the 33 biopsies were positive for malignant cells, confirming recurrence of the primary head and neck malignancy. Of the 33 CT-directed FNA, 13 were negative for malignant cells. Three of these 13 were found to be false-negative FNA. None of the patients had complications from the procedure. CT directed FNA of masses at the skull base or in the parapharyngeal area can be performed safely. A high degree of accuracy is achieved, with 30 (90.9%) accurate in identifying the presence or absence of malignancy in our series. (*Skull Base Surgery, 5(4):199–205, 1995*)

Fine needle aspiration (FNA) cytology has proven to be useful in obtaining a cytologic diagnosis in the current management of patients with head and neck malignancy.[1–3] The review by Smallman et al[4] of the literature shows that sensitivities for percutaneous FNA cytology of head and neck lesions range from 77 to 95% and specificities range from 93 to 100%. When a nonpalpable mass is found, computed tomography (CT)-directed FNA has been described as a technique for obtaining a tissue diagnosis.[5–7]

The parapharyngeal area is difficult to examine clinically. A lesion may be discovered on magnetic resonance imaging (MRI) or CT before there is clinical evidence of an abnormality. This is particularly true after a patient has had tumor resection with soft tissue or flap reconstruction. A finding at imaging may suggest recurrent disease that cannot be palpated. The abnormality is deep to the mucosal surface and so cannot be directly visualized for biopsy by a peroral transmucosal approach, particularly when the lesion is not of sufficient size to bulge the mucosal surface. Peroral transmucosal biopsy is made more difficult by the proximity of these lesions to vital structures, such as the carotid artery.

With CT guidance, a needle can be placed directly into the lesion and the position confirmed with the CT image. The carotid artery and jugular vein are visualized and thus avoided. In utilizing an image guided technique, a biopsy can be performed with a greater degree of confidence.

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We present an analysis of 33 CT-directed FNA biopsies performed on 30 patients with lesions suspicious for neoplasia in the parapharyngeal area at the skull base. Most of these patients had previously been treated for local malignancy and were evaluated for possible recurrence. The purpose of the study is to evaluate the safety and accuracy of the procedure.

MATERIALS AND METHODS

Thirty patients (15 males and 15 females) underwent CT-directed FNA cytology of lesions in the parapharyngeal region just inferior to the skull base. A total of 33 biopsies were performed on patients ranging in age from 4 to 75 years. Twenty-four of the patients had a history of prior malignancy. Thirteen of these had previously been treated for squamous cell carcinoma of the head and neck region (Table 1). All patients had CT or MRI with intravenous contrast media at the time of the initial evaluation. The position of the carotid artery and jugular vein could be identified with respect to the mass.

The lesions in our series included masses that were deep to the mucosal surface without identifiable ulceration or mucosal component. Most were adjacent to the carotid artery, vertebral artery, or both. Patients presenting, for the first time with a primary tumor in the prestyloid parapharyngeal space were not biopsied unless there was an imaging finding such as an irregular border or invasion of contiguous structures suggesting malignancy. Most primary tumors of the parapharyngeal space are considered to be benign and, at our institution, are either removed as an excisional biopsy or evaluated further with arteriography.

At the time of the biopsy, the CT scan was performed with intravenous contrast medium unless the position of the carotid artery had been clearly defined during the initial examination and further documentation was considered unnecessary. Contiguous 3 or 5 mm axial slices were used to localize the mass. The patients were placed in a supine position with the head angled slightly, depending on the approach used. The approach was determined by the size and location of the mass (Table 2; Figs. 1–5). The image showing the proposed needle pathway was chosen. The laser light on the CT gantry was used to identify the position on the patient corresponding to that image and a line was drawn on the patient's skin. The proposed entry site was determined and marked and distances were calculated from the skin surface to the mass using the measure cursor function on the operator's console.

