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Review Article

Auricular trauma: A review

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ABSTRACT:
When viewed from the aesthetic aspect, the external ear is unique in its own way. And this external ear is the most frequently involved structure that is being affected in facial trauma. Accidental injury of the auricle occurs in all age groups, but people participating in high-risk activities such as wrestling, boxing and football players are more prone to ear injury. The auricle or pinna is a flattened, irregular, ovoid structure which is the external expansion of the cartilaginous canal. The complicated shape of the auricle is due to its irregular plate of elastic cartilage which is 0.5 to 2 mm in thickness. Different classifications of auricular trauma are described in the literature. Some are related to specific causes of injury (eg, sharp or blunt trauma, burn, chemical burn); others consider anatomic landmarks of the ear and the nature and extent of tissue trauma or tissue loss. The principles of reconstruction remain with using the simplest and most reliable methods to reproduce an auricle that has strong structural support and is aesthetically inconspicuous. Techniques vary and the surgeon should be facile in a number of repairs that best suit the specific defect and patient. There are many different reconstructive options when managing a patient with auricular trauma. The decision regarding reconstruction should be based on the nature of the injury, the blood supply to the avulsed segment, and the stability of the patient. Extensive injuries often involve multistage procedures for optimal repair. Primary repair should be attempted if the avulsed segment is attached by a wide pedicle.
Keywords: Ear, trauma, auricle, laceration

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INTRODUCTION

The external ear (auricle) is unique in its aesthetic role where the normal auricle often goes unnoticed; yet even a small irregularity can stand out and become conspicuous. Injury to the ear is not an unknown subject. The auricle's exposed position on the head predisposes it to many soft tissue injuries.[1]Trauma to the auricle may result in laceration to partial or complete loss. Accidental injury at home or on the roads is the commonest cause followed by assault bullet injury, frost bite, burns, animal bites etc. Accidental injury of the auricle occurs in all age groups, but people participating in high-risk activities such as wrestling, boxing and football players are more prone to ear injury.[2] Accidental injury in a child without a confirmed history of trauma should raise, question of possible child abuse. Severe auricular trauma, especially complete amputations, is a rare injury. To date, less than 100 of these have been reported in the literature. [3]

The localization of the defect, its extent, and the condition of the tissue surrounding the defect are essential criteria for treatment planning. If not properly managed at the time of initial insult, these injuries can be disfiguring for patients and may require multiple procedures for repair. A thorough understanding of the anatomy and histology of the ear, as well as a standardized way of approaching traumatic injuries to this region, can minimize future cosmetic deformities.[4]

ANATOMY

The auricle or pinna is a flattened, irregular, ovoid structure which is the external expansion of the cartilaginous canal. The complicated shape of the

auricle is due to its irregular plate of elastic cartilage which is 0.5 to 2 mm in thickness. [5]

The skin over the lobule and the margin of the helix is fibro fatty and loose. The skin of the lateral surface is dense and attached to the perichondrium without any subcutaneous tissue. The skin on the medial surface on the other hand has subcutaneous tissue present. This allows greater mobility when excising skin on the medial surface as part of the resection or to serve as a donor graft. The elastic cartilage of the ear provides a structural framework that is flexible yet resilient. Certain parts of this cartilaginous framework are critical for maintaining structural support and proper contour, whereas other parts, such as the concha and triangular fossa, can be excised without significant deformity.[6,7]

Branches of the external carotid artery supply the auricle. The superficial temporal artery supplies the anterior and lateral portions of the auricle, and the postauricular artery supplies the medial and lateral surfaces of the auricle as well as the mastoid region. Branches of the occipital artery also contribute to the auricular blood supply.[8]

The sensory innervations of the auricle is diverse and provided by several nerves, including the auriculotemporal nerve, the lesser occipital nerve, the greater auricular nerve, auricular branch of the vagus nerve, and branches of the facial nerve.[9,10]

Other anatomic key aspects include:[11,12]

- Normal adult ear height ranges from 5.5 to 6.5 cm.
- The width of the auricle is 55% of its length.
- The vertical height of the auricle is approximately equal the distance from the lateral orbital rim to the root of the helix.
- The helix protrudes 1 to 2.5 cm from the skull with an angle of 25 to 30 degrees (1.5 to 2 cm and 15 to 20 degrees3).
- The superior aspect of the ear is at the level of the tail of the eyebrow or upper eyelid.
- The auricle is tilted posteriorly 20 degrees and is parallel to the dorsum of the nose.

