TABLE. Summary of Branch Facial Nerve Palsy After Superficial Temporal Artery Biopsy Cases: Current Study and Previous Reports

Patient	Age (Years)	Sex	Site of Biopsy	Surgeon Specialty	Follow-up	Recovery
1	78	M	Temporal	Ophthalmology	1 month	None
2	60	F	Pre-auricular	Vascular surgery	5.5 years	10%
3	87	M	Temporal	Vascular surgery	9 months	75%
4	66	F	Temporal	Plastic surgery	9 months	None
Study mean	72.8				1.8 years	
Slavin 1986	55	F	Temporal	Not listed	6 month	70%
Bhatti 2000	63	F	"Temporal scalp region"	General surgery	1 month	None
Bhatti 2001	75	M	Temporal	General surgery	6 months	None

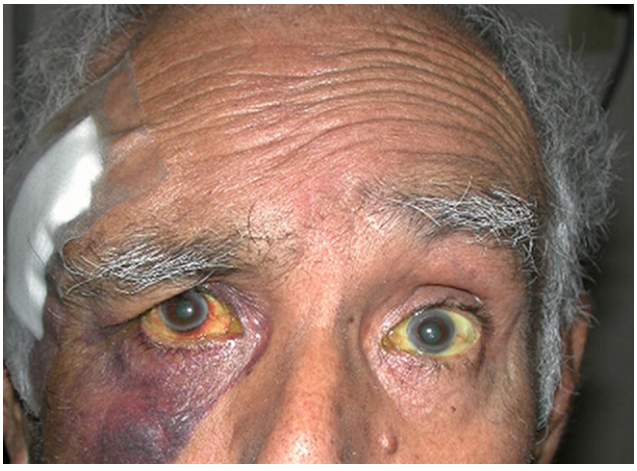

FIGURE 1. Patient 1 demonstrating right frontalis palsy after superficial temporal artery biopsy. The biopsy site in the pretrichial region is covered by the bandage.

Three previously reported cases were identified with review of the literature and were included in the Table for comparison. Including these patients in our series gave a total of 7 patients (3 male, 4 female, mean age 69.1 years, range 55 to 87 years). Recovery of function ranged from zero to 75 percent.

DISCUSSION

LITTLE ATTENTION HAS BEEN GIVEN TO THE POTENTIAL consequences of superficial temporal artery biopsy, since most physicians believe that complications are rare and inconsequential. Reported complications include visible scarring, hematoma, wound infection and dehiscence, skin necrosis, and the most severe, a cerebral infarction, presumably attributable to dependent collateral blood flow to the brain via the superficial temporal artery.[1–3,7]

Facial nerve injury has been previously reported as a consequence of superficial temporal artery biopsy.[4–6] In each of the 3 cases, operative notes describe technical difficulties with the procedure. One report noted the dissection to be "more extensive than usual," another

