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CT and MR Appearance of Recurrent Malignant Head and Neck Neoplasms after Resection and Flap Reconstruction

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PURPOSE: To describe the appearance of recurrent malignant neoplasms in patients who have undergone resection of primary head and neck tumors with flap reconstruction. **METHODS:** Thirty-two examinations, 26 CT and 6 MR scans, were retrospectively reviewed in 25 patients with documented recurrent malignant neoplasms. Confirmation of disease was by biopsy or disease progression. The flaps included 15 myocutaneous, 6 free composite, 2 jejunal free grafts, and 2 combined jejunal and myocutaneous flaps. **RESULTS:** The most common location of recurrence was in the primary tumor bed involving the undersurface or suture line of the reconstruction flaps, 14 of 32 scans; both nodal and flap recurrence was seen in 12 of 32 scans. **CONCLUSIONS:** When examining patients who may have recurrent disease after flap reconstruction, the radiologist should be aware of the type of flap used and the expected appearance. Tumor recurrence in this patient population is manifest either as a focal recurrent mass at or near the suture line of the reconstruction flap, or nodal disease, usually in the contralateral neck.

Index terms: Surgery, resective; Head, neoplasms; Neck, neoplasms

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Flap reconstruction has become a popular method for closing the surgical defects that result from resection of advanced malignant head and neck neoplasms. A flap is a transfer of tissue from one area to cover or reconstruct a soft-tissue defect at another location in the same patient. The main advantage of the flap reconstruction is that resection and reconstruction can be completed in a one-stage procedure (1–3). Other advantages include protecting the cervical carotid artery and other structures during radiation therapy, fewer postoperative complications, and improved postoperative cosmetic results (4–6). Unfortunately, the distorted anatomy and changes in the soft tissues that may follow the surgery, especially if the area has been irradiated, makes detection of recurrent tumor by physical examination difficult. Cross-sectional imaging using computed tomography (CT) and magnetic resonance (MR) imaging has become an essential tool for the otolaryngologic-oncologic surgeon to aid in the evaluation of a patient with suspected recurrent disease (7–11).

This study describes the appearance on CT and MR imaging of recurrent tumors in patients who have undergone flap reconstruction for malignant head and neck neoplasms, and the advantages of the two modalities are discussed.

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Materials and Methods

The study includes a total of 32 examinations (26 CT and 6 MR scans) obtained from 25 patients during a 4-year period (1988 to 1992). The study population consisted of 19 men and 6 women, ranging in age from 41 to 76 years (mean age, 60 years). All patients had undergone surgical resection of malignant extracranial head and neck neoplasms, ipsilateral radical neck dissection, and flap reconstruction. Nineteen of 25 patients had radiation therapy. As shown below, the most common primary tumor site was the oropharynx.

Retromolar trigone/base of tongue/tonsil	8
Oral cavity/floor of mouth	5
Hypopharynx/larynx	4
Parotid	2
Cervical esophagus	2
Maxillary sinus	1
Skin	1
External auditory canal	1
Nasopharynx	1
Total	25

The types of reconstructive flaps used follow.

Myocutaneous	15
Free composite	6
Jejunal	2
Jejunal/myocutaneous	2
Total	25

The myocutaneous flap, which involves transfer of both a muscle and its overlying skin, was the most common flap used. Sources of the flap included the pectoralis major, rectus abdominus, and trapezius muscles. Jejunal flaps were used to reconstruct the pharyngoesophagus, except in one patient who had a tubed pectoralis flap used for that purpose. Free composite flaps, composed of skin, muscle, and portions of bone to which the muscle attaches, were taken from the forearm or scapula and used primarily to reconstruct the oral cavity, oropharynx, and mandible.

All patients were referred for CT or MR imaging because of clinical suspicion of recurrent cancer. Symptoms and signs of suspected recurrence included palpable masses, mucosal ulcers, new onset of pain, cranial nerve palsy, dysphagia, or pain with swallowing. Proof of tumor recurrence was by biopsy or fine-needle aspiration in 21 of 25 patients. Three patients did not undergo biopsy but had clinical progression of disease and strong clinical suspicion for recurrence with no signs of infection. All three died soon after their CT or MR studies. A single patient was lost to follow-up. Surgical details, including flap type, history of radiation therapy, biopsy results, and clinical presentation, were obtained by chart review.

