



Original Article

Management of Acquired Atresia of the External Auditory Canal

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OBJECTIVE: The aim was to evaluate surgical techniques and their relationship to postoperative success rate and hearing outcomes in acquired atresia of the external auditory canal.

MATERIALS and METHODS: In this article, 24 patients with acquired atresia of the external auditory canal were retrospectively evaluated regarding their canal status, hearing, and postoperative success.

RESULTS: Acquired stenosis occurs more commonly in males with a male: female ratio of 2–3:1; it seems to be a disorder affecting young adults. Previous ear surgery (13 patients, 54.2%) and external ear trauma (11 patients, 45.8%) were the main etiological factors of acquired ear canal stenosis. Mastoidectomy (12/13) and traffic accidents (8/11) comprise the majority of these etiological factors. Endaural incision is performed in 79.2% and postauricular incision for 20.8% of cases during the operation. As types of surgical approach, transcanal (70.8%), transmastoid (20.8%), and combined (8.4%) approaches are chosen. The atretic plate is generally located at the bony–cartilaginous junction (37.5%) and in the cartilaginous canal (33.3%); the bony canal is involved in a few cases only. Preserved healthy canal skin, split- or full-thickness skin grafts, or pre- or postauricular skin flaps are used to line the ear canal, but preserved healthy canal skin is preferred.

CONCLUSION: The results of surgery are generally satisfactory, and complications are few if surgical principles are followed.

KEYWORDS: External auditory canal, acquired ear deformities, atresia

INTRODUCTION

Acquired stenosis or atresia is an uncommon disorder of the external auditory canal. Its incidence has been estimated at 0.6 cases per 100,000 [1]. It has different names in literature such as post-inflammatory medial meatal fibrosis [2,3], post-inflammatory medial canal fibrosis [4], post-inflammatory acquired atresia [5], canal atresia [6], and stenosis of the external auditory canal [7]. The term canal stenosis has often been used to describe cases of acquired atresia; however, these are two separate entities. Acquired atresia consists of a soft tissue plug in the proximal portion of the external auditory canal between the lateral surface of the tympanic membrane and the medial canal skin (Figure 1). It may be caused by trauma (ear surgery, thermal or chemical burns, radiation, or accidents such as lacerations or gunshot wounds), chronic otitis externa, or neoplasia [8]. Canal stenosis is described as narrowing of the whole external ear canal. Previous otologic surgery accounts for majority of the cases of acquired atresia [9]. The diagnosis is simple, but the treatment may sometimes be challenging. In this article, we would like to present our experience and discuss the principles of treatment and factors that are involved in success.

MATERIALS and METHODS

Twenty-four patients with acquired atresia of the external auditory canal that was surgically treated at our department were retrospectively evaluated in this study. Of the 24 patients, 18 were males and 6 were females. The average age was 30.5 years (range 8–56); the average age of the males was 29.7 and that of the females was 32.5. For every patient, a complete physical examination, pure-tone audiogram, and temporal bone imaging either in the form of Schüller's and Towne's views or high-resolution computed tomography was performed. Some patients were treated at a time when computed tomography was not widely accessible; therefore, Schüller's and Towne's views were obtained. During the ear examination, a probe was used to determine the depth and consistency of the atretic or stenotic plate. During the operation, the atretic tissue was removed, and generous widening of the bony canal was performed with a burr. Depending on the pathology that was present in the external or middle ear, subsequent reconstruction varied. In cases where cholesteatoma developed behind the atretic plate, the cholesteatoma was removed, tympanic membrane was grafted, and hearing reconstruction was conducted as needed. To line the denuded ear canal, skin grafts (split- or full-thickness) (Figure 2), local flaps, or preserved canal skin was used. After the operation, the ear canal was packed with nylon

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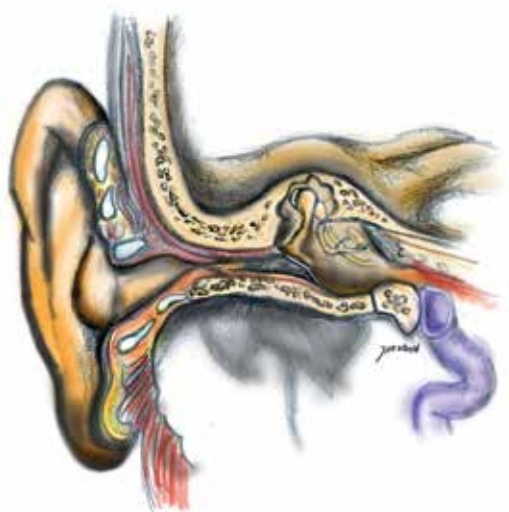