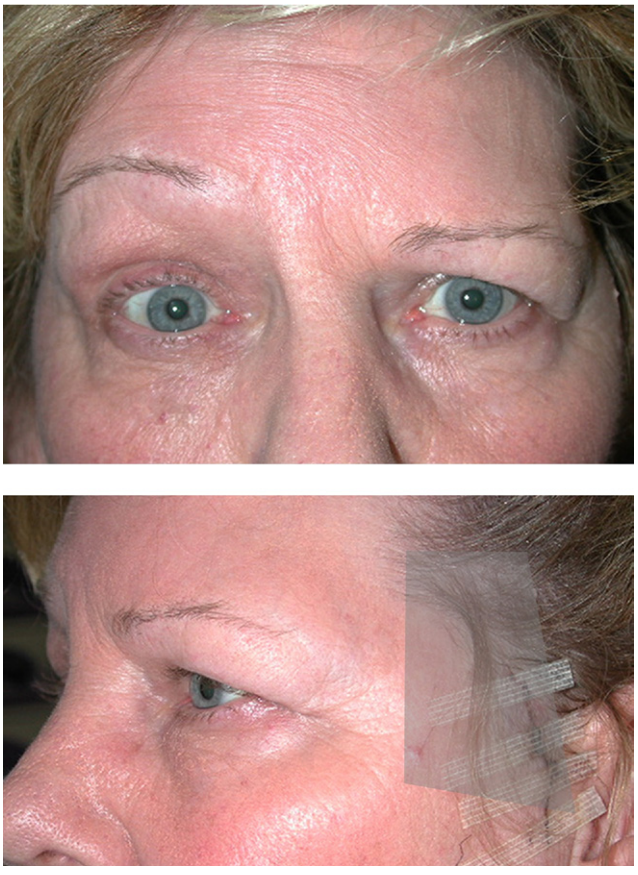

FIGURE 2. Patient 2. (Top) Patient 2 demonstrating left frontalis palsy after superficial temporal artery biopsy. (Bottom) The shaded area delineates the "danger zone." Adhesive tape covers the preauricular incision.

required 2 separate incisions, while the third described difficulty attributable to "the nature of the tissues." Furthermore, the incision was made within a few centimeters of the lateral orbital rim.

The incidence of facial nerve trauma during superficial temporal artery biopsy is not known, although it is presumed to be quite rare. Guffey Johnson and associates found 1.25 percent of specimens submitted as temporal artery biopsy contained vein or peripheral nerve (presum-

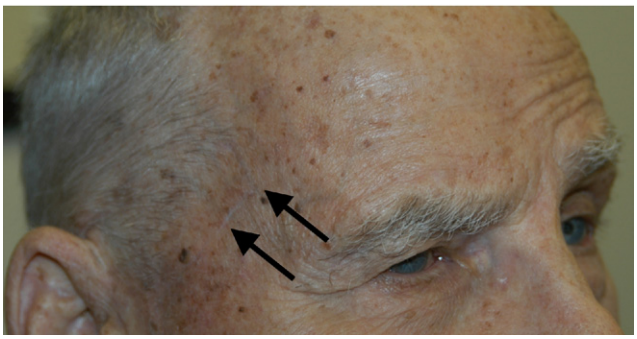

FIGURE 3. Patient 3 demonstrating right frontalis palsy after superficial temporal artery biopsy. Arrows denote the healed pretrichial incision site.

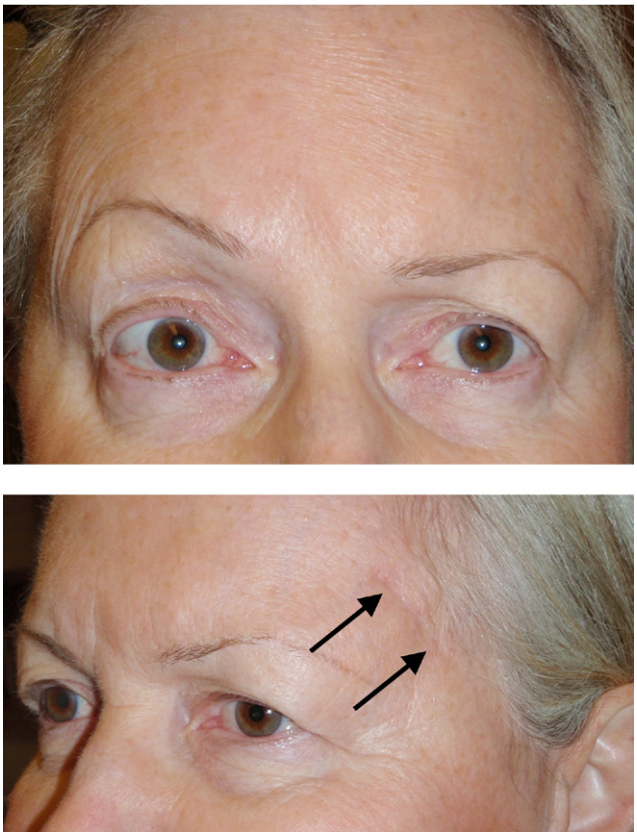

FIGURE 4. Patient 4. (Top) Patient 4 demonstrating left frontalis palsy after superficial temporal artery biopsy. (Bottom) Arrows denote the healed pretrichial incision site.