Table 1. Treatment for Previous Malignancy

Patient History	*No. Patients*
Squamous cell carcinoma	13
Nasopharyngeal carcinoma	5
Melanoma	2
Adenoid cystic carcinoma	1
Malignant fibrous histiocytoma	1
Myoepithelioma	1
Rhabdomyosarcoma	1
Lesion identified on imaging study with no history of malignancy	6

Table 2. Approach for Fine Needle Aspiration Biopsy

Retromandibular approach	14
Premandibular approach	8
Sigmoid notch approach	3
Suprazygomatic approach	2
Directly through surgical flap	6

The skin was then sterilely prepared and a local anesthetic was administered. Intravenous sedation and analgesia were required in some patients, including two pediatric patients. A 25 gauge local anesthetic needle was advanced along the calculated path toward the lesion. Repeat 3 mm thick CT slices were obtained at the level of the needle to verify the trajectory. A 22 gauge spinal needle was advanced parallel to the anesthetic needle. Repeat CT images were performed to confirm the needle placement at the margin or within the lesion. A 10 cc syringe was connected to the end of the spinal needle. With suction applied as the aspiration was performed, the needle was moved in and out approximately 1 cm with a slight twisting motion. Particular attention was given as to the location of the carotid artery and the jugular vein.

The aspirates were expelled onto glass slides and smeared. Air-dried slides were stained with Levkostat (Fisher Scientific, Pittsburgh, PA). Alcohol-fixed slides were also prepared for Papanicolaou staining. Representative slides were examined under the microscope to determine the adequacy of the specimen. Up to three passes were performed unless the specimen was deemed adequate for proper cytologic analysis earlier.

Following the performance of the aspiration biopsy, the patient was observed for approximately 2 hours with evaluation of the vital signs as well as evidence for bleeding or changes in the neurologic status. The procedures were performed on an outpatient basis unless the patient was already in the hospital for other reasons. All patients with negative FNA results had clinical or imaging follow-up to confirm the findings of the initial aspiration biopsy. One patient had a repeat CT-directed FNA. Four patients underwent surgical exploration and biopsy. Two patients died of unrelated causes and pathologic evaluation of the suspicious area was performed. Four patients had repeat clinical and imaging evaluation averaging 2 years.

RESULTS

Twenty of the 33 biopsies performed were positive for malignant cells. Sixteen of the patients had recur-