Figure 1. Coronal view of acquired atresia of the external ear canal

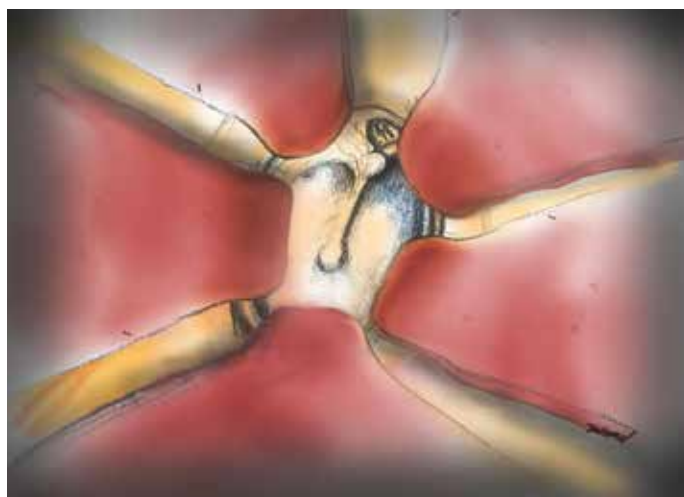


Figure 2. Split-thickness skin grafts lining an enlarged ear canal

strips and antibiotic-soaked Gelfoam (Pfizer; New York, NY, USA) pieces; a mastoid dressing was applied. The pack was removed after 3 weeks, and the patient was followed-up with frequent cleaning of the ear canal; antibiotic or steroid eardrops were used as needed. After the healing of the ear canal, a control audiogram was obtained. At least one year of postoperative follow-up was advocated to evaluate the results of surgery. Statistical analysis was performed with SPSS 21 (IBM, Atlanta, USA) software using Mann-Whitney U and chi-squared tests. Ethics committee approval, as well as informed consent, was obtained prior to the study.

RESULTS

Previous ear surgery (13 patients, 54.1%) and external ear trauma (11 patients, 45.9%) were the main etiological factors of acquired ear canal stenosis. Among surgically acquired cases, mastoidectomy was the main cause in 12 out of the 13 cases; atresia in the other patient was acquired after tumor excision. Of the 11 cases due to ear trauma, 8 were due to traffic accidents, one was acquired after a bomb explosion, one was due to a cut around the ear canal, and the other was

acquired after a fall that caused a temporal bone fracture. Endaural incision was chosen for 19 cases (79.2%) during the operation and postauricular incision was performed in the other 5 cases (20.8%). As for the type of surgical approach, a transcanal approach was chosen for 17 (70.8%) cases, a transmastoid approach for 5 (20.8%) cases, and a combined approach for 2 (8.4%) cases. In 9 patients (37.5%) the atretic plate was located at the bony-cartilaginous junction; in 8 patients (33.3%) it involved the cartilaginous canal only; in 3 patients (12.5%) it was located within the bony canal only; and in 3 patients (12.5%) it involved both the bony and cartilaginous canals. In another patient (4.2%) external skin made up the atretic plate (Table 1). Eight patients (27.5%) had cholesteatoma behind the atretic plate and the cholesteatoma was excised completely during the operation. Four patients required a split-thickness skin graft to cover the new ear canal; a full-thickness skin graft was used on one patient. Preauricular and partially buried postauricular flaps were used in another patient to line the ear canal, as described by Beal et al.^[10]. The remaining 18 patients did not require any additional material for coverage; in these patients, the remaining ear canal skin was preserved and used for secondary epithelialization of the ear canal. No complications, either intra- or postoperatively, were seen. Five patients developed restenosis and had to undergo revision surgery with ultimately satisfactory results. Traffic accidents and one case of psoriasis caused four of the revision cases. Endaural incision was chosen for four patients and postauricular incision was chosen for the other one. The remaining 19 cases all had satisfactory results. The hearing results were also satisfactory except for the cases with previous mastoidectomy. All patients had an air-bone gap of 10 dB or less; one case had total sensorineural hearing loss after trauma.