Figure 1 Basic ear landmarks. The first line defines the oval shape of the ear. The second line defines the helical rim from its root and crus helicus. The third line defines the concha, antitragus, and tragus. The fourth line highlights the fossa triangularis.

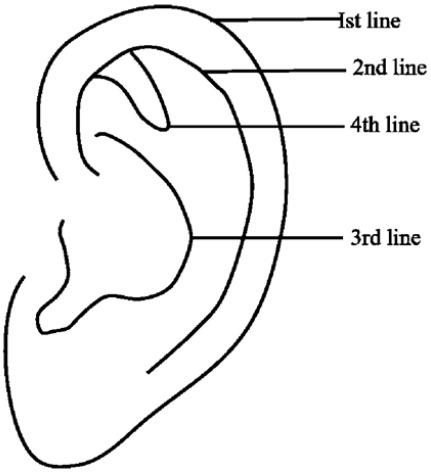


Figure 2 Anatomical subdivisions of the pinna.

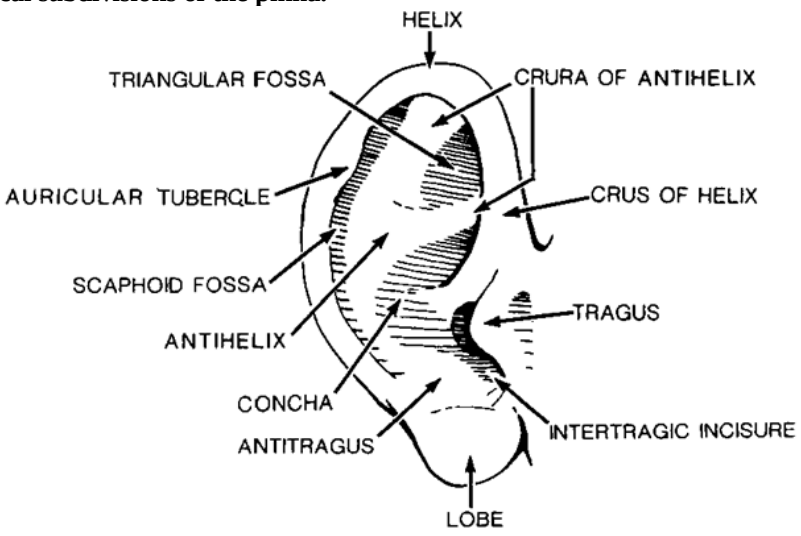


Figure 3 Position, orientation, and dimension of a normal ear

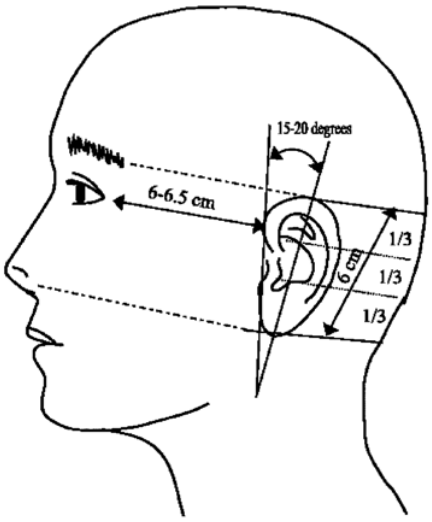


Figure 4 Sensory nerves of the external ear: medial (posterior) surface. (Adapted from Glasscock ME, Shambaugh GE. [1990]. Surgery of the Ear. 4th ed. Philadelphia: WB Saunders, 37.)

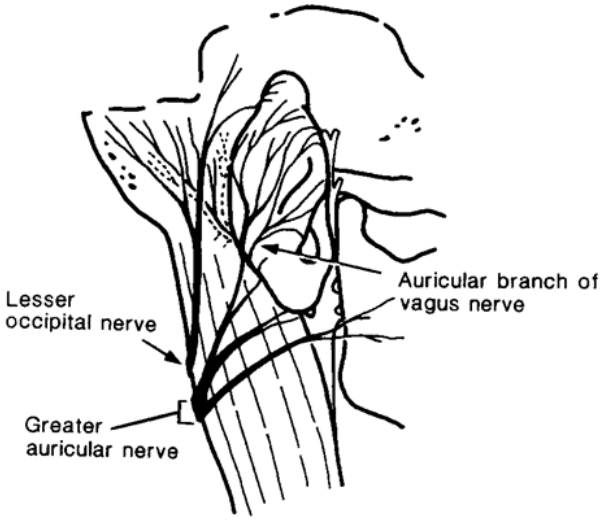


Figure 5 Sensory nerves of the external ear: lateral (anterior) surface. (Adapted from Goycoolea MV, Paparella MM, Nissen RL. [1989]. Atlas of Otologic Surgery. Philadelphia: WB Saunders, 9.)