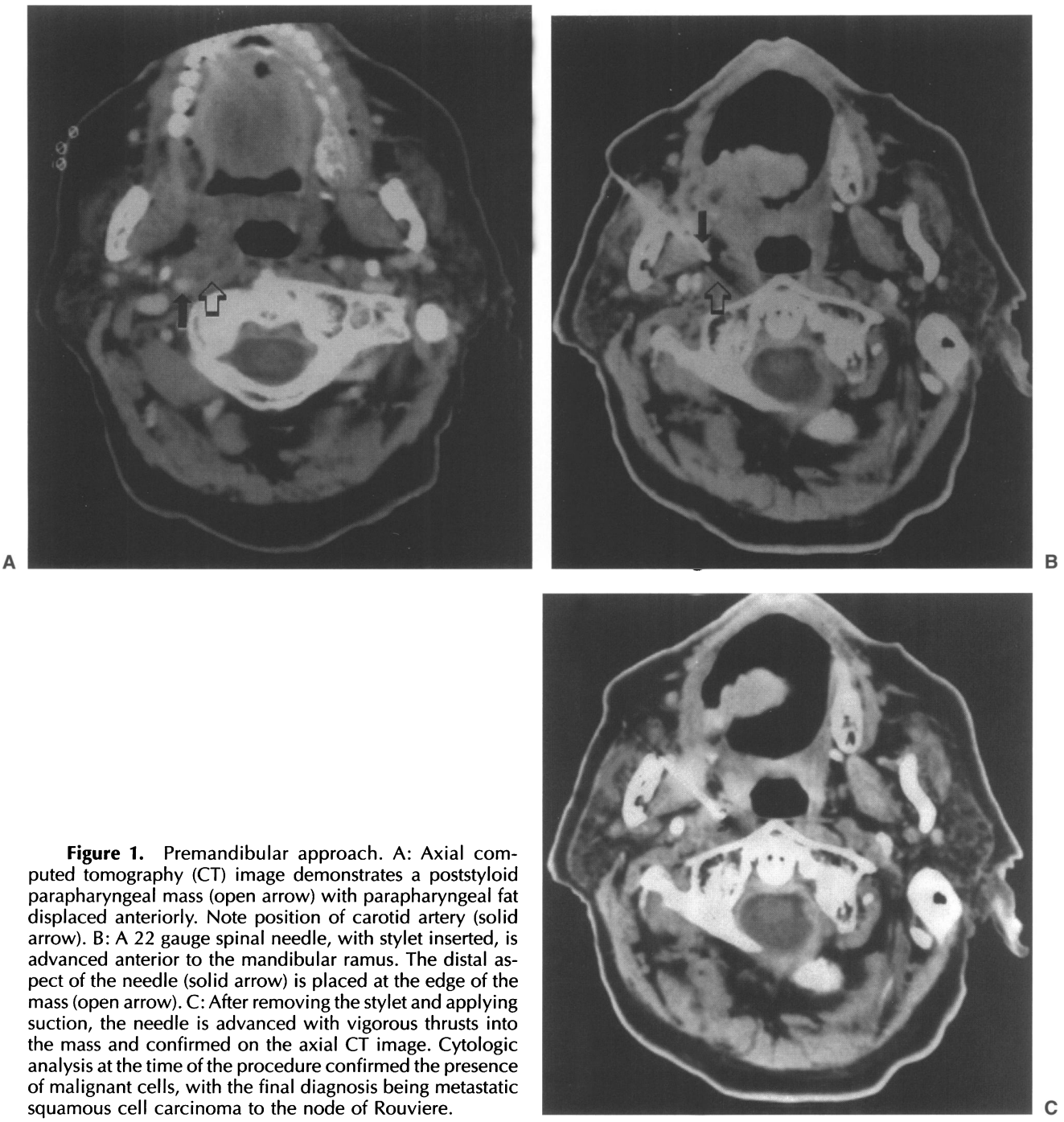


Figure 1. Premandibular approach. A: Axial computed tomography (CT) image demonstrates a poststyloid parapharyngeal mass (open arrow) with parapharyngeal fat displaced anteriorly. Note position of carotid artery (solid arrow). B: A 22 gauge spinal needle, with stylet inserted, is advanced anterior to the mandibular ramus. The distal aspect of the needle (solid arrow) is placed at the edge of the mass (open arrow). C: After removing the stylet and applying suction, the needle is advanced with vigorous thrusts into the mass and confirmed on the axial CT image. Cytologic analysis at the time of the procedure confirmed the presence of malignant cells, with the final diagnosis being metastatic squamous cell carcinoma to the node of Rouviere.

rence of squamous cell carcinoma of the head and neck region. A new diagnosis of squamous cell carcinoma was made in one patient. The remaining four patients had recurrence diagnosed of melanoma, adenoid cystic carcinoma, myoepithelioma, and malignant fibrous histiocytoma (Table 3).

Thirteen of the 33 biopsies performed were negative for malignant cells at the time of the initial CT-directed FNA cytology. Of these 13 patients, four had surgical exploration, which was negative. Negative FNA and surgical findings were further confirmed by repeat CT and clinical evaluation showing no progression of the abnormality. Two patients died of unrelated causes and autopsy yielded no evidence of malignancy in the suspicious area on the imaging studies. Four patients were followed with repeat clinical and imaging studies, which showed a stable appearance to the lesion and no evidence of progressive neoplastic growth.