Nineteen patients had single CT scans; one patient had an MR study only; one patient had two CT scans (2 months apart); three patients underwent both CT and MR imaging within a 2-month period of time; and one patient had a total of four studies, two CT and two MR scans. All CT scans were performed after a 50-mL bolus of 60% iothalamate meglumine (Conray; Mallinkrodt, St Louis, Mo) followed by a 300-mL drip of 30% diatrizoate meglumine (Hypaque; Winthrop, New York, NY). CT technique included axial 5-mm section thickness from the top of the frontal sinus through the primary tumor site, and 5- or 10-mm section increments through the remainder of the neck to the carina. Direct coronal scans at 5-mm section increments were obtained in patients with paranasal sinus or oropharyngeal lesions. Both soft-tissue and bone windows were obtained. MR imaging was performed on a 1.5-T superconducting magnet (Philips Medical Systems, Shelton, Conn) using a quadrature head-and-neck coil. Examinations consisted of T1-weighted (500–750/15–20/1–2 [repetition time/echo time/excitations]) sagittal and axial sequences at 3- to 5-mm section thickness, and T2-weighted (2000–3000/25–90/1) axial sequences using 5- to 6-mm section thickness. Additional supplementary T1-weighted coronal sequences were performed in some patients. One T2-weighted study was performed using a fast spin-echo sequence, an echo train of 8, and effective echo times of 35 and 90. Sequences were obtained through the primary tumor bed to the thoracic inlet. Three patients were imaged after receiving 0.1 mmol of gadopentetate dimeglumine (Magnevist; Berlex Imaging, Wayne, NJ) per kilogram of body weight. Immediately after contrast administration, T1-weighted sequences in the axial and/or coronal planes were obtained. One patient underwent additional enhanced fat-saturation sequences using a spectral presaturation inversion-recovery technique.

All studies were retrospectively reviewed, and features of recurrent tumors were recorded. The suspected recurrences were described with respect to locations in the head and neck, proximity to the primary tumor beds, the reconstruction flaps, and the flap suture lines, and whether they were focal or diffuse. Pharyngoesophageal recurrences were described as intraluminal or occurring at the suture line. The enhancement patterns with either iodinated contrast material or gadopentetate dimeglumine were noted. On MR scans, the signal intensities of the lesions and the flaps were compared with muscle on both the T1- and T2-weighted sequences. Lymph nodes were noted with respect to location, size, presence of necrosis, and extracapsular spread of tumor. High jugular and submandibular nodes larger than 1.5 cm and nodes larger than 1.0 cm in all other chains were considered malignant. Any node with central necrosis was reported as metastatic. Bone destruction, skull base involvement, and perineural spread were noted.

Results

All patients had CT or MR evidence of recurrent disease. The patterns of tumor recurrence in the 32 patients follow.

Mass in tumor bed or flap	14
Focal mass and nodal recurrence	12
Nodal recurrence alone	4
Normal CT	1
MR evidence of skull base recurrence	1

In one patient the CT scan showed no tumor, but the MR scan, performed less than 2 months later because of persistent pain, showed definite tumor in the foramen ovale and cavernous sinus.

A focal mass, either solid or cystic, was the most common appearance of the recurrences occurring in patients with myocutaneous and

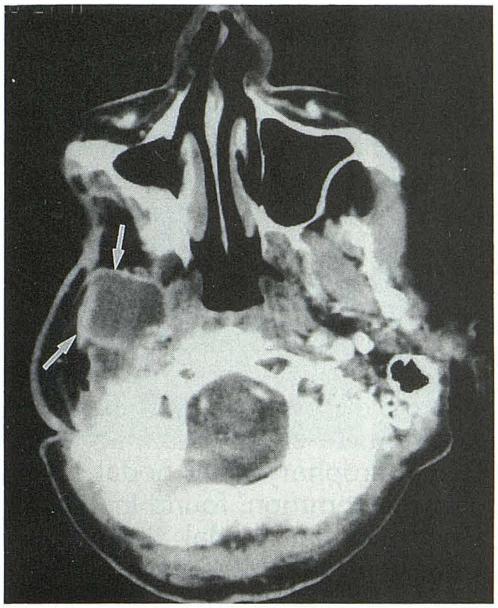


Fig 1. Contrast-enhanced CT reveals focal necrotic recurrence (*white arrows*) beneath a pectoralis major myocutaneous flap. Notice the cystic appearance with peripheral enhancement. The muscular portion of the flap has atrophied, leaving primarily fat, which is normal in density.

free composite flaps (Figs 1 and 2). Most occurred in the recipient flap beds, at the suture lines between the surgical defects and the reconstruction flaps. Only one patient had a focal recurrence at the distal portion of the flap. The solid masses enhanced diffusely with iodinated contrast, whereas the cystic, presumably necrotic, masses enhanced only peripherally.

