Reconstruction after Extirpation of the Auricle

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ABSTRACT

The purpose of this study is to introduce the procedure and results of a combined free flap reconstruction with an external ear prosthesis after tumor extirpation from the lateral side of the head. Over the last 3 years, four patients have undergone total auricle extirpation for varying tumor processes. Each was reconstructed with a radial forearm flap, preserving the external auditory meatus. After primary healing and adjuvant therapy, a prosthetic pinna was applied. Combined use of microsurgical techniques with a prosthetic ear has produced an aesthetically superior result for large soft-tissue defects of the side of the head. This combined technique is able to provide the best aspects of both microsurgical and prosthetic reconstructions for a superior result for the patient.

KEYWORDS: Auricle extirpation and reconstruction, combined free flap and external ear prosthesis post tumor

On rare occasions, a tumor will involve the external ear, so that extirpation requires removal along with surrounding tissue. The area of the external ear is in a unique position, as it is a transition zone for surrounding tissue. The skin of the lateral face blends into the ear anteriorly; the skin of the scalp approaches the ear superiorly and thins significantly in the posterior portion; and the skin of the neck transitions into the ear from below. Often, if the external ear needs to be removed for a malignancy, it leaves a large defect in the temporalis muscle below, and may leave exposed temporalis bone and a bare and uncovered external auditory meatus. This type of extirpation poses two problems. First, the loss of the external ear and second, the exposure of a large portion of the lateral skull.

Although a prefabrication of all the required tissue, including the external ear, would be an ideal solution to such a problem, the time constraints of tumor therapy presently nullify this alternative. As these defects may be as large as 10 to 12 cm in diameter, local tissues have been inadequate. Several unique requirements need to be considered when reconstructing this defect. First, an exposed external auditory meatus in the temporal bone needs to be either covered or maintained. For stereo hearing, maintaining the otherwise functional ear apparatus with a patent auditory meatus would be ideal. Because of aggressive pathology, tissue replacement that stands up to radiation is a necessity. A reliable primary closure is mandatory, as a problem in healing can delay further oncologic therapy. The final consideration in reconstruction, in addition to just "O-Filling," is to create a platform for an aesthetic result. Consideration in this area needs to be paid to the contour, the lateral side of the scalp, the color and texture of skin, and a foundation to support some facsimile of an ear.

PATIENTS AND METHODS

Over the past several years, four such unique defects have been managed at our institution. Although each of the patients had a different pathology, the final defect

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for reconstruction was essentially the same. Each patient was reconstructed with a radial forearm free flap to cover the initial defect which included maintenance of the external auditory meatus. All of these free flaps survived totally (100 percent), and healed quite rapidly for primary closure. There were no delays in delivery of adjuvant therapy and finally, all patients left the hospital within 5 days of surgery (Table 1).

Surgical Technique

After extirpation of the tumor, the defect is surveyed for length and width requirements and any other unique tissue requirements. We have found a collaborative effort with our oncologic surgeons to be beneficial to all parties.[1] Preparation of the vessels is usually quite simple, using the facial branch of the carotid artery or the occipital branch which is within the defect. Additionally, the internal jugular vein is often at the base of the defect for easy venous drainage. Thus, the pedicle length requirement is minimal. Once an appropriate artery is chosen for anastomosis, we apply a micro clamp and confirm that there is adequate pulsatile blood flow. The vein is prepared by circumferentially dissecting around the vein and placing vessel loops. Attention is then placed to harvest of the radial forearm flap, which is preferentially taken from the nondominant wrist. A preoperative Allen's test is always done in the clinic during the discussion of flap options. Despite having a clinically favorable Allen's test, we always perform an intraoperative Allen's test on the table to confirm pulsatile blood flow throughout the hand with the radial artery clamped.

The dimensions of the defect are outlined on the forearm and initial elevation is started at the wrist crease on the radial side. The radial artery can be circumferentially dissected and temporarily occluded while the tourniquet is down, and a Doppler probe is used to check flow throughout the digits. If the flow is adequate to all the digits, then the tourniquet is re-elevated and dissection continues. During dissection, we make a conscious effort to locate and preserve all branches of the radial sensory nerve. We are also very careful to protect peritenon over the exposed tendons of the wrist. Occasionally, we will discard the palmaris longus tendon, rather than allowing it to give us a postoperative problem with skin graft adherence. We normally do not incorporate the cephalic vein in our dissection and prefer to use the radial artery for arterial inflow in the venae comitantes for venous outflow of this flap.

