

Acute external ear lesions: clinical aspects, assessment and management

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Abstract. *Acute external ear lesions: clinical aspects, assessment and management.* We reviewed the literature concerning the assessment and the management of the external ear traumas, which is not very rich. Nevertheless, we outlined the practical attitudes in the four major conditions met: the auricular haematoma, the auricular perichondritis, the auricular laceration and auricular burns. All these pathologies must be promptly treated because there is a risk of perichondritis, which can destroy the cartilage and will result in a severely deformed ear.

Auricular haematomas must be drained as soon as possible, lacerations with exposed cartilage must be stitched urgently, and burnt ears should be washed, coated with alginates (Flaminal®) and covered with a loose dressing. Antibioprophylaxis should always be prescribed after a complete microbiological sampling.

Introduction

As with the nose, the ears are prominent parts of the head. This is why they are easily exposed to mechanical, thermic or toxic traumas.

Besides an aesthetical function, the extrinsic functions of the external ear are multiple:

- they amplify and direct the sound towards the external auditory canal
- they protect the middle ear

The external ear may be anatomically subdivided into two parts:

- the external auditory canal, which is composed of a lateral fibrocartilaginous portion and a medial bony portion

- the pinna (Figure 1 shows the anatomy of the external ear)

The sources of blood supply are connected to two major ramifications of the external carotid artery:

- the superficial temporal artery (STA)
- the posterior auricular artery (PAA)

The STA enters the helical root and continues along the margins of the helix, as well as communicates with the PAA, forming a helical arcade running along the helix, which may be used for microanastomosis to reconstruct an auricular avulsion. The perichondrium, which is adherent to the cartilage, supplies blood to the cartilage.

The venous drainage is doubled:

- the anterior one joins the superficial temporal vein

- the posterior one joins the posterior auricular vein and the superficial occipital vein. Both discharge into the external jugular vein.

The sensitive innervation is complex and depends on:

- the auriculotemporal nerve (from V3 cranial nerve)
- the great auricular nerve (from cervical plexus)
- the intermediate nerve of Wrisberg (from VII cranial nerve)
- the auricular ramification of the vagus nerve (from X cranial nerve)

The motor innervation relies on the facial nerve (VII cranial nerve).

In this chapter, we will develop four topics dealing with the diagnosis and management of auricular trauma in the emergency care unit:

- Part I: Auricular haematoma
- Part II: Auricular perichondritis
- Part III: Lacerations of the pinna and loss of auricular tissue
- Part IV: Burns of the external ear

General considerations

One crucial challenge in the management of external ear trauma is to prevent the evolution toward chondritis, which is an inflammation of the cartilage, in this case due to an infection. One first crucial step is to collect swabs for culture.

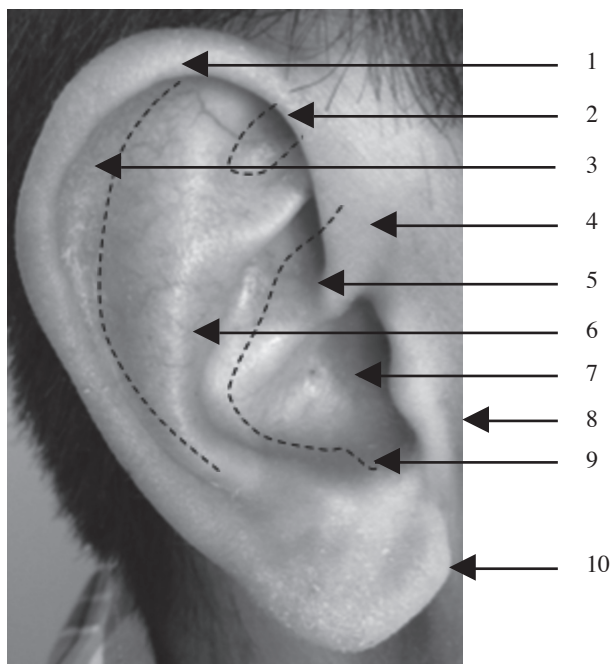


Figure 1

Anatomy of the pinna.

Legend:

- 1: helix
- 2: triangular fossa
- 3: scaphoid fossa
- 4: root of the helix
- 5: cymba concha
- 6: antihelix
- 7: concha cava
- 8: tragus
- 9: antitragus
- 10: lobule

Prophylactic antibiotic treatment (ciprofloxacin is a first choice to prevent infection with *Pseudomonas aeruginosa*) is generally necessary after a careful cleaning of the wound (see below for each type of traumatism). If a reconstruction is needed, the goal is to preserve the function and restore the anterior and lateral profiles. As for every human body wound, the tetanic vaccinal status should be checked and vaccination or immune globulins administered according to the history of tetanus immunization (see Table 1, Part IV: Lacerations of the pinna and loss of auricular tissue).

According to the Sanford Guide to Antimicrobial Therapy 2012-2013, the bacteria most often found in the external ear are *Staphylococcus aureus*, the *Enterobacteriaceae* group and *Pseudomonas aeruginosa*. If there is a history of water contamination (“swimmer’s ear”), the antibiotic should cover *Pseudomonas*, which means that an antipseudomonal agent has to be administered

(e.g., ciprofloxacin, 500 mg, twice a day for one week). In the other cases, amoxicillin-clavulanic acid is sufficient (500 mg, three times a day in our department, according to the infectiologists). The patient should present to an ENT department within 48 hours. In all cases, antibiotics should be adapted according to the result of the microbiological cultures and the antibiogram. Each time the cartilage is openly exposed, a general antibiotic prophylaxis is necessary to avoid a chondritis. If the only damage is a skin abrasion (e.g., lobule tear), a local antibacterial treatment (cream with fusidic acid, e.g., Fucidin®, provided by Leo) is enough.

Part I: Auricular haematoma

1. Aetiologies & physiopathology

The most common aetiology of auricular trauma is blunt force trauma, such as contact sport injuries (wrestling, boxing, mixed martial arts, football or rugby). Other origins are any types of assault where the ear is hit, traffic accidents or bullet injuries.

Trauma causes shearing forces that disrupt the adherence of the perichondrium to the underlying cartilage, especially anteriorly, where the skin is tightly fixed to the perichondrium. In the case of haematoma (Figure 2), the blood accumulates between the cartilage and the perichondrium, while the blood supply is interrupted and the underlying cartilage can undergo necrosis and become infected. If not treated, this leads to cartilage loss, fibrosis and neocartilage formation, ending up in a cauliflower ear (see Part II, Figure 6).