Focal pharyngoesophageal recurrences within the jejunal autografts appeared as extraluminal or intraluminal masses, again at the upper portions of the grafts in the anastamotic sites. Additionally, marked luminal narrowing with proximal dilatation, or eccentric lumina, were seen with recurrent tumors.

Diffuse changes with distortion of fat and fascial planes around the flaps was another manifestation of local tumor recurrence (Fig 3). This was impossible to differentiate from radiation-related soft-tissue changes in those patients who had received adjuvant radiation therapy.

Although only six MR scans were included in this series, several trends were observed. MR signal intensities within the tumors were variable, especially on T2-weighted images. On T1-weighted sequences recurrent tumors were lower in signal intensity than fat and nearly isointense to muscle. However, the intensity of nonnecrotic disease on T2-weighted images ranged from low to high, precluding the use of signal intensity as a predictor for recurrent disease. This seemed to be independent of prior treatment with radiation. (Of the six MR examinations, three were performed after radiation treatment.) For example, one patient who did not have radiation therapy had a luminal recurrence that was hyperintense on the T2-weighted sequences (Fig 4), whereas another patient who had imaging several months after radiation had presumed recurrent disease that was lower in signal intensity on T2-weighted images (Fig 5). The three patients who received gadopentetate dimeglumine had focal recurrent tumors, and enhancement of

A B

Fig 2. Focal solid recurrence beneath a pectoralis major myocutaneous flap. The solid mass (*white arrows*) increased in size from the first (*A*) to the second (*B*) CT scan, performed 4 months later.

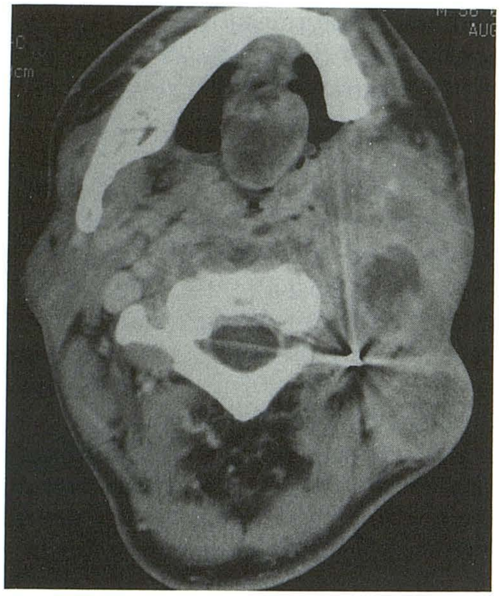


Fig 3. Diffuse recurrence in a myocutaneous flap, with associated necrotic adenopathy. The entire flap and recipient bed have been replaced by enhancing tumor, which extends into the fat of the flap and to the skin. The internal carotid artery cannot be discretely detected. Notice the necrosis within the recurrent tumor.

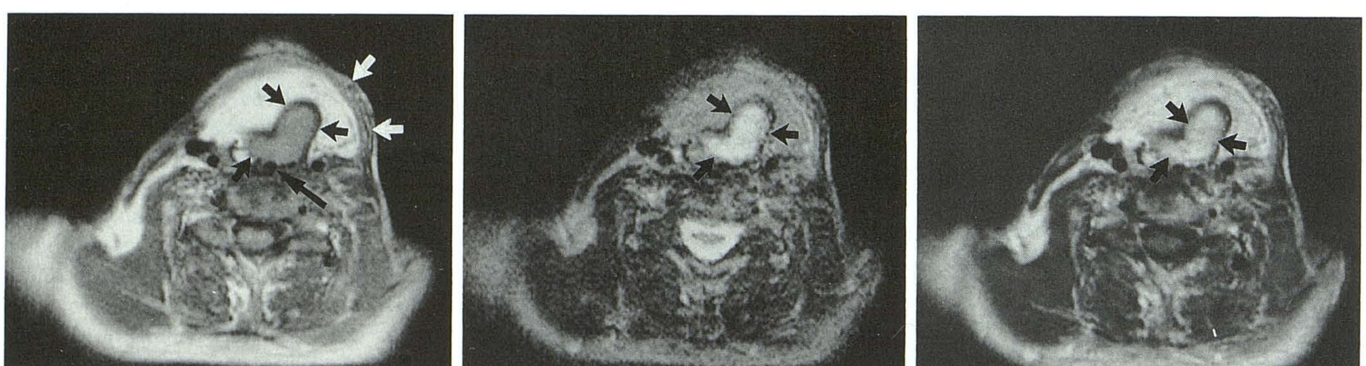
the tumors after gadopentetate dimeglumine was seen in all three patients (Fig 4C).