Once harvest is complete, the flap is transferred to the head and neck area, where a temporary inset is done with skin clips while the microanastomoses are carried out. A standard end-to-end microsurgical arterial anastomosis is done, usually with 9-0 nylon interrupted suture. We prefer end-to-side anastomosis to the internal jugular vein for venous drainage, as the venae comitantes present a size mismatch. There is often a dominant vena comitans which is preferentially chosen. If the vessels are of equal size, we may choose to anastomose both for venous outflow. Once microanastomoses are complete, then our attention is paid to recreating the external auditory meatus. Since the radial forearm flap has such a robust blood supply, creating a defect in the center of the flap is well tolerated. We do this by cutting a U-shaped defect, so an actual flap can be brought down to the skin of the ear canal and the remainder of the raw surface can be skin grafted. We put a drain underneath the flap and bring it down through the neck, remote from the microanastomoses. The rest of the insetting is done in standard fashion.

We pay very close attention to the donor site, which we close first by circumferential purse string suture. We use a 3-0 Dexon suture for this and are able to shrink the size of the defect prior to skin grafting. The remainder of the defect is prepared then for a skin graft. If we have maintained adequate peritenon on the exposed tendons, then a skin graft of .013 inch is harvested from the ipsilateral upper thigh area and applied non-meshed. If there is concern that there is loss of peritenon on any of the tendons, then a portion of the superficialis muscle may be rolled over that tendon and sutured into place prior to applying the skin graft. A thick layer of antibiotic ointment is applied over the skin graft, the graft then covered with a non-adherent dressing. The arm is placed in a palmar plaster splint with the fingers and thumb left free. This is taken down in 5 days.

RESULTS

Each of the patients had primary healing of their wounds. The free flaps have had 100 percent survival, the donor sites in these instances have all been left

Table 1 Patient Data

Pt. No.	Sex	Age	Pathology	Complications
1.	M	66	Recurrent desmoplastic melanoma	None
2.	F	33	Grade 3 fibrosarcoma	None
3.	F	44	Epithelioid hemangioendothelioma	Re-operated for constricted ear canal
4.	M	77	Recurrent high-grade spindle cell carcinoma	None

without further treatment at 5 days postoperatively, without any long-term donor-site morbidity or need for further surgery. All skin grafts have taken 100 percent primarily. Two of the patients requiring postoperative radiation had it administered at our facility. These flaps have withstood the radiation without difficulty. As far as the donor sites are concerned, the patients have had no functional deficits to the donor arms. There have been no sensory deficits. The dorsum of the donor thumb in all cases has maintained intact sensation. None of the patients has complained of cold intolerance (despite living in Minnesota). As a radiated fasciocutaneous flap is not the ideal stage from which to start an autogenous ear reconstruction, each of these patients has been offered a prosthetic ear manufactured at our prosthetic laboratory. One patient required additional surgery to better open her external auditory meatus (Figs. 1, 2).

DISCUSSION

The radial forearm flap was first introduced by the Chinese as a reliable free skin replacement.[2] Because of the ease of elevation, the reliable and large-sized pedicle, and the overall durability, the flap has become popular in head and neck surgery. It can be used as a composite tissue flap, including a portion of the radius, and it has also been shown to tolerate prefabrication.[3–5] Because it is thin and pliable, it is ideal for intraoral defects. Its greatest detraction has always been with problems at the donor site. But most of these problems fall into two categories—the controllable and the uncontrollable.