2. Management

To avoid local complications, drainage of the ear has to be undertaken as soon as possible. Proper management of acute haematoma refers to drainage and prevention of the reaccumulation of blood, so as to avoid later complications. Usually, the patient presents shortly after the trauma. If the accident happened less than 10 days before, drainage or aspiration can be carried out in the emergency room. If the patient shows up after 10 days, the case should be managed by a trained ENT or plastic surgeon because debridement of the fibrosis and the newly formed cartilage is mandatory.¹

The emergency procedure can be done under local anaesthesia. An auricular anaesthetic block is

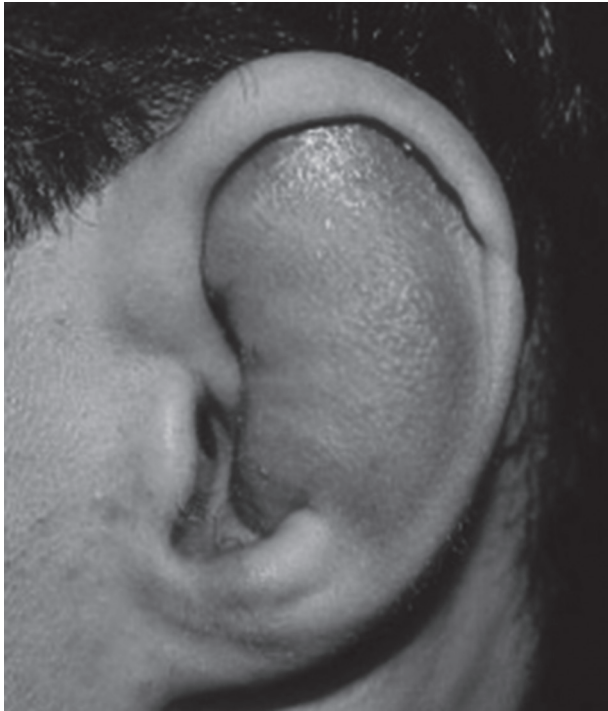


Figure 2.

Acute auricular haematoma of the left ear. Drainage should be performed as soon as possible to prevent infection, which ends in cartilage destruction and a cauliflower ear

easily performed with Xylocaine® (1% lidocaine and 1/100.000 epinephrine, Astra Zeneca) which can be injected directly into the area to be incised (Figure 3).

Drainage and complete evacuation of sub-perichondrial blood to relieve pressure are the two essential ingredients for successful treatment.^{2,3}

In this approach, different steps must be respected:

2.1. Incision and drainage

Incision has to be done along the natural skin folds to improve the cosmetic outcome. The haematoma has to be completely expressed or suctioned, as much as possible, without additional damage to the cartilage or the perichondrium. The empty space is washed out with a saline solution (0.9%NaCl). The skin is replaced without any sutures or only loose and spaced sutures with a non-absorbable string (e.g., Ethylon® 4-0, provided by Ethicon, triangular needle) if the incision is large.



Figure 3

Points of puncture to perform an auricular block. Note that, when too deep, infiltration in the anterior and inferior parts of the tragus may generate a facial palsy

2.2. Contention

To avoid the recurrence of haematoma, some kind of pressure has to be applied, either by bolster placement (Figure 4), with cotton or gaze plugs at the anterior and posterior faces of the pinna sutured through the ear, or with through-and-through whip-type absorbable mattress sutures without bolsters. The sutures keep the skin and perichondrium in approximation to the cartilage. A simple pressure by dental rolls or cotton balls without transfixation is insufficient most of the time. Different kinds of ear moulds, which assure compression, have been described, such as ear silastic splints, thermoplastic splints or plaster moulds.

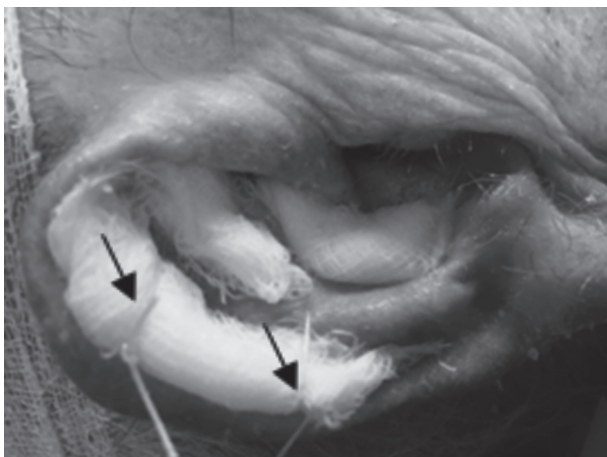


Figure 4

Bolster placement with gaze plugs at the anterior and posterior faces of the pinna sutured through the ear (the arrows show the stitches)

Another technique consists of haematoma needle aspiration, which leaves the plastic cannula within the haematoma cavity for three to five days with antibiotic ointment and bandaging.⁴ This can also be done with rubber drains. After five days, the cannula is smoothly removed, with subjects having to avoid any head or ear contact for a few days more.

Some authors describe the use of fibrin glue as very efficient in the management of auricular haematoma.⁵ The haematoma is evacuated after incision, while the cavity is washed out and fibrin glue is applied liberally, followed by a pressure dressing being applied and secured with a prolene bead suture.

Wrapping the head is a good way to keep the dressing in place. Contact sports should be avoided for the time that the dressings are in place.

Broad-spectrum antibiotics covering *Staphylococcus* and/or *Pseudomonas* are used in any case for seven to 10 days. If possible, from a cardiovascular point of view, neither aspirin nor anticoagulants should be used for seven days because of the bleeding context.

The management of old haematomas is not an emergency; the patient should be sent for an ENT consultation to plan for larger reconstructive surgery.

3 Take-home messages: What to do in the emergency department

- If not managed promptly and properly, auricular haematoma gets infected, while the cartilage will be destroyed, which causes cosmetic damage.
- The bloody collection should be drained (incision/suction with needle) and a bolster dressing should be left in place for three to five days. The ENT department will remove it.
- Antibioprophylaxis is necessary: ciprofloxacin, 500 mg, twice a day for seven to 10 days

Part II: Auricular perichondritis

1. Introduction

Perichondritis, which arises from inflammation of the perichondrium and the cartilage, can affect multiple ENT regions, such as the pinna, the nose, the larynx or the trachea. Auricular perichondritis is the most frequent condition because of the anatomic exposure of the ear. It can involve two different origins: traumatic with induced infection (main cause) and autoimmune. Very frequent among young adults, it can also be due to the high prevalence of ear-piercings, which complicate anatomical damage.⁶

The most common pathogen is *Pseudomonas aeruginosa*, which penetrates the epithelium and invades the underlying soft tissue and the perichondrium.⁷

Affected patients usually present with painful swelling, erythema, warmth and tenderness of the pinna.

