Variability of the Postauricular Muscle Complex

Analysis of 40 Hemicadaver Dissections

Aldo Benjamin Guerra, MD; Stephen Eric Metzinger, MD; Rebecca Crawford Metzinger, MD; Chen Xie, MD; Yue Xie, MHA; Peter Lister Rigby, MD; Thomas Naugle, Jr, MD

Background: The postauricular area is often explored by reconstructive and otologic surgeons. We previously reported on the use of postauricular tissues as a graft for wrapping hydroxyapatite implants in orbital reconstruction. This procedure reduced the incidence of implant exposure, while achieving acceptable cosmetic results. Although much is known about the postauricular area, muscle and fascial relationships and potential variations in anatomy remain ill defined.

Objectives: To identify and analyze variations in the patterns of the postauricular muscle complex (PMC) and to study the relationships of the fascial contributions from the components that make up the PMC.

Methods: Dissections were performed using 40 fresh specimens. Muscular and fascial components of the PMC were dissected, analyzed, and photographed.

Results: The PMC receives contributions from the occipitalis and trapezius muscles, the deep temporal and sternocleidomastoid fasciae, and the superior and posterior auricular and platysma muscles. Major contributors to the PMC were present in every specimen. Minor contributors were more variable in their presence and contributions. The posterior auricular muscle was identified as having several muscle bundles in 1 specimen and absent in 2 specimens (5%). The occipitalis fascia was seen to insert superior to the auricle and to blend with the deep temporal fascia in 3 cases (7%). The platysma muscle contributed to the PMC in 8 cases (20%).

Conclusions: This study demonstrated important variations in the presence and contributions of 7 previously known muscular structures and their role in forming the PMC. Seven distinct patterns are identified, and the potential clinical implications of these anatomical variations are illustrated.

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The postauricular area is frequently in clinical practice for otologic, reconstructive, and aesthetic purposes. Important structures in this area include the trapezius, occipitalis, and extrinsic auricular muscles and the temporalis and sternocleidomastoid fasciae. Investigators in previous studies have found these structures to be reliable. However, descriptions of potential anatomical variations and the relationships that these musculofascial structures share with each other have not been fully elucidated. Anatomical variations in the postauricular area may alter the results and design of vascularized flaps and musculofascial grafts harvested from this area. Also, these variations could have clinical implications in otologic and otoplastic surgery.

Vascularized tissue transfers from the postauricular area have various applications in reconstructive surgery. As with any other part of the body, a sound understanding of the anatomy of the postauricular area is necessary to ensure that such transfers are safely carried out. Retroauricular grafts, on the other hand, can be used as alternatives to vascularized tissue, depending on recipient site requirements. For instance, small retroauricular grafts have been used successfully in lip augmentation. Also, agenesis, hypoplasia, neuromuscular dysfunction, and proximal insertion of the posterior auricular muscle have been implicated in the etiology of protruding ears. Similarly, it has been suggested that absence of the superior auricular muscle plays a role in the pathogenesis of lop ear. Potential therapeutic maneuvers in the treatment of the protruding ear are likely to be influenced by the underlying surgical anatomy.

Methods

Forty fresh hemicadaver heads were used in this anatomical study. To standardize the experiment, 1 surgeon (C.X.) performed all the dissections. Photographs were obtained using a 35-mm camera with a 105-macro lens for all specimens. Distance and lighting were standardized in all cases. The ethnicity and sex of
the specimens were recorded. Incisions were made along the postauricular crease starting 3 mm above the auricle. Two horizontal incisions were extended from the superior and inferior aspect of the auricle to facilitate elevation of the skin–soft tissue envelope. The skin and subcutaneous tissues were dissected from the underlying muscular and fascial structures and the cranium. Each hemicadaver dissection was plotted to document the different patterns of muscle and fascia contributing to the postauricular muscle complex (PMC).