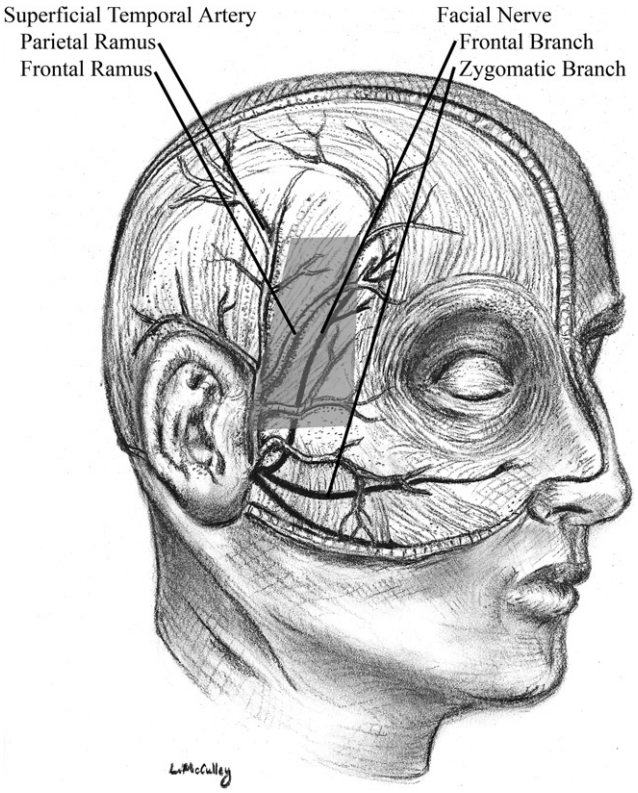

FIGURE 5. Schematic of the course of the superficial temporal artery and facial nerve. The artery typically bifurcates into an anterior frontal branch and posterior parietal branch. The temporal branch of the facial nerve courses deep to the superficial temporal fascia within the "danger zone" (shaded gray). The more posterior parietal branch of the superficial temporal artery, rather than frontal branch, therefore provides a readily accessible and safer biopsy location. (Illustration courtesy of Lynda McCulley, PharmD).

ably sensory), rather than a muscular artery.[8] The functional consequence of this was not provided. This finding stresses the potential difficulty accurately distinguishing the artery intraoperatively.

Recovery of frontalis function after biopsy-related injury was variable. In our series, 3 patients were followed for 9 months or more. Of these, 1 reported 75% recovery, 1 reported 10% recovery, and the other had no return of facial nerve function. The patient who was observed for only 1 month had no return of function, but that time interval is too brief to draw any conclusions. The variability of recovery is consistent with previously published reports, which spanned from zero to 70 percent return in function.[4–6] The degree of recovery likely relates to the exact mechanism of injury. Inadvertent cautery or stretching of the nerve would seem more likely to produce transient or partial injury, whereas in those with complete and permanent injury, the nerve was likely severed. Admittedly, this is speculative as no surgeon acknowledged awareness that the nerve was injured intraoperatively.

Immediately anterior to the tragus, in the preauricular region, the branches of the facial nerve run deep to the parotid gland. The frontal branch crosses the zygomatic arch approximately 2.5 cm anterior to the tragus, heading in a superoanterior direction. At this level, branches of the facial nerve run in the innominate fascia, a fibro-fatty layer deep to the superficial temporal fascia, for

a distance of 1.5 to 3.0 cm. Then, as the nerve continues superiorly, it becomes superficial and courses immediately deep to the superficial temporal fascia[9] (Figure 5). In the pretrichial temple, anterior to the hair line, the nerve branch is approximately 0.9 to 1.4 cm posterior to the lateral orbital rim. The nerve terminates by innervating the frontalis, orbicularis oculi, and corrugator supraciliaris muscles.