Auricular perichondritis needs to be treated promptly and vigorously by antibiotics. The risk of severe infection and cartilage necrosis is high because of the poor blood supply of the auricular cartilage. Abscesses, characterized by fluctuant swelling, are a frequent complication and should be incised and drained properly, as any resulting pressure on the cartilage may lead to its ischaemic necrosis, resulting in severe cosmetic deformations of the pinna.

Differential diagnoses of auricular perichondritis include superficial skin infections, herpes zoster oticus, insect bites or allergic contact dermatitis, which, at first sight, can dangerously mislead the diagnosis of perichondritis.



Figure 5A

Mild perichondritis of the left auricle after piercing

2. Post-traumatic and infectious auricular perichondritis

Background: The ear is a common site of injury after aggression, accidents or sports activities, such as boxing, or through piercing, which has become more and more popular among teenagers.⁶ In contrast to earlobe-piercings, “high” ear-piercing through the avascular cartilage is associated with an important risk of infection and perichondritis (Figure 5).⁸ Perichondritis can also develop secondary to malignant otitis externa, with diabetes mellitus as a major risk factor. The majority of perichondritis-associated infections are caused by *Pseudomonas aeruginosa* (up to 95%) and, secondly, *Staphylococcus aureus*.⁷ Risk factors for infection are exposure to water after injury or the use of an open piercing gun instead of a sterile needle.^{7,9} Diagnosis remains essentially clinical.

Clinical signs and symptoms: Very painful swelling, erythema, warmth and tenderness of



Figure 5B

Severe perichondritis of the left auricle with abscess formation

the pinna at the site of injury, sparing the non-cartilaginous ear lobe. Acute tenderness on deflecting the ear and fever are frequent signs.

Management: Any foreign body or piercing has to be removed carefully, if necessary under local anaesthesia with an auricular block (see above, Part I, Figure 3). There should be prompt antibiotic treatment with an oral fluoroquinolone (e.g., ciprofloxacin, 500 mg, twice a day),¹⁰ which is sufficient in uncomplicated cases and the early phase of infection. Abscesses should be incised, drained and cultured quickly. Debridement of necrotic tissue is essential to the healing process. For dressing, a firm pressure bandage (e.g., Velpau® 10 cm, provided by Lohmann and Rauscher) needs to be applied.¹¹ In the case of an abscess with cartilage necrosis, intravenous broad-spectrum antibiotics are recommended. Concerning the particular case of infection due to earrings in the lobule, it is necessary to get rid of the jewel and apply antibiotic cream containing mupirocin (e.g., Bactroban®, provided by GSK); no general antibiotic prophylaxis is needed if the skin covering the cartilage is spared and healthy. An appointment at the ENT department is desirable two days later for control.

Complications: The cauliflower ear (Figure 6). Post-traumatic perichondritis usually progresses rapidly. If untreated it may result in subperichondrial abscesses with ischaemic necrosis of the cartilage.

Other complications are haematoma or hypertrophic scarring and keloid formation. Toxic shock syndrome has also been described.⁸

2.1. Differential diagnosis of the infectious perichondritis

2.1.1. Herpes zoster oticus

Background: Herpes zoster oticus (Figure 7) is due to the reactivation of endogenous latent varicella-zoster virus (VZV) within the geniculate ganglion, with possible neurological and dermatological manifestations. Herpes zoster oticus is rare,¹¹ but represents a serious otologic complication. The virus passes through the sensory nerve fibres into the associated dermatome via the nervus intermedius of Wrisberg, which innervates the pinna, the external auditory meatus, the soft palate and the anterior two thirds of the tongue. The association of herpes zoster oticus with peripheral facial nerve paresis is defined as Ramsay Hunt syndrome (96%



Figure 6

Cauliflower ear: Severe cosmetic deformation of the pinna known as cauliflower ear has a poor chance of satisfying plastic reconstruction.

of cases). The cranial nerves V, VIII, IX and X may be involved.

Clinical signs and symptoms: Painful, unilateral rash and vesicular eruption of the pinna and the external auditory canal, (rarely) lesions on the ipsilateral soft palate and tongue, and ipsilateral facial paralysis in the case of neurological involvement, with possible disturbance of taste perception, hearing (tinnitus, hyperacusis) and lacrimation.

Management: There are limited, yet controversial, data on the treatment of herpes zoster oticus and Ramsay Hunt syndrome. Hospitalization and combined intravenous acyclovir-corticosteroid therapy is generally recommended.¹²

2.2. Relapsing polychondritis

Background: Relapsing polychondritis is a rare immune-mediated connective tissue disease characterized by relapsing inflammation of the cartilage, particularly the pinna, leading to its destruction. Collagen type II of the cartilage is supposed to be a potential target antigen.¹³ The

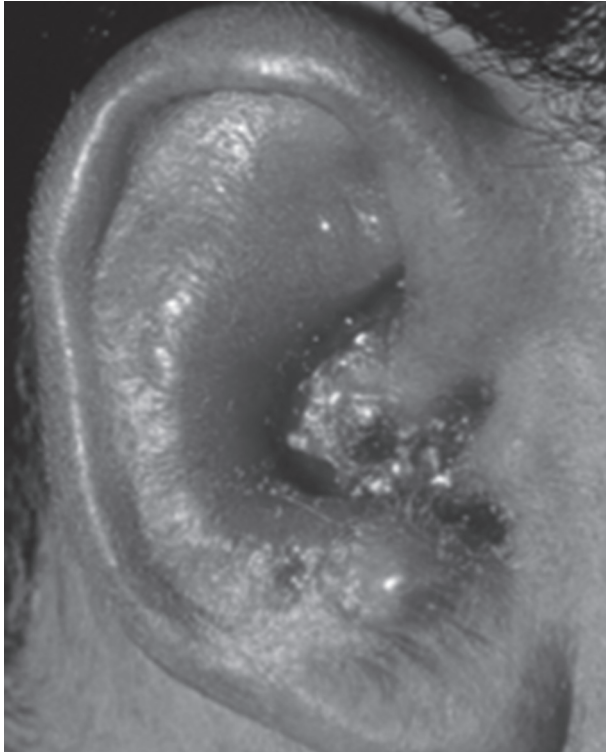


Figure 7

Herpes zoster oticus of the right ear: Reactivation of endogenous latent VZV within the geniculate ganglion.

episodes vary in severity and frequency. If it affects the airway cartilage of the larynx, trachea and bronchi, it can lead to severe obstructive respiratory disease with high mortality.