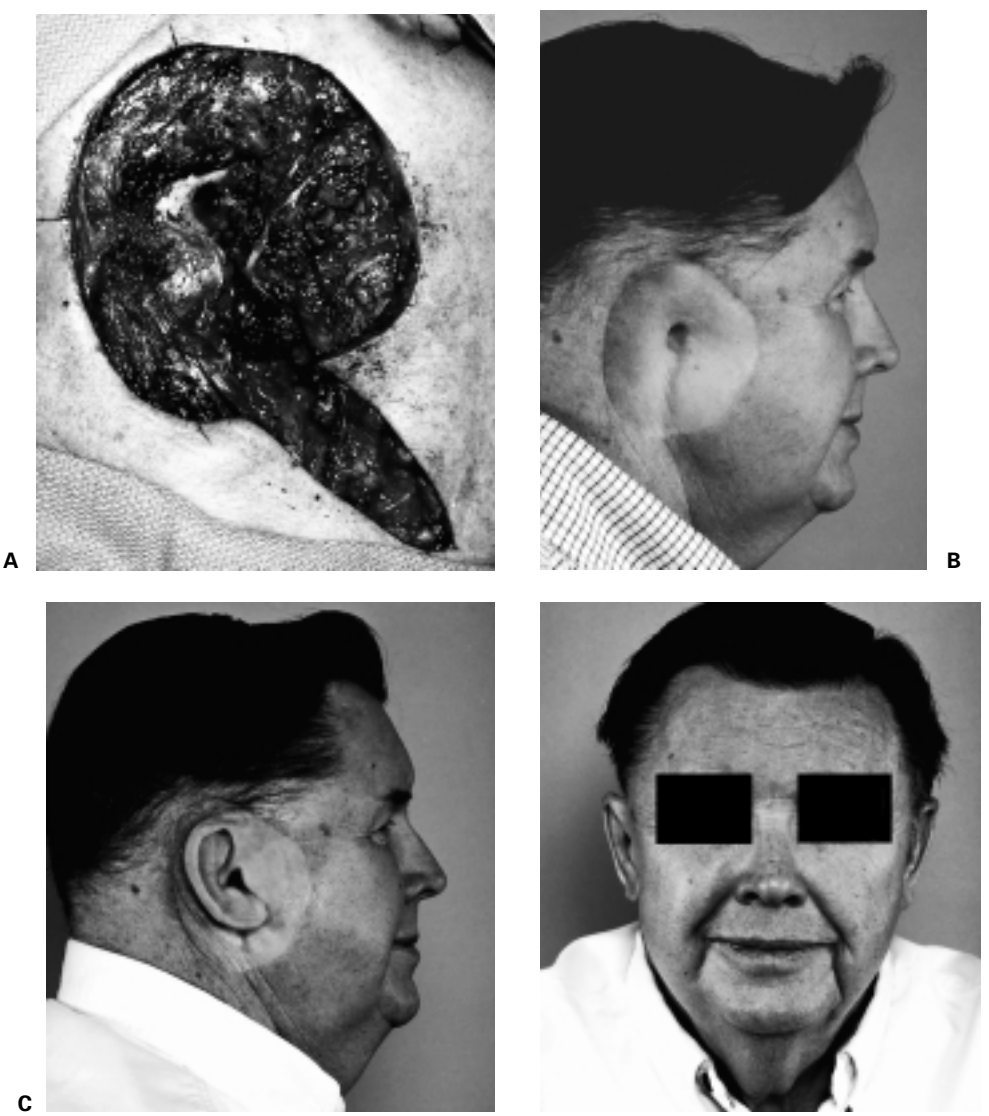

Figure 1 A, Surgical defect. B, Postoperative result. C, Sideview, postoperative result with prosthesis. D, Frontal view, postoperative result with prosthesis.