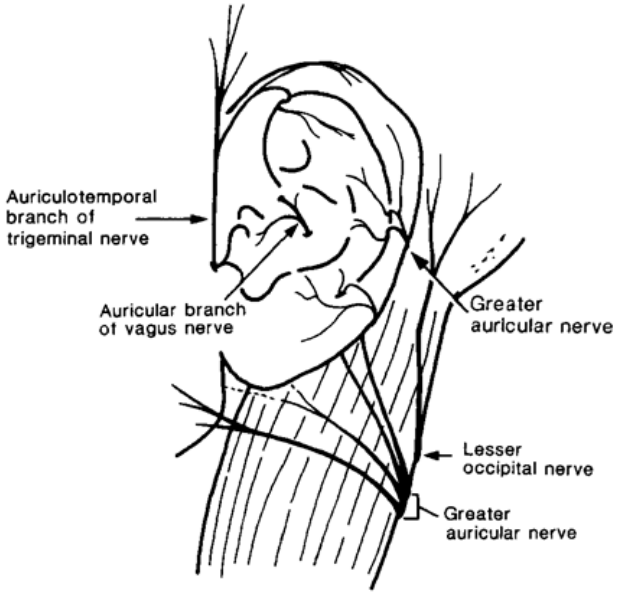
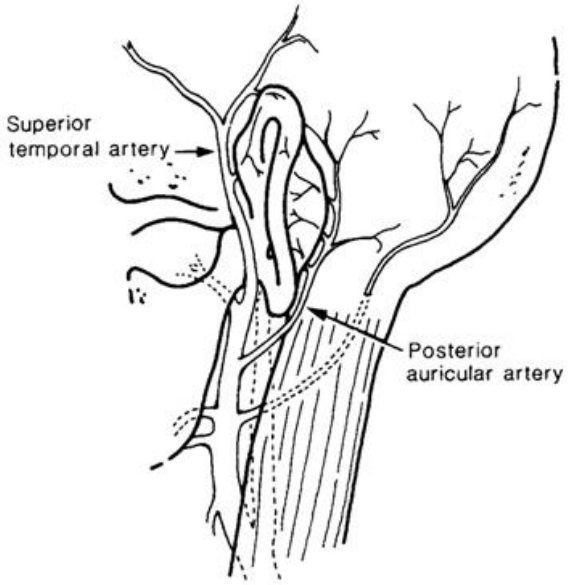


Figure 6 Major arteries of the pinna. (Adapted fromMiyamoto RT, Miyamoto RC. [1995]. Pathology of the earcanal. In: Ballachanda BB, ed. The Human Ear Canal. San Diego: Singular Publishing Group, 64.)



CLASSIFICATION OF AURICULAR TRAUMA

Different classifications of auricular trauma are described in the literature. Some are related to specific causes of injury (eg, sharp or blunt trauma, burn, chemical burn); others consider anatomic landmarks of the ear and the nature and extent of tissue trauma or tissue loss. For clinical aspects Weerda's classification into four degrees of injuries3 has proved to be very useful (Table 1).[13]

Classification of auricular trauma according to Weerda[13]	
First degree	Abrasions without significant cartilage involvement
Second degree	Tear with nutrient skin pedicle
Third degree	Avulsion without segmental loss: Partial avulsion Total avulsion
Fourth degree	Avulsion with segmental loss: Partial defect Total auricular loss

SUPERFICIAL TRAUMA (FIRST DEGREE)

These cases are characterized by abrasions without or only a little cartilage involvement. The wounds are rinsed and the wound edges adapted and carefully sutured. Small defects are closed with small local skin flaps.

TEAR WITH NUTRIENT SKIN PEDICLE (SECOND DEGREE)

Primary readaptation of the partially amputated part of the auricle is the best solution in these cases (Fig. 1). Because of the excellent vascular supply of the auricle with many branches communicating with each other, even subtotal amputations with a very narrow skin pedicle (6 mm in width) can be reconstructed successfully.