Clinical signs and symptoms: Auricular involvement is the most common feature (up to 90% of cases):¹⁴ unilateral or bilateral pain, warmth and tenderness of the pinna, diffuse, violaceous, and erythematous inflammation sparing the ear lobes with acute or subacute onset. There is no history of trauma. The episodes are recurrent and often associated with ocular (scleritis, conjunctivitis or uveitis) and nasal manifestations (saddle nose).

Management: There are no evidence-based treatment guidelines for relapsing perichondritis. The approach is, first of all, empirical and aimed at decreasing systemic inflammation. For patients with auricular perichondritis, but no visceral involvement, first-line therapy consists of non-steroidal anti-inflammatory drugs (NSAIDs) in very mild cases; in cases of non-response or more severe cases, prednisone (30 to 60 mg/day) or dapsone (initial dose 50 to 100 mg/day) is recommended.

Complications: Autoimmune auricular perichondritis may result in cauliflower ear due to inflammatory destruction of the cartilage.

3. Conclusion

Perichondritis is a frequent and serious post-traumatic complication. There should be no delay in the diagnosis, nor should it be mistaken for superficial uncomplicated skin lesions. The sooner the diagnosis of perichondritis is made and a correct treatment is started, the better the outcome, with less residual deformation.

4. Take-home messages: What to do in the emergency department

- Any painful swelling, erythema, warmth and tenderness of the pinna should be considered as an infectious auricular perichondritis.
 - Iral (cytobrush) and bacterial swabs should be collected. A general neurological exam, including the cranial nerve tests, should be carried out and written down in the patient's records to rule out the onset of a Ramsay Hunt syndrome. For typical presentations with auricular vesicles and facial palsy, acyclovir should be started.
 - Any foreign body should be removed.
 - In cases of abscess, the ENT specialist should drain the collection as soon as possible due to poor antibiotic efficacy in this case. If no ENT is present, the pus may be sucked out through a sterile needle. The sampling must be sent for microbiological exam and the ear packed in a compressive wrapping. General antibiotics must be commenced as soon as possible (cf. infra).
 - Any wound should be disinfected daily with an antiseptic lotion.
 - An empirical antibioprophyllaxis, such as ciprofloxacin, 500 mg, orally, twice a day, should be started.
 - The patient must be referred to the ENT department within 48 hours.

Part III: Lacerations of the pinna and loss of auricular tissue

1. Introduction

The epidemiology, prevalence and incidence of the auricle traumatism are poorly analysed in

the scientific literature. However, from the few studies available, it appears that a traffic accident, a brawl and/or a bite are the most frequent causes of auricular traumas. In this latter case, it is important to differentiate the causative agent: a human being, a wild animal or a pet.

During the anamnesis and clinical evaluation, symptoms and signs of middle/inner ear or central nervous system (CNS) injuries must be systematically looked for.

- Middle ear injuries: hearing loss (conductive), bloody otorrhoea
- Inner ear: vertigo, hearing loss (sensorineural), nausea and vomiting
- CNS: headache, vomiting, altered mental status

The management of the middle and inner ear traumatism will be discussed in another chapter.

Skin lacerations with an intact perichondrium only require topical antibiotics or may be treated by oral first-generation cephalosporin. Exposed cartilage implies the use of fluoroquinolones. When the patient suffers from a human/animal bite, amoxicillin-clavulanic acid is necessary to cover the oral flora of the biter.

In cases involving loss of tissue, the aim of the reconstruction is to restore the symmetry in the frontal and the lateral planes. The original convoluted shape of the ear makes this even more complicated.

As for every human body wound, the tetanic vaccinal status (Table 1) has to be checked and vaccination or immune globulins administered according to the history of tetanus immunization (see Table 1 below). According to the Sanford Guide, when tetanus toxoid and tetanus immune globulins are given concomitantly, separate syringes and separate injection sites should be chosen (vaccines in the deltoid area and immune globulins in the gluteal area).

Specific cases:

- **Human bite:** For medicolegal reasons, an initial blood test should comprise antibody testing for HIV and hepatitis B and C. A control must be done three months after the traumatism. If the patient had no previous vaccination for hepatitis B, one dose of hepatitis B immunoglobulins should be given and vaccination should be started. HIV medications are not routinely indicated after a human bite if the assailant is not known to be seropositive.

- **Wild animal:** Rabic vaccination should be considered. While the rabic virus is not endemic in Belgium, infected dogs coming from North Africa have been detected. This specific point should be investigated during the anamnesis. After cleansing, and if available, a virucidal agent, such as povidone iodine, benzalkonium chloride or alcohol, should be used to irrigate the wounds. For a patient not vaccinated against rabies (or who is not responder), the administration of 20 international units of human rabies immunoglobulins (HRIGs) per kg body weight is recommended. If feasible, the full dose should be infiltrated around the wounds, while any remaining volume should be administered intramuscularly at an anatomical site distant from the site of vaccination, but never in the same limb. HRIGs should not be administered in the same syringe as the vaccine. For a patient vaccinated against rabies (a known responder), a vaccination using the human diploid cell rabies vaccine (HDCRV) should be intramuscularly administered in the deltoid area (two doses of 1 ml): one dose on day 0 and one dose on day 3.

In Belgium, HRIGs and the HDCRV are delivered by the Instituut Volksgezondheid/Institut de la Santé Publique, Brussels, 02/373 31 50, 02/373 31 11 or email rage@ipv.fgov.be.

According to the Stanford Guide to Antimicrobial Therapy 2012-2013, the recommended general antibioprophyllaxy concerning bite wounds is as follows:

- **Children:** amoxicillin-clavulanic acid, 40 mg/kg/day (amoxicillin component) per os, three times a day for three to five days
- **Adults:** amoxicillin-clavulanic acid ,875 mg per os, three times a day for three to five days

2. Lacerations and cuttings

After cleansing, the skin must be stitched to close up the wound. If necessary, the cartilage is cut parsimoniously to allow for a full tegument covering without any tension. This clinical situation may be managed in the emergency department by a surgeon. After an auricular block (see above, Part I, Figure 3), the skin must be dissected and separated from the perichondrium using a pair of scissors. The cartilage is then partially removed and the skin stitched (Figure 8).