**RESULTS**

Twenty male and 20 female hemicadaver heads were dissected. One female specimen was Hispanic, and 1 male specimen was African American. The rest of the specimens were white. In all specimens, the PMC was found to have contributions from the occipitalis muscle, trapezius muscle, temporalis fascia, and sternocleidomastoid muscular fascia. These 4 musculofascial components were considered to be the major contributors to the area. Minor contributors to the PMC were the posterior auricular, superior auricular, and platysma muscles. The minor contributors were muscular and did not contribute significant fascial components to the PMC. The greatest variability occurred as a result of the presence or absence of minor contributors and occipitalis muscle-fascial components. Interestingly, all these muscle groups are located more superficially in the retroauricular area and in the same plane as the superficial musculoaponeurotic system and platysma of the face. The platysma muscle contributed to the PMC only 20% of the time. The superior auricular muscle was present in 35 specimens (88%), and the posterior auricular muscle was present in 38 specimens (95%). Also, 4 separate muscular bundles were seen in 1 posterior auricular muscle specimen. The occipitalis muscular fascia extended anteriorly to cover the temporalis fascia in 3 cases (7%).

We classified the patterns into 7 distinct types as follows:

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<thead>
<tr>
<th>Type</th>
<th>No. (%)*</th>
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<tbody>
<tr>
<td>1</td>
<td>27 (68)</td>
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<tr>
<td>2</td>
<td>7 (18)</td>
</tr>
<tr>
<td>3</td>
<td>1 (2)</td>
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<td>4</td>
<td>1 (2)</td>
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<td>5</td>
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<td>6</td>
<td>2 (5)</td>
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<td>7</td>
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*Percentages do not total 100 because of rounding.

In type 1, which was the most common pattern seen (68%), the specimens contained the 4 major contributors: the occipitalis and trapezius muscles, the temporalis and sternocleidomastoid fasciae, and the extrinsic auricular muscles without platysma (Figure 1). In type 2, which was the second most common pattern seen (18%), the specimens contained all the major and minor contributors (Figure 2). In type 3, the specimen contained all the major and minor components except for the superior auricular muscle (Figure 3). The type 4 specimen contained all the major contributors, with the posterior auricular muscle being the only minor contributor (Figure 4). The type 5 specimen lacked all 3 of the minor contributors, with the occipitalis muscular fascia extending forward to the superior point of the auricle and blending with the temporalis muscle fascia (Figure 5). In type 6 specimens, the posterior auricular muscle was found along with the anterior occipitalis muscular fascial extension that
blends with the temporalis fascia (Figure 6). The type 7 specimen contained all the major contributors, with the superior auricular muscle being the only minor contributor (Figure 7).

**COMMENT**

The occipitalis, trapezius, sternocleidomastoid, and auricular muscles have previously been described as being significant components of the PMC. Our study demonstrated that 7 structures can contribute to the PMC. In our study, the major contributors to the PMC, which were present in every specimen, were the occipitalis and trapezius muscles and the temporalis and sternocleidomastoid fasciae. Partial absence of the trapezius muscle has been reported but is thought to be extremely rare. The trapezius and sternocleidomastoid muscles arise from a common premuscle mass during gestation, and there have been re-
ports of anomalies within these muscles\textsuperscript{15-17}. The fascial provisions of the major contributors to the PMC were noted to be strong, reliable, and capable of holding sutures. The presence and components of the minor contributors to the PMC were more variable than those of the major contributors. In the group of minor contributors, the muscle found most consistently was the posterior auricular muscle, which was present in 38 (95\%) of the 40 cases. The extrinsic auricular muscles have been well documented\textsuperscript{3-5}. The posterior auricular muscle has been described as a double-bellied flat muscle with an intervening ligament\textsuperscript{2}. In 1 specimen, this muscle was identified as having 4 separate bundles. Similar variations have been observed by others\textsuperscript{7}. Also, the minor contributors to the PMC were found to be completely absent in 1 case (type 5). The anterior fascial extension of the occipitalis muscle to the temporalis fascia served to replace these components. In 1 case, extension of the occipitalis muscle fascia occurred concurrently with a posterior auricular muscle (type 7).
Absence or dysfunction of auricular muscles has been implicated in the pathogenesis of certain ear deformities. Of note, none of our cadavers was found to have abnormalities of the external ear, implying that despite variations, patients may not manifest obvious deformities of the auricle. Based on our dissections, it appears that other structures involved in the PMC can compensate for the deficient extrinsic muscles (types 5 and 7). The etiology of protruding and lop ears is multifactorial, although intrinsic and extrinsic auricular muscles play major roles in the ultimate shape and position of the auricle. Functionally, in vertebrates, postauricular muscles are used to identify potential mates and predators, as well as in fight-or-flight reflexes. In humans, extrinsic muscles respond to sound stimuli when studied with electromyographic techniques and maintain involuntary function. There is a linear relationship between ear projection and insertion site of the posterior auricular muscle.
in patients with and without protruding ears.\textsuperscript{18} However, Furnas\textsuperscript{26} and Mustarde\textsuperscript{20} recommend resection of the posterior auricular muscle in correction of the prominent ear. An alternative reconstruction for protruding ears involves transposing the insertion of the posterior auricular muscle onto the concha.\textsuperscript{21} In principle, this technique corrects valgus of the concha and underfolding of the antihelix. Azad et al\textsuperscript{22} have combined transposition with anterior conchal scoring and concha-mastoid sutures. Anterior transposition of the posterior auricular muscle has been found to be a useful adjunct in our hands. Patients with patterns 5 and 6 are not candidates for transposition because they lack a posterior auricular muscle.