There were three false-negative biopsies. Two of the three patients underwent open surgical evaluation rather than repeating the CT-directed FNA because of the highly suspicious appearance at imaging. Surgical pathologic

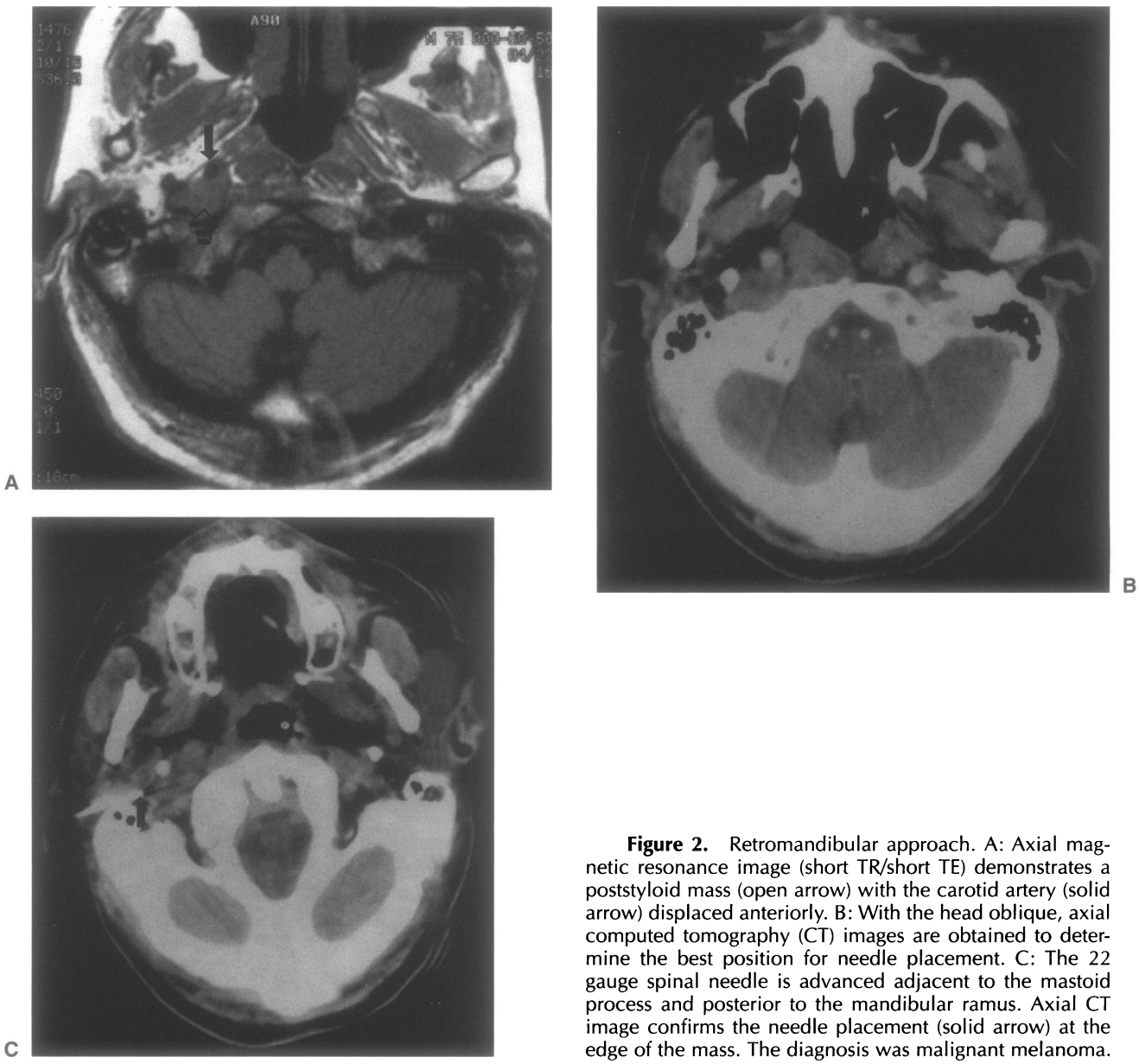


Figure 2. Retromandibular approach. A: Axial magnetic resonance image (short TR/short TE) demonstrates a poststyloid mass (open arrow) with the carotid artery (solid arrow) displaced anteriorly. B: With the head oblique, axial computed tomography (CT) images are obtained to determine the best position for needle placement. C: The 22 gauge spinal needle is advanced adjacent to the mastoid process and posterior to the mandibular ramus. Axial CT image confirms the needle placement (solid arrow) at the edge of the mass. The diagnosis was malignant melanoma.

study confirmed recurrent squamous cell carcinoma. The third patient had a repeat CT-directed FNA, which was positive for squamous cell carcinoma (Table 4).