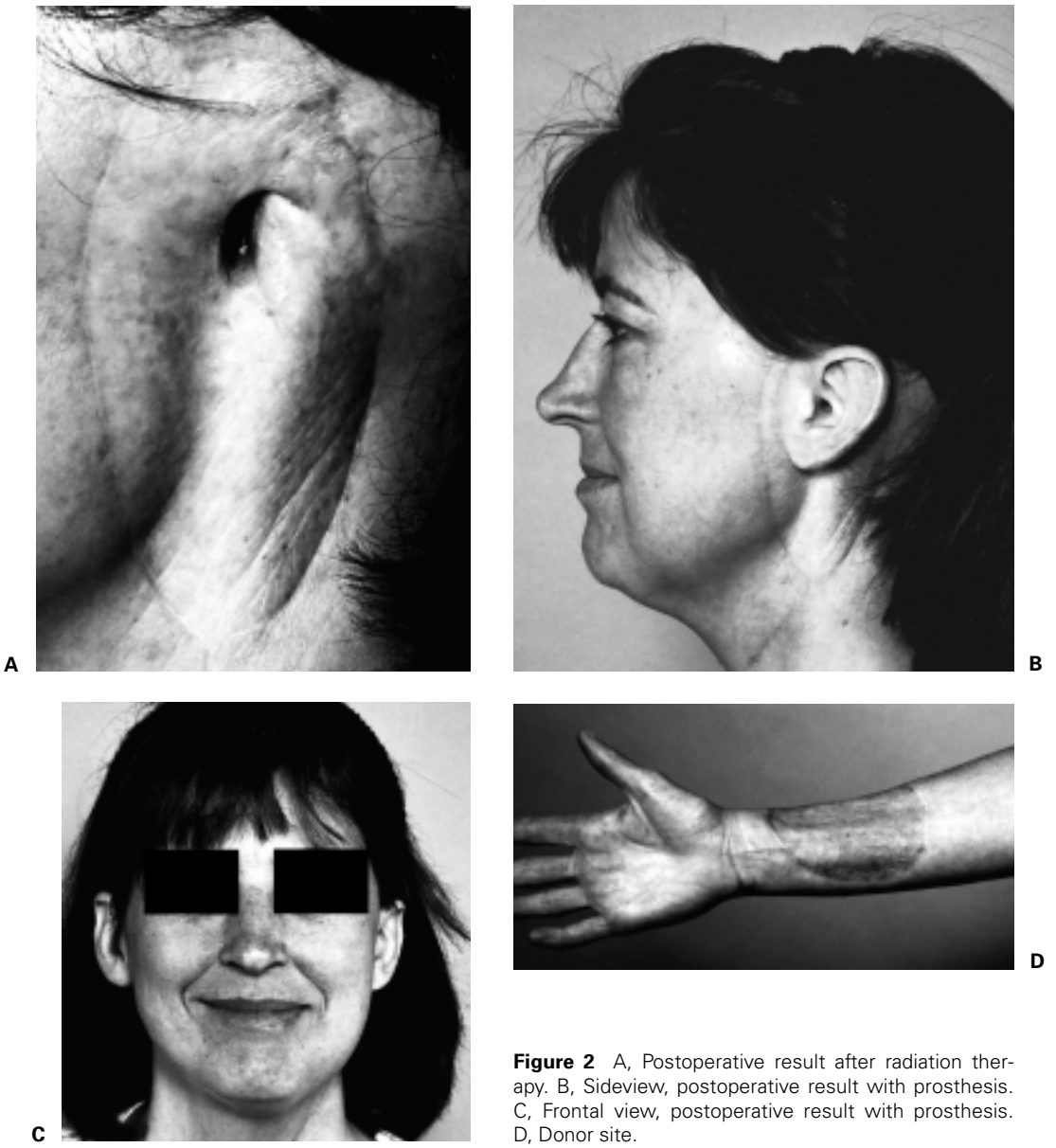

Figure 2 A, Postoperative result after radiation therapy. B, Sideview, postoperative result with prosthesis. C, Frontal view, postoperative result with prosthesis. D, Donor site.

Use of preoperative screening and an intraoperative Allen's test are essential prior to the harvest of the radial forearm flap. Although there have been reports of hand ischemia with radial artery harvest, this has been unusual in our practice. When this problem is encountered on the Allen's test, it can be resolved with either radial artery reconstruction or the choice of another flap. An additional donor-site problem we have been able to control has been preservation of branches of the radial sensory nerve. With careful sharp dissection on the radial border of the flap, these nerves are readily identified in the subcutaneous fat and can be preserved in the arm without compromise of the flap. With preservation of an adequate peritenon on the tendons, and keeping the exposed tendons moist throughout the procedure, we have been able to virtually eliminate postoperative tendon exposure as a complication of this harvest. Rarely, if ever, do we need to roll some of the superficialis muscle over the tendon to help a better support of a skin graft.[6] If the palmaris tendon is bowstringed across the donor site, we will often sacrifice it, rather than have an essentially functionless tendon disrupt the smooth contour of the donor-site closure. Using a pursestring stitch around the edges of the donor site, we found it helpful to restore normal skin tension and to narrow the defect down to its actual size. Our dermatomes are reliably able to harvest split-thickness skin grafts at .013 inch, but if we were to err, we would err on the thicker side of skin grafts for this area. The thicker flaps do improve the aesthetic result.

The unfortunate consequence of this harvest that cannot be controlled by meticulous operative technique

is the aesthetic result. A split-thickness skin graft on the forearm, which is in an exposed area, is conspicuous. A fair amount of our preoperative discussion is done to prepare patients for the fact that a patch of skin will be applied to their arms and, at very best, will always be noticeable as a patch. We can offer serial excision or tissue expansion to help minimize the defect to a linear scar, but none of these patients in this series have elected any further treatment.

Outstanding ear reconstructions have been achieved in cases of congenital absence of the ear.[7] In the situation we describe, where the ear has been removed for malignant tumor, the tissues for reconstruction are less than optimal. Another consideration is that the pathology involved in many of these patients precludes long-term survival, and thus a multi-stage reconstruction. By providing a durable and reliable skin coverage in this area, we have been able to replace the ear with a prosthesis. Up to this point, we have used adhesive prosthetics, although osseointegrated implants could be considered. With a combination of a well-made prosthesis and some cover makeup to transition the color changes in the skin, we have been able to achieve reasonable and, most important, socially acceptable results.

Complete extirpation of the auricle with surrounding tissue creates a rather unique defect. Requirement for coverage of the temporal bone with reliable vascularized tissue is of primary importance. The thin, pliable, radial forearm flap is able to provide soft-tissue coverage without adding to the aesthetic contour defect. Additionally, the radial forearm flap is extremely reliable and can tolerate an opening through it to accommodate the external auditory meatus. This is essential in allowing the patient to continue to have stereo hearing, as the remainder of the hearing apparatus is intact. In our experience, the radial forearm flap has held up well after radiation therapy, and it creates a stable platform.

In conclusion, we think the unique reconstructive requirements after loss of the auricle are met by this reconstruction. We have been able to reliably fill the soft-tissue defect. In all cases, the external auditory meatus was able to be maintained through the flap. The contour of the lateral side of the face is maintained and allows for application of a prosthetic ear. This reconstructive sequence should be considered, when ablative tumor surgery requires removal of the ear and the surrounding skin.

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