PARTIAL AND TOTAL AVULSION WITH EXISTING SEGMENT (THIRD DEGREE)

The success of a classic replantation as a composite graft is particularly dependent on the size of the amputated auricle segment and on the associated size and surface of the nutrient base. However, the ischemic time of the amputated segment, which usually amounts to less than 4 to 6 hours,[10] can almost be neglected based on animal studies by Weerda and colleagues[13] and does not influence the success or failure of a direct replantation as a composite graft, even in microsurgical replantation.[7,8] Direct reattachment as a composite graft can be achieved when the amputated part is smaller than 15 mm in diameter.

A direct readaptation of larger segments is rarely successful (Fig. 2). Therefore, multistage so-called pocket methods have been suggested. Their common characteristic is that the skin of the amputated auricle is in part or completely removed from the cartilage. The cartilage itself is then stored in a well-vascularised pocket, either in the ear region[15] or remote area (abdominal, supraclavicular, cervical).Other authors suggest repositioning of the cartilage and covering it with local skin flaps, with platysma, or with a temporoparietal fascia flap.

Another technique to salvage and reconstruct an amputated auricle has been described by Baudet and coworkers.[11] He removes the posterior skin of the

amputated auricle; creates little windows into the cartilage in the triangular fossa, scaphoid fold, and cavum conchae to allow an exposure and contact of the underside of the anterior skin to the vascularized bed; and replants it into its original position (Fig. 3). He leaves the anterior skin intact and sutured it to the mastoid skin. In a second step some months later, the auricle is lifted up and the retroauricular sulcus reconstructed with a skin graft.

The most important problem of all these techniques is a very high failure rate of about 60%.In addition, the delicate elastic cartilage is unable to withstand the contractile forces of scarring especially when using the pocket principle including its modifications. Because of distortion and flattening the contours of the auricular cartilage are lost in time so that the esthetic results are not convincing in a high number of cases.

In 1980, Pennington and colleagues[14] reported the first successful microsurgical replantation of an auricle using vein grafts to the superficial artery and vein. Compared with all other techniques microsurgical replantation offers the best chance for success and shows excellent aesthetic results. Nevertheless, microvascular replantation is very challenging, not only because of the small vessel diameter less than 1 mm. Depending on the type of injury, additional vessel damage by stretching and pressure may occur with an increasing risk of vascular complications, especially on venous congestion. A suitable vein cannot always be found in the amputated part, sometimes not even after successful arterial revascularization.In such cases and in cases of visible venous congestion it is essential to prevent or reduce a venous backflow problem using multiple skin punctures, stitch incisions, and leeches. Regarding several reports that venous connections between the replanted auricle and therecipient bed occur within a week after replantation, a venous drainage procedure should be performed during that time period. The technique by Baudet can be summarized as an appropriate second choice if a microsurgical replantation is not possible.[11,15] However, the pocket techniques should no longer be used.

PARTIAL AND TOTAL AVULSION WITHOUT EXISTING SEGMENT (FOURTH DEGREE)

Severe injuries to the auricular region with loss of the amputated auricle or auricle segment have to be covered by local skin flaps or free skin grafts. After some month's secondary reconstruction of the auricle can then be undertaken.

RECONSTRUCTION OPTIONS FOR INJURIES TO AURICLE

The principles of reconstruction remain with using the simplest and most reliable methods to reproduce an auricle that has strong structural support and is aesthetically inconspicuous. Techniques vary and the surgeon should be facile in a number of repairs that best suit the specific defect and patient.

- Primary closure: wedge, star-shape
- Grafts: full-thickness skin grafts, composite grafts
- Structural grafts: cartilage (autologous, homologous), PRF grafts, collagen membrane grafts (allograft)
- Regional cutaneous flaps: periauricular advancement, interpolation, and tubed flaps
- Local composite/chondrocutaneous flaps: helical rim, conchal
- Pedicle fascial flaps: temporoparietal fascial flap (TPFF)
- Prosthetic ear

CONCLUSION

There are many different reconstructive options when managing a patient with auricular trauma. The decision regarding reconstruction should be based on the nature of the injury, the blood supply to the avulsed segment, and the stability of the patient. Extensive injuries often involve multistage procedures for optimal repair. Primary repair should be attempted if the avulsed segment is attached by a wide pedicle. However, if the pedicle is narrow, a local advancement flap will likely be necessary. Completely avulsed segments require microvascular or pocket techniques for successful repairs. Postoperatively, all of these patients should be monitored closely and placed on antibiotics, given the propensity for infection, especially in dirty wounds such as human bites.

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