Of the 33 CT-directed FNA performed, 30 (90.9%) were accurate in confirming the presence or absence of malignancy. In only 3 of 33 (9.1%) FNA performed were the results inconsistent with the final cytologic diagnosis.

DISCUSSION

Tumors of the parapharyngeal area can represent a difficult diagnostic problem.[8,9] They are frequently identified on imaging studies yet may remain hidden from the clinician due to the location deep to an intact mucosal surface. When the tumor identified on the imaging study bulges the mucosal surface, a peroral transmucosal biopsy can be performed. This "blind" biopsy, however, puts the carotid artery at risk and there is no way of confirming that the biopsy sample comes directly from the area of concern on the imaging study.

Previous report by Das et al[10] on peroral FNA cytology of oral and pharyngeal masses demonstrated an accuracy of 78%. The aspirations included mucosal lesions of the oropharynx, which would increase the assurance of directly sampling the lesion and improving the degree of accuracy. Mondal and Raychoudhuri[11] reported their results on peroral FNA cytology performed on patients with parapharyngeal masses with an intact mucosa with or without external swelling in which they achieved an 88% diagnostic accuracy. Smaller lesions can lead to a high false-negative rate for aspirations with the peroral tech-

Figure 3. Sigmoid notch approach. The 22 gauge spinal needle is advanced through the sigmoid notch of the mandible and into the parapharyngeal mass. Patients experienced slightly more discomfort with this approach.

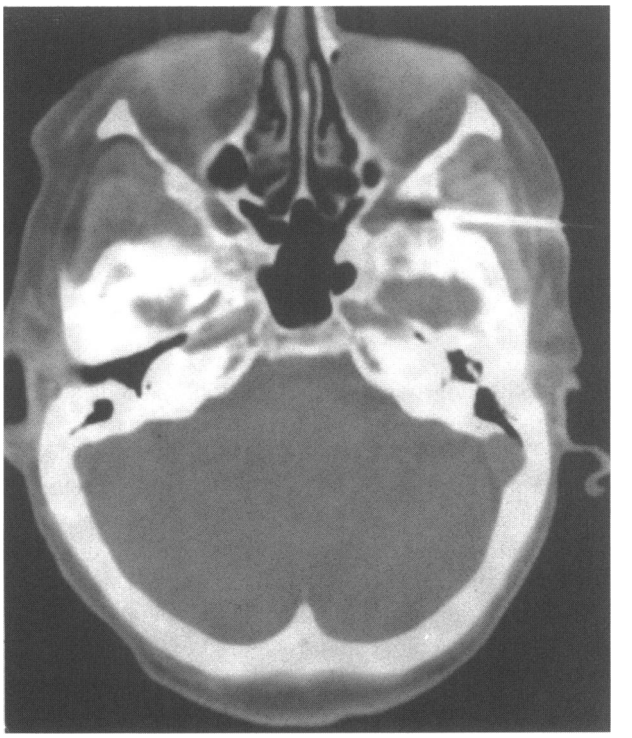
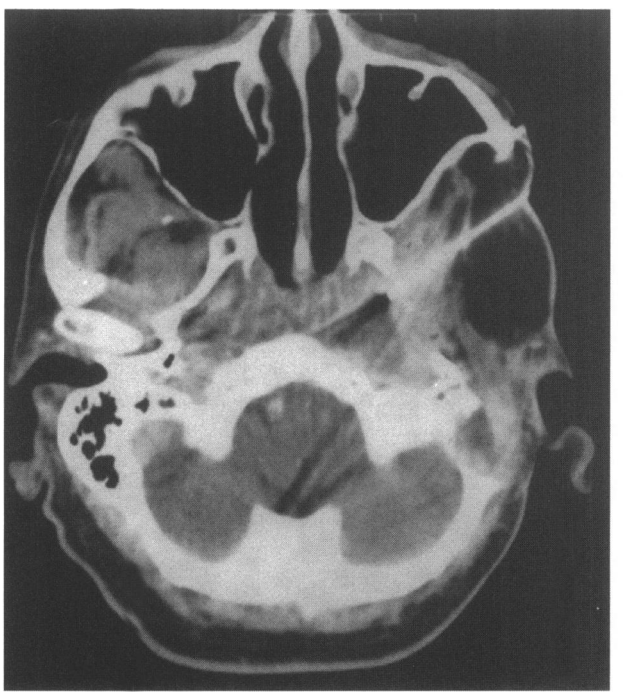