Use of the retroauricular fascial layer in transfer of vascularized tissues for various reconstructive procedures has been reported.\textsuperscript{23-25} Clearly, a thorough knowledge of the vasculature of these flaps is important for successful flap transfer.\textsuperscript{26-28} However, based on our findings, we estimate that retroauricular fasciae and its variations play a significant role in providing an additional margin of safety in flap transfer. This margin of safety is evident in clinical reports, which use fasciae to carry random-pattern or axial circulation to skin components.\textsuperscript{29-30} To access the vessels and to free the deeper (temporalis) fascia, which carries the flap, the more superficial structures must be divided, as previously described.\textsuperscript{31} If the superficial anatomy of the retroauricular area is aberrant, the flap vasculature may be damaged during surgery, as the appropriate dissection plane may be difficult to identify. Venous insufficiency is also related to the underlying muscle and fascial anatomy as well as to greater anatomical variability of veins.\textsuperscript{32} Although we did not specifically describe the relationships between the PMC and the venous drainage, we believe that the fascial structures and their variations play an important role in dissipating venous congestion. Several authors have already recommended widening the amount of fascia harvested to increase venous drainage.\textsuperscript{33,34}

The retroauricular fascia can also be extremely useful as a graft. While variations do exist, the fascial layer is consistently thick enough to provide for a durable graft.\textsuperscript{35-37} The PMC fascia grafts are important in challenging situations, such as the wrapping of hypodermatite spheres in postenucleation socket reconstruction. Long-term follow-up has demonstrated the reliability of this technique.\textsuperscript{38} As substitutes for other tissues, postauricular fascia grafts are thought to be superior alternatives to dermal fat grafts and superficial musculoaponeurotic system grafts in cosmetic lip augmentation.\textsuperscript{39} Retroauricular fascia is thicker and sturdier than both dermal fat grafts and superficial musculoaponeurotic system grafts and seems to resist the dynamic forces of the orbicularis oris muscle.\textsuperscript{40} Other authors have used the strong fascial layer for placement of sutures in otoplasty, with great reliability.\textsuperscript{41}

We used fresh human cadavers to study the variations and relationships of the muscular and fascial components of the PMC. Our findings were obtained from a small sample size, primarily elderly whites. Different ethnic groups may display patterns that are different from those observed in the present study. Knowledge of these anatomical variations can help in the planning and safe transfer of vascularized tissue, in maneuvers for aesthetic and reconstructive otologic surgery, and in providing strong and reliable grafts in restoration of the globe. Further study is needed to fully understand the relationship of the variations described and their potential effects on flap complications.

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Correspondence: Aldo Benjamin Guerra, MD, Aesthetic Surgical Associates, 3939 Houma Blvd, No. 216, Metairie, LA 70006.

\textbf{REFERENCES}