In cases involving a wide laceration, a bolster dressing will be set (see above, Part I, Figure 4).

Table 1

Post-exposure prophylaxis of tetanus according to the Stanford Guide to Antimicrobial Therapy 2012-2013

History of tetanus immunization	Wound: tetanus-prone		Wound: not tetanus-prone	
	Vaccination	Immune globulins ¹	Vaccination	Immune globulins ¹
Unknown, uncertain	Primary vaccination	Yes	Primary vaccination	No
Incomplete primary vaccination (< 3 doses)	Finish primary vaccination	Yes	Finish primary vaccination	No
Complete primary vaccination				
*Last booster dose administered < 5 years ago	No	No	No	No
*Last booster dose administered ≥5 but <10 years ago	1 dose	No	No	No
*Last booster dose administered ≥10 but <20 years ago	1 dose	Yes	1 dose	No
*Last booster dose administered ≥20 years ago	2 doses (interval of 6 months)	Yes	2 doses (interval of 6 months)	No

¹TIG: (human) tetanus immune globulin (administer 250 to 500 international units intramuscularly)

A circular laceration of the conduct needs the insertion of an expansive dressing, regularly soaked with droplets (blending of corticosteroids and antibiotics) to prevent stenosis.¹⁵

2.1. Skin abrasions

These are cases where the skin is avulsed and the cartilage exposed. When the perichondrium remains intact, a second-intention healing is possible; alternatively, a full thickness skin graft may be carried out. If the perichondrium is damaged, the cartilage must be excised or fenestrated in order to facilitate the ingrowth of granulation tissue.

2.2. Particular case: lobule tear

Typically occurring with earrings, the main complication is the retraction of the lobule's thin skin. To prevent notching, the suture must be a Z-plasty:¹⁶ the resulting scar is parallel to the inferior edge of the lobule.

3. Loss of tissue

Where possible, the piece of auricle must be reattached; even if a necrosis happens, this final result will not be any less aesthetic than the one following a wait-and-see attitude. The avulsed segment has to be wrapped in a saline-soaked gauze, then placed on ice until the reimplantation.^{16,17} Barinka's classification distinguishes four amputation types, but it does not influence the management. Any loss of tissue needs an ENT/plastic surgery opinion within 24 hours.

3.1. Replantation

3.1.1. Segmental avulsion

All partial avulsion with a remaining pedicle should be stitched in a multi-layered way (cartilage edges together and skin edges together as well) as soon as possible. As mentioned above, tension in the stitches may lead to dehiscence. This explains why cartilage may be cut if necessary.

Loss of tissue smaller than 1.5 or 2 cm^{17,18} may be stitched as a composite graft because there will be no aesthetic consequences.

The direct reattachment as a composite graft has unpredictable results, which is why several teams prefer to bury the cartilage. Loss of tissue smaller than half of the pinna must be buried within three weeks using the pocket principle of Mladick.¹⁷ The description of this surgical technique is not the objective of the present review. Briefly, the avulsed segment is treated as a composite graft, while its revascularization is managed in a two-step procedure carried out by a specialist under local or general anaesthesia.

In teams trained to perform microvascular anastomosis, a direct replantation may be considered;¹⁸ the likelihood of viability after reattachment is judged by the specialized surgeon. The replantation of composite graft with microanastomosis is a time-consuming procedure and implies the administration of anticoagulant; the ensuing bleeding may require blood transfusions.

3.1.2. Total avulsion

Microvascular anastomosis replantation offers the best aesthetic results. The timing of replantation



Figure 8A
Cutting with uncovered cartilage

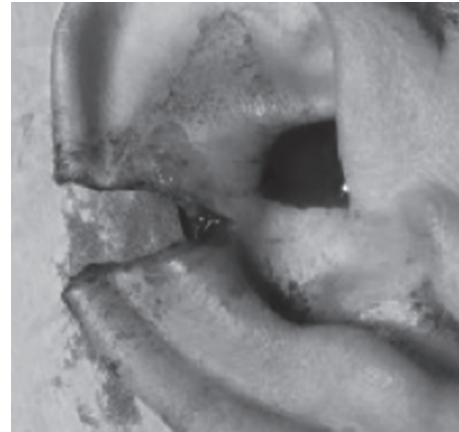


Figure 8D
Result after cartilage resection: cutaneous margins fit the limit of the cartilage



Figure 8B
Dissection of the subcutaneous tissues



Figure 8E
Absorbable stitches along the cartilage

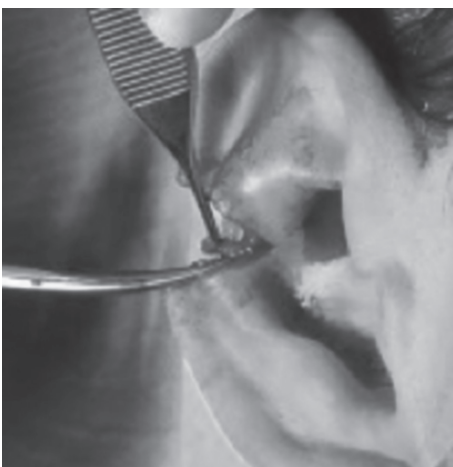


Figure 8C
Excess of cartilage resection



Figure 8F
Non absorbable stitches along the skin

should be as quick as possible. Contraindications are as follows: locally, if the anatomy of the recipient area is too damaged and, in a systemic point of view, if the patient is in shock with bad vital parameters, which do not allow for a good revascularization of the pinna, or if there is a risk of necrosis of the avulsed segment (poor state of preservation, extensive burn etc.), the pocket principle could be performed. Treatment choice

depends on the specialized team's training level and experience.

3.2. No possible replantation

When the avulsed segment is lost or too bruised, or if the patient's state is critical, the ear will be stitched without any attempt of replantation. To restore a harmonious helical rim, a wedge resection (Figure 9) is chosen for small defects.