Figure 4. Suprazygomatic approach. The 22 gauge needle is placed superior to the zygomatic arch, which allows for direct access to the pterygopalatine fossa.



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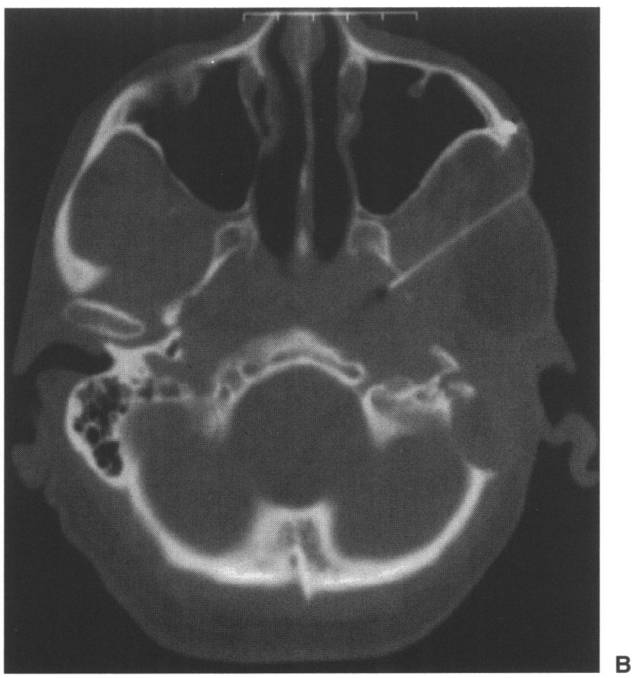

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Figure 5. Directly through the surgical flap. With this approach, the patients experienced the least discomfort due to denervation from the surgical reconstruction. The 22 gauge spinal needle can be advanced directly through the surgical flap and into the suspicious lesion. Special attention must be given to the location of the major arteries due to the distortion of the anatomy from the surgical reconstruction. A: Soft tissue window. B: Bone window.

Table 3. Results of Fine Needle Aspiration Biopsy

Diagnosis	*No.*
Squamous cell carcinoma	16
Melanoma	1
Adenoid Cystic carcinoma	1
Myoepithelioma	1
Malignant fibrous histiocytoma	1
Infection/inflammation	10
False-negative result	3

nique, as demonstrated in the series of Castelli et al [12] of 44 patients with 19% false negative results.

CT-guided FNA cytology addresses these issues in that the needle tip is confirmed to be within the tumor at the time of the biopsy. This reduces the percentage of false-negative aspirations. In our series of 33 biopsies, our accuracy rate was 90.9%. Utilizing CT guidance, inadvertent injury to the carotid artery or the jugular vein is avoided. No complications occurred in the 33 biopsies performed at our institution. Similarly, Yousem et al[7] had no complications in a series of 17 patients.