The signal intensities of the reconstructive flaps on MR scans reflected the composition of the flaps. The fatty regions of the flaps were predictably high signal on T1-weighted sequences and faded in signal intensity on the T2-weighted images (Figs 4A and B). The muscular portions of the flaps had a signal intensity equal to that of normal muscle. The enhancement patterns of the normal portions of the flaps, remote from the recurrent tumors, were variable. One patient, who had a myocutaneous flap to reconstruct a large skull base defect and received adjuvant radiation therapy, had heterogeneous enhancement after gadopentetate dimeglumine. The two other patients studied with gadopentetate dimeglumine had no enhancement in the muscular portions of the flaps. One received adjuvant radiation; the other did not.

The pattern of nodal recurrence was similar to the appearance seen in primary nodal disease (12). Retropharyngeal nodal metastases were the most common, found in 10 of 16 patients with recurrent nodal disease. Jugular chain nodes contralateral to the primary disease and radical neck dissection were seen on 5 studies in 4 patients. One patient who underwent both CT and MR had a necrotic retropharyngeal lymph node more conspicuous on MR than on CT.

Discussion

The appearance of recurrent tumor in a reconstruction flap is not unique but has features similar to primary malignant tumor in the head and neck. As expected, the most common location for focal recurrence in our series is in or near the primary tumor bed. Tumors that ultimately require reconstructive flaps to close large defects are usually advanced and, even



A B C

Fig 4. Luminal recurrence in a tubed pectoralis major flap.

A, T1-weighted (800/30) image shows the normal high signal intensity within the normal flap fat and the normal muscular portion of the flap (*white arrows*). The recurrence, seen within the lumen (*small black arrows*), is slightly hyperintense with respect to muscle. The small residual air-filled lumen (*long black arrow*) is void of signal.

B, T2-weighted (2300/90) image shows that the recurrent tumor (*black arrows*) is hyperintense. The normal flap fat has faded in signal intensity, as expected.

C, T1-weighted (800/30) image with gadopentetate dimeglumine. Notice the enhancement of the recurrent tumor (*black arrows*).

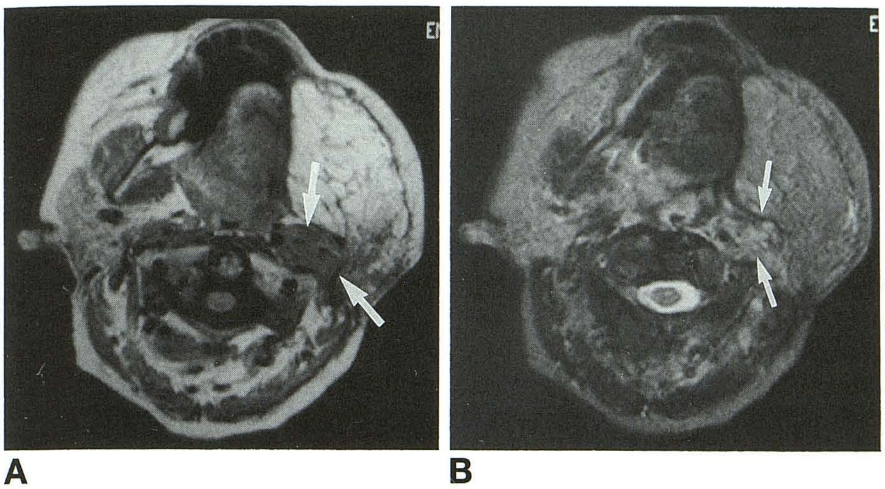


Fig 5. Presumed recurrent tumor deep to a myocutaneous flap.