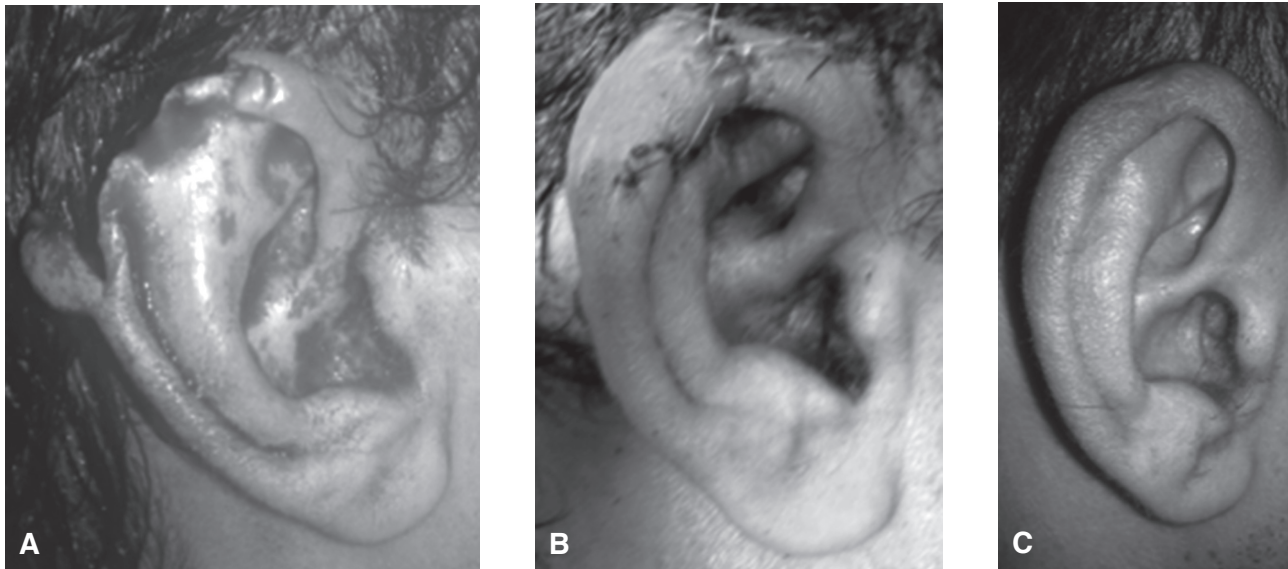


Figure 9 A, B and C

The piece of ear was not available. The pinna was stitched following the wedge resection technique. A: Day of the aggression; C: Three months after the brawl

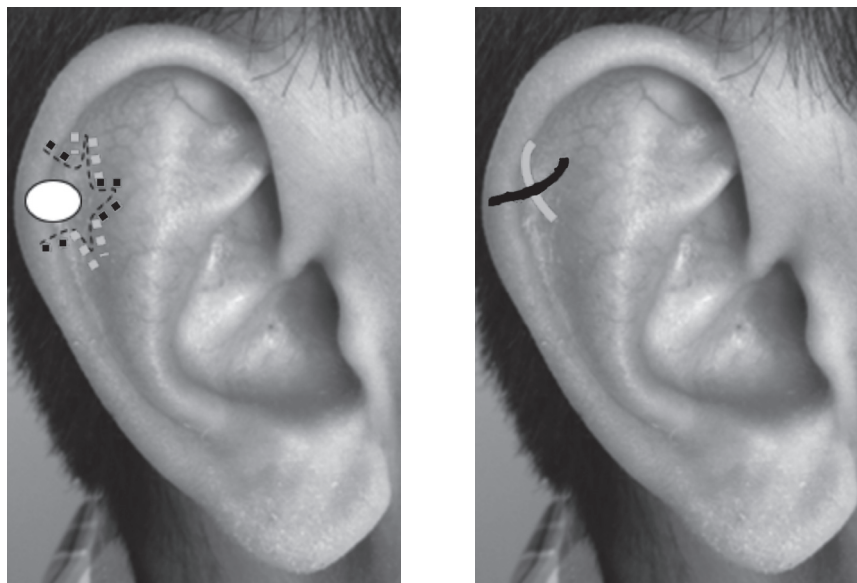


Figure 10

Star excision of a helical rim defect
The injury is included in the star resection. Although the result is a slightly smaller ear, it presents a preserved shape.

For bigger wounds, a star excision (Figure 10) is preferable to prevent a curved distortion.¹⁶ Second-look surgery is possible when reconstructing a pinna with concha, septum or rib cartilage. In some cases of total avulsions, a bone-anchored prosthesis provides very good aesthetic results, although some patients are reluctant to pursue this alternative.¹⁹

4. Conclusion

Summary of Part IV concerning the lacerations and the loss of auricular tissue.

5. Take-home messages: What to do in the emergency department

- Anamnesis
 - usual medication (anticoagulants?)
 - medical/surgical antecedents and allergy
 - smoking
 - mechanism of the trauma (public road accident, brawl, bite etc.) and age of the wound
 - symptoms of middle/inner ear traumatism or CNS injury?
 - assessment of the contamination risk: tetanus, HIV/HBV/HCV, rabies etc.
- Examination:
 - draw up a statement:
 - laceration/avulsion
 - bruised skin/cartilage
 - signs of middle/inner ear trauma?
 - signs of CNS injury?
- Management:
 - antibiotics (and vaccines, if necessary)
 - blood test, including coagulation, serologies, haemoglobin, renal and hepatic functions
 - loss of auricular tissue - wrap the avulsed segment in a saline-soaked gauze, place it on ice and call the ENT department
 - cleaning of the wound using a soapy solution
 - exeresis of all the foreign bodies (glass, metal etc.)
 - resection of all the non-viable skin - if some areas of the cartilage are uncovered, they should be sparingly cut
 - reconstruction (immediate/delayed) according to the ENT department's advice

Part IV: Burns of the external ear

1. Introduction

Even if it is not obvious in a burn trauma patient, the early management of burned ears is of great importance to the final aesthetic and functional result. In cases involving a glass-wearing patient, persistent ear deformities or the destruction of the ear concha may be invalidating.

2. Burns degree – scale

As burns do not affect the skin uniformly, a single injury can reach varying depths. Burns are classified according to the four degrees scale:

Usually, in ear burns, the lesions are classified as partial thickness (Figure 11) or full thickness burns.

3. Causative agents of burns

Burns can be classified following the causal agent.

3.1. Thermal burns

This is where the degree of lesions are in direct relation with the temperature and time of exposure. Examples include:

- **contact burns** with a hot object (e.g., a grill, a pan)
- **scald:** contact with a hot liquid; the most frequent domestic burn, especially in children
- **flame or combustion:** contact with an inflamed object or substance; in the latter case, a chemical burn may be involved
- **frostbite:** cold exposure induces local vasoconstriction and can lead to cellular death

3.2. Chemical burns

Many chemical products are available for current housekeeping use, such as bleaching or cleaning agents, disinfectants and thinners. Therefore, their concentrations are very low, while their reactions on the skin lead to minor (first- or second-degree) burns, thereby rarely needing emergency care treatment.