Similar to the facial nerve, the superficial temporal artery is deep to the auricularis anterior muscle in the preauricular area. After crossing the zygomatic arch, the artery runs within the superficial temporalis fascia. In the majority of patients, the superficial temporal artery branches into a frontal and parietal ramus approximately 2.5 cm superior to the zygomatic arch.[10] The frontal ramus of the artery travels anteriorly, deep to the pretrichial temple skin. However, the parietal ramus has a superior and posterior course relative to the tragus.

The "danger zone" was noted as an area of the temple where the frontal branch of the facial nerve and the frontal ramus of the superficial temporal artery are separated in depth only by a partial layer of fascia, the superficial temporal fascia. This area is bounded by (A) the tragus of the ear, (B) the junction of the zygomatic arch and lateral orbital rim, (C) the area 2 cm superior to the superior orbital rim, and (D) the point superior to the tragus and in horizontal alignment with (C).[11] The best strategy for avoiding damage to the nerve is to obtain a segment of the artery that is outside the "danger zone." Because of the potential for frontalis paresis, we prefer to biopsy the parietal branch if possible.

Some surgeons may elect to biopsy the frontal branch because of its readily identifiable location on hairless temple skin. The layer of subcutaneous fat is thinner than that overlying the parietal ramus, making the nerve more easily palpable. Underlying hairless skin, the frontal ramus is in fact visible in many patients. The added thickness of the subcutaneous fat and the presence of hair make the parietal branch more challenging to locate. As advocated by others, we often use a handheld Doppler ultrasound to map the course of the artery.[12,13] Accurately plotting the course of the artery limits the need for extensive dissection, decreasing the risk of damage to the facial nerve. If the artery cannot be easily located, intraoperative ultrasound using a sterile sleeve over the probe can be helpful. The presence of hair is a deterrent in some surgeons' opinion. We routinely shave the hair overlying the parietal ramus. Using an electric razor, this takes less than a minute. An added benefit is that any resulting scar is not visible once the hair has regrown. By shaving the surgical region, and identifying the artery with Doppler when necessary, the parietal ramus can be easily biopsied.

Rarely, when biopsy of the frontal branch of the superficial temporal artery is necessary (because of palpable nodules within the artery,[14] previous parietal ramus biopsy, or essential cerebral collaterals based on angiography[15]), injury to this area may be minimized by carefully identifying the artery of interest, using Doppler ultrasound if necessary. Meticulous surgical technique should be employed, maintaining hemostasis to allow for complete visualization of tissues and judicious blunt dissection without penetrating the superficial temporalis fascia.

Studies specifically addressing the relative sensitivity of biopsies obtained from the temporal and parietal branches of the superficial temporal artery have not been performed. However, GCA is a systemic process and pathologic evidence of inflammation has been demonstrated in numerous locations, including the occipital artery,[16] facial artery,[17] and arteries of the internal carotid circulation.[18,19] Therefore there is no reason to think that biopsy of the parietal branch is any less useful in assessing the presence of GCA than its anterior counterpart.

This study is limited by biases inherent to all retrospective studies. For example, the severity of injury may be exaggerated. Patients with less severe injury who enjoy a complete recovery might be less apt to be referred and therefore go undetected. Also, measurement of the degree of recovery is not precise and is based simply on clinical impression. Photographs taken at the time of injury and at the last follow-up visit were not consistently available and could not be assessed. Finally, given the tertiary referral nature of our practice, selection bias may have occurred.

Although rare, this potential complication should be considered when recommending a superficial temporal artery biopsy. Surgeons can minimize the risk with proper surgical site selection and knowledge of the relevant anatomy.

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