A, On this T1-weighted (800/30) image the recurrent tumor (*white arrows*) is nearly isointense to muscle. The overlying flap fat is indurated and "dirty." This focal abnormality, which is masslike in appearance, was not biopsied. The patient died soon after this scan was performed.

B, The presumed tumor (*white arrows*) on this T2-weighted (2500/90) sequence obtained at the same level is slightly more intense in signal than muscle but less intense than the recurrence in Figure 4B.

despite wide surgical resection, may have microscopically positive tumor margins. Close scrutiny of the recipient flap bed both by physical examination and cross-sectional imaging may help detect the earliest recurrence.

Although we had only six recurrences on MR, the variation in signal intensity on T2-weighted images within the recurrent tumors suggests that MR will not be specific in predicting recurrent cancer. Other authors have stressed that high signal intensity on T2-weighted images may be caused by a variety of both malignant and benign lesions (10). The three recurrent tumors in our series imaged with gadopentetate dimeglumine enhanced, but unfortunately so did the reconstructive flap in one patient. Our series is small, but it suggests that even gadolinium-enhanced MR images may not predict recurrence accurately.

Recurrent tumor involved the nodal chains in a pattern similar to nodal disease in primary tumors. Special attention to the retropharyngeal region and the contralateral neck are required, because this is where recurrences are common. Thus, the entire neck must be scanned and examined with care as if the patient is presenting de novo. Bone involvement was also seen, especially with free composite flaps when they were used to reconstruct the jaw. Skull base erosion beneath a flap may be the first sign of recurrence, and this area should be carefully reviewed with attention to bone detail. Unfortunately, osteoradionecrosis can have a similar CT and MR appearance as tumor within bone. Again, the sensitivity for detecting disease is high, but the specificity of our current imaging procedures is low.

None of the patients in this series had benign masses mimicking recurrent tumor. However, we must stress that the appearance of recurrent tumor on CT or MR is not pathognomonic, and a number of surgical complications may mimic recurrent disease. During the first 6 to 8 postoperative weeks, focal hematoma, abscess, fistula, edema, or even the reconstruction flap itself may appear similar to a recurrent tumor on CT or MR images (7–9, 13, 14). Although the study may be nonspecific in the first 2 months, the clinical setting will help determine the cause of a focal mass. A fever would imply infection or abscess, but a mass that develops rapidly, is soft to palpation, and gradually resolves more likely would represent a hematoma or seroma. Precise knowledge of what type of surgical procedure was performed, coupled with a familiarity of the expected appearance of a flap on CT or MR, will make it unlikely that one would misinterpret the flap as recurrent tumor. At our institution, the head and neck surgeon and the radiologist are in close communication regarding the patient and the surgical procedure performed. Such a relationship can only augment patient care.

More delayed lesions that potentially could look like tumor are postradiation changes, focal fibrosis, and lymphoceles (10, 14, 15). Acute changes in the soft tissues commonly seen after radiation treatment are loss of normal fat density or intensity, with "dirty" fat, loss of normal fascial planes, thickening of mucosal surfaces, and increased enhancement in salivary glands. These changes are diffuse and are not unlike diffuse recurrent tumor. Stricture formation in pharyngoesophageal reconstruction, a common finding in recurrent tumor of the neopharynx, also can follow radiation therapy in free jejunal autografts in animals (16).

Overall, the addition of imaging studies, both CT and MR, adds another dimension to the diagnosis and follow-up care of patients with malignant head and neck neoplasms. The use of these techniques in the postoperative period allows the surgeon to detect a recurrence earlier than may be obvious on physical examination. Recurrences that occur beneath the flap are particularly prone to late presentation, which may be obviated by judicious use of imaging. Baseline postoperative scans have been advocated (7).

Conclusion

We have described a series of recurrent tumors in patients who have had resection of primary malignant neoplasms of the head and neck and repair of the surgical defects with reconstructive flaps. The appearance of recurrent tumor in this setting is not unique but is often similar to the primary tumor. Knowledge of the type of flap used coupled with a familiarity of the expected appearance of the flap can help detect recurrent tumor accurately.

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