However, the use of concentrated dangerous chemicals is unavoidable in some industry sectors. When accidents occur involving such use, they are responsible for life-threatening burns associated with inhalation poisoning. These situations are



Figure 11

Partial-thickness burns: Dermis is exposed in limited areas.

managed in line with SEVESO directives, a European protocol for the prevention, preparedness and response in case of industrial accidents.²⁰

3.3. Electrical burns

This is where the degree of lesions depends on the voltage of the source and the time of exposure. Unfortunately, these lesions have a very destructive character, often being deadly.

In thermal burns, the destruction appears due to coagulative necrosis, which is induced by the energy transference associated with local vessels' thrombosis. Besides these effects, there is also a direct injury to the cellular membranes in chemical or electrical burns.

4. External ear involvement

Ear involvement is due to its prominence in the lateral parts of the face and, because of the thinness of its structures, the subcutaneous tissue is absent in this region. It is worth remembering that the cartilage of the ear is particularly vulnerable, given that it is totally dependent on the overlying perichondrium and skin, from which the blood supply is assured by diffusion. Maximal cartilage preservation is the most important aspect of minimizing final scars.

The literature regarding ear involvement in burned persons is not very rich. The largest retrospective study was published by Mills et al. in 1988: of 4,794 burned patients, 52.7% had ear burns (unilateral or bilateral).²¹ Bhandari found an incidence of ear burns in almost 90% of a population of patients with head and neck burns.²² Skedros et al. found 42% of patients with burned ears among 182 patients with facial burns.²³

- Chondritis prevention

Chondritis is considered to be the most serious complication in cases of burn wounds. Its incidence is highly variable, depending on the studies: it was 30% in the series by Bhandari et al.,²² 29% in the series by Skedros²³ and 3% in the latest part of Mills' study.²¹ It occurs as often in full thickness burns as in partial thickness burns, while it can present as a delayed complication, even after the initial re-epithelialization,^{23,24} from three to five weeks after the injury. The clinical signs are increasing tenderness, erythema, dullness, warmth and swelling. The upper part of the ear is pushed laterally, resulting in an "increased cephalochondral angle" (Figure 12). At the beginning, chondritis is localized to the helix or antihelix, after which it can spread rapidly to the entire ear. Abscess formation can occur. In most cases, serial bacterial cultures found *Pseudomonas* or *Staphylococcus* species, although sterile cultures have also been reported. Empirical antibioprophyllaxis is recommended (ciprofloxacin, 500 mg, twice a day). The patient should be referred within 48 hours to the ENT department.

Almost all the publications agree on some standard measures in the acute care of the burnt ear. Their discontinuity or interruption is considered responsible for the failure of aesthetic ear salvage.

5. Acute management

The first-line treatment in a severe burn must follow specific guidelines with respiratory management and organ support.

Once the patient is stabilized, that is to say, with an acceptable cardiovascular status, the goal of the treatment for the burnt ear is chondritis prevention. The ear must be gently disinfected and washed with sterile water, as well as debrided if necessary. In cases of chemical burns, the washing procedure must be very intensive and repeated every two hours in the first four or five days. Contact with

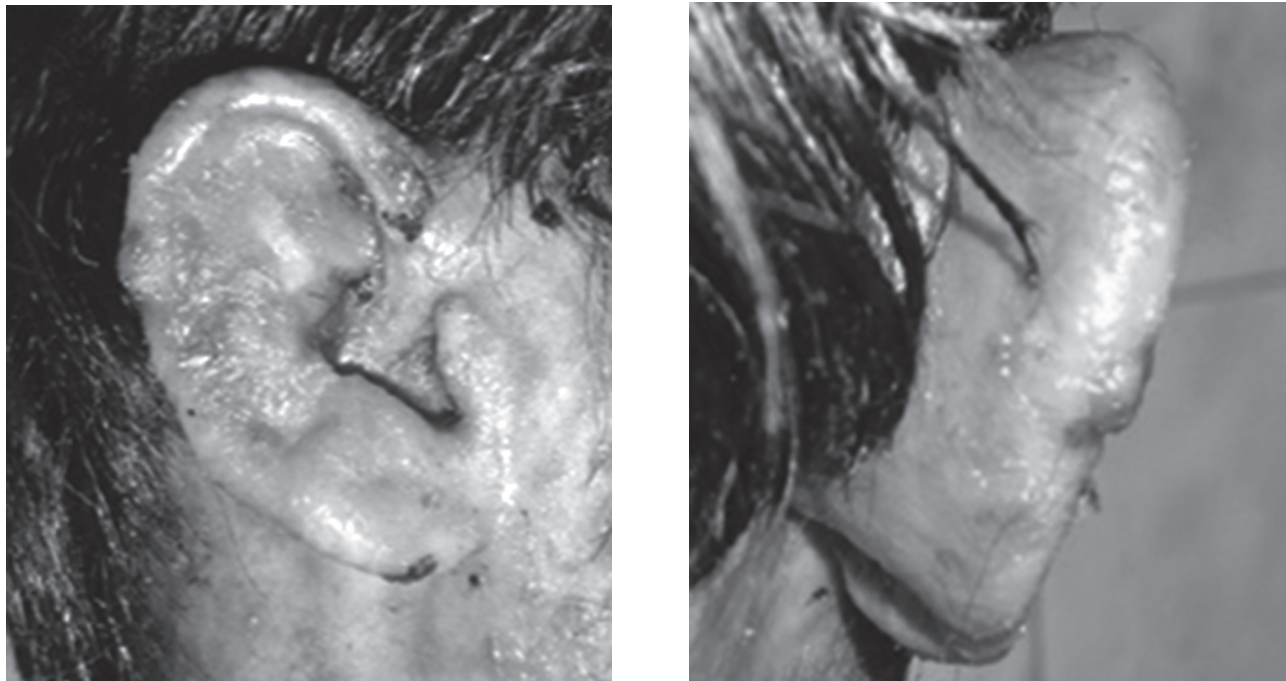


Figure 12

Chondritis with increased cephalochondral angle: The ear is erythematous, tender and starts swelling. For this reason, the upper part is lateralized from the skull.

the hair must be avoided because of contamination risk.