A 22 gauge spinal needle was used for the aspiration in our series. This allows for an adequate aspirate for the cytopathologist to evaluate. The number of passes with the needle in each patient varied, depending on the results of the cytologic assessment at the time of the procedure. Up to three passes were performed unless the specimens were deemed diagnostic earlier. Three standard approaches were used: (1) retromandibular, (2) sigmoid notch, and (3) preramus/paramaxillary. Two variations done in certain situations included the suprazygomatic approach and direct passage through the surgical reconstruction flap into a suspicious area. The choice of approach depended on the position of the tumor relative to the carotid artery and the ramus of the mandible.

The retromandibular approach provided access to the both prestyloid and poststyloid parapharyngeal spaces. The needle can be passed anterior or posterior to the styloid process, depending on the position of the tumor. The needle was passed anterior to the styloid for prestyloid masses or for tumors located medial to the carotid but protruding further anterior than the artery. This would occur in metastasis to the node of Rouviere. The styloid could be used as a landmark to avoid the carotid, yet the anterior part of the tumor could be accessed.

The needle could be passed posterior to the styloid to reach lesions posterolateral to the carotid. Care was taken during actual sample collection to use a trajectory to limit the "in and out" movement of the needle to avoid the carotid. In one case early in our experience, a 25 gauge needle was purposely passed through the carotid to reach a node. A positive result was achieved without complication.

The preramus approach was used for anterior masticator space lesions or for masses medial to the carotid artery and not protruding anteriorly enough to allow the retromandibular approach. In these cases, the needle is kept close to the ramus so that the angle chosen "protects" the carotid. Keeping the needle close to the ramus also avoids passage of the needle through the mucosa into the oral cavity close to the retromolar trigone.

The sigmoid notch approach was used for masses close to the skull base and foramen ovale in the area of the upper masticator space. Using this approach, the carotid is not usually at risk. The third division of the trigeminal nerve does pass in close proximity. Of all the approaches, this seemed to entail the most discomfort for the patient.

Biopsies through reconstructive flaps were probably the easiest. Pain was minimal because of interruption of sensory innervation. Frequently, bone had been surgically removed, which allowed for easier access to the target area.

One case was done using a suprazygomatic approach to access the pterygopalatine fossa. This approach was chosen because the needle trajectory was slightly downward, thus avoiding entrance into the orbit via the inferior orbital fissure. This case was done with an orbital surgeon available in case a hematoma did extend into the orbit.

One additional case, not included in the study group, was done through the oral cavity. The needle was passed through the retromolar trigone into the masticator space. The needle was relatively stable against the buccal surface of the teeth with the mouth in the closed position. However, we believe that passing the needle through the cheek is more stable.

Most of the patients had known malignancy and the biopsy was done to evaluate potential recurrence. This reflects a bias related to the patient population at this institution. Biopsies of primary parapharyngeal masses have been reported. At our institution, this is rarely done. A tumor that can be localized within the prestyloid compartment is considered to be of salivary gland origin. Since approximately 80% of these tumors are benign pleomorphic adenomas, the tumor is removed as an excisional biopsy without preoperative confirmation. Biopsy is considered if the lesion has an irregular margin or extension away from the primary site, suggesting malignancy. Tumors of the poststyloid parapharyngeal space are, also, usually benign. Arteriography may be done to differentiate paraganglioma from other lesions arising

Table 4. True- and False-Negative Biopsies

True-Negative Biopsies	*False-Negative Biopsies*
4 patients—surgical exploration with clinical and imaging follow-up	2 patients—open surgical biopsy positive for malignancy
2 patients—autopsy results with pathologic evaluation of suspicious area	1 patient—repeat CT-directed FNAB positive for malignant cells
4 patients—clinical and imaging follow-up	

from the nerve sheath. Again preoperative biopsy is seldom done.

Some authors have used coaxial systems to avoid multiple passes through the skin. This was not done in our study but has potential benefit in lesions that are in a poorly accessible location. The coaxial system does require use of a second needle, larger than the final needle used for the actual biopsy.

CONCLUSION

CT-guided FNA with cytology is a safe and accurate method for evaluating suspected parapharyngeal tumors, particularly recurrent carcinoma.

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