Application of a topical antiseptic agent is mandatory in order to prevent infection and suppurative chondritis. Silver sulphadiazine (e.g., Flammazine®, provided by Qualiphar) has a good antimicrobial action and is often used as the first choice with burned patients. Its application must be repeated three to four times per day until complete healing. However, it is not recommended for the ear because of the risk of silver oxidation and tattooing when in contact to light. For this reason, we prefer the use of alginates (Flaminal®, provided by Flen Pharma).

Mafenide acetate (e.g., Sulfamylon®), a water-soluble topical antibacterial, seems to offer better penetration into the cartilage; hence, it prevents chondritis more effectively than sulphadiazine. Unfortunately, it is not available in Belgium.

Compared with a burn located elsewhere on the body, biological dressings can also be used in cases of burned ear. Their virtues are to diminish the infection risk and activate the epithelialization. There are many studies concerning semi-biological dressings, cadaver allografts, human amnion or

artificial skin utilization in burned patients, but there is a lack of specific information concerning their utility in the ear region. Applied elsewhere on the body, they seem to be more effective than silver sulfadiazine.

Occlusive dressings with minimal pressure during bandaging reduce the risk of nosocomial infection. The retro-auricular region must be gently dressed too, even if the skin covering the mastoid is preserved.

Special care must be taken to avoid any kind of pinna pressure, given that it is well known that local pressure can increase scar formation or contribute to chondritis. All aggressive contact must be avoided. Intubation tubes fixation systems, pillows, sheets and circumferential head dressings can all contribute to pressure necrosis and chondritis. The use of protective cups to avoid the smallest trauma seems to be very useful. This system also protects the occlusive dressing.

In case of partial thickness burns, if the skin is detached in small pieces, but the perichondrium still intact, a partial thickness skin graft can be applied while waiting for granulation and epithelialization. If the cartilage is exposed in a limited surface, it

can be debrided, while the skin graft can be applied over the remaining cartilage.²⁴ Generally, it is recommended that the retro-auricular skin must be preserved for possible secondary reconstructions, while there is usually no need for donor skin graft at this stage.²⁵

In cases of full thickness burns without exposure of the cartilage, two different approaches are proposed:

- Rosenthal considers that leaving the eschar on the surface of the cartilage is the best approach to take, as it acts as a biological dressing and protects it from desiccation. Once the granulation tissue appears, a skin graft can be applied.²⁶ However, in cases involving a local suppurative phenomenon, the eschar should be debrided.

- Achauer et al. take the opposite view in three case reports. The authors advocate the excision of the full-thickness affected skin and the salvage of the cartilage using a vascularized flap, whether regional or distal. A local temporoparietal flap seems to be the best choice in their experience.²⁶ Moreover, Firmin and Marchac, based on a study of 134 patients, recommend strongly preserving this flap because it is considered to lead to better results during secondary reconstruction.²⁵

5.1. Chondritis treatment (see also Part II):

If it is installed, the treatment aims to limit the phenomenon.

It is important to mention that systemic antibiotherapy seems to be ineffective in cases of established chondritis, with the diffusion mechanism being strongly affected. Although local chemotherapy is of great importance, it is commonly accepted that any painful swelling and erythema of the pinna occurring after a burn trauma should be considered as an infectious auricular polycondritis and treated with added antibiotics, to be given orally. 500 mg of ciprofloxacin administered twice daily is the most effective empirical antibiotherapy. The patient should be referred within 48 hours to the ENT department.

In cases involving an abscess, the simple drainage of the collected pus should be sufficient, although adjuvant oral antibiotherapy is always necessary (see Part II). Some authors recommend bilateral drainage with local polymyxin irrigation.

Another proposed solution is the lateral bivalving incision, which splits the ear into anterior

and posterior surfaces and excises the whole of the necrotic yellowish cartilage. The two surfaces are packed with gauze, which is soaked in antibacterial solution and changed every 24 hours until secondary closure occurs. If there is a progression of cartilage necrosis, it should be excised. This approach is considered to be very effective in reducing chondritis progression.

6. Secondary post-traumatic reconstruction

Any burnt ear should be referred to the ENT or reconstructive surgery department within 48 hours following the emergency appointment, although it can also be managed by the emergency specialist. At distance from the injury, once the principal inflammatory and infectious phenomena are controlled, a secondary reconstruction can be envisaged, depending on the patient's aesthetic expectations.

At this stage, a burned ear may present in three different ways:

- scaring of the ear surface
- the loss of the helix or antihelix cartilaginous structure
- the total loss of the ear

Reconstruction at this stage must be performed by a highly trained team, which may comprise ENT and plastic surgeons, following microtia reconstruction protocols. Most frequently, the retro-auricular skin and superficial temporoparietal flap are preferred for the reconstruction; hence, the importance of their preservation at the acute stage. Local expanders can also be used.

Usually, the cartilage framework is harvested from costal cartilage.

In case of total loss, the placement of a bone-anchored prosthesis may be considered as an acceptable alternative.

7. Conclusions

Isolated external ear burns are excessively rare. Very often, they are associated with concomitant head and neck burn wounds and can have a life-threatening potential. Their management should follow standard acute burn care guidelines.

When life-threatening conditions are stabilized, the acute stage treatment of the external ear is different with regard to the degree and type of burn. At this stage, it is mandatory to minimize

and prevent the local complications as much as possible, with chondritis being the most frequent.

In some cases, delayed reconstructions are necessary at the second stage once the burns are healed. Surgery is often planned in multiple steps, with the goal being functional and aesthetic, as much as possible similar to the pre-incident stage. In very severe cases, this goal cannot be achieved, necessitating prosthesis placement.

8. Take-home messages: What to do in the emergency department

- Wash and disinfect the burnt ear.
 - Carry out topical antiseptics with Flaminal® (Qualiphar).
 - If exposed cartilage, note that resection is controversial. If no ENT team is available to judge, leave it intact.
 - Apply an occlusive dressing with minimal pressure; if possible, only use a protective cup. No circumferential head dressing should be used.
 - Carry out perichondritis antibioprophyllaxy with ciprofloxacin, 500 mg, twice a day.
 - In cases of established perichondritis with an abscess, see the take-home messages in Part II.
 - ENT control is expected within 48 hours.

Conclusion

Usually the pinna is not the centre of interest for emergency specialists when a polytrauma patient or a severely burnt patient arrives in hospital. Nevertheless, when all the life-threatening conditions are controlled, it is important to take care of the external ear, given the aesthetic and hearing implications it may represent.

In the previous four parts, we reviewed the various mechanisms of injuries and the milestones in the management of each of them. In all the cases, ENT and emergency specialists will work together in order to prevent delayed complications.

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