DISCUSSION

Acquired atresia of the external auditory canal may be complete or partial, circular or semilunar; it may be of traumatic or infectious origin. According to our series, it occurs more commonly in males, with a male/female ratio of 2-3/1; it seems to be a disorder of young adults. Ear trauma, ear surgery, and external otitis are the main etiologic factors and among these mastoidectomy and traffic accidents constitute the great majority in our series. The atretic plate may be made up of fibrous, osseous, or cartilaginous tissues, or combinations of these. Post-traumatic ear canal atresia occurs when there is circumferential loss of epithelium. The remaining epithelium between the site of the atresia and the tympanic membrane continues to desquamate, which leads to secondary canal cholesteatoma^[6]. Post-surgical meatal atresia may be the result of a simple mastoid operation in which the skin and periosteum of the osseous meatus were elevated and reapplied with pressure packing; it may follow an endaural operation in which the incision was allowed to close too rapidly; or it may be due to blunting following a lateral graft technique or due to a keloid in the scar of an endaural incision^[11].

The location of the atretic plate is also important. In the great majority of cases, it is located in the cartilaginous portion or at the bony-cartilaginous junction of the ear canal. The bony canal is involved in a few cases. Prevention of atresia is the best treatment. Early treatment of external canal injuries is crucial if stenosis or atresia is to be prevented^[6]. In cases with traumatic fracture of the auditory canal, early repositioning of the fragments may be advocated; after repositioning, the fragments must be supported with a stent or tamponade

Table 1. Acquired atresia of the external auditory canal: Distribution of patients according to the etiology, incision, location of the atretic plate, and surgical approach

			Number of Patients (%)
Etiology	Ear Surgery	Mastoidectomy	12 (50%)
		Tumor excision	1 (4.2%)
	Trauma	Traffic accident	8 (33.3%)
		Explosion	1 (4.2%)
		Laceration	1 (4.2%)
		Temporal bone fracture	1 (4.2%)
Incision	Endaural		19 (79.2%)
	Postauricular		5 (20.8%)
Location of Atretic Plate	Bony–cartilaginous junction		9 (37.5%)
	Cartilage canal only		8 (33.3%)
	Bony canal only		3 (12.5%)
	Bone and cartilage canal		3 (12.5%)
	External skin		1 (4.2%)
Surgical Approach	Transcanal		17 (70.8%)
	Transmastoid		5 (20.8%)
	Combined		2 (8.4%)

for 3–6 weeks. When the stenosing process is still in an early active healing phase, treatment with packs or wicks that are soaked with an antibiotic-steroid ointment may be preventive. The pack serves as an obturator, the steroids reduce the formation of granulation tissue and fibrosis, and the antibiotics reduce the risk of infection^[9].

Principally, treatment of the atretic ear canal is surgical. The involved stenotic tissue must be removed. The bony canal must be generously widened with a burr because subsequent osteoblastic activity may lead to restenosis, especially in children. In cases of traumatic fractures of the auditory canal that involve the temporomandibular joint, the condyle of the mandible must be separated from the ear canal with a bone or cartilage graft in order to prevent its future prolapse into the canal and the graft must be covered with skin. The residual healthy skin of the external ear canal should be preserved to line the new canal. Any bare area within the auditory canal should be covered with a skin graft, because granulation tissue may develop at these sites and predispose to restenosis.

Canalplasty should not focus on the bony portion alone; proper canalplasty requires adequate meatoplasty. Creation of a wide meatus tends to preserve the normal lateral migration of cerumen and desquamated keratin, which allows them to extrude easily. The surgeon must take care to preserve the native healthy canal skin, because skin grafts lack an inherent migratory ability and do not contain ceruminous and sebaceous glands^[12]. Therefore, continued aural toilet is important in this patient group.

According to Parisier et al.^[12], as much as 50% of canal skin can be lost and will regenerate without skin grafting. In cases in which a larger

amount of skin is removed, skin grafting may be needed to prevent healing by secondary intention. Although skin grafts are not a perfect replacement for normal canal skin, they are infinitely better than the unpredictable healing that results from granulation. Skin grafts, either split- or full-thickness, or pre- or postauricular flaps may be used to line the new ear canal but by preserving the epithelial layer and thinning the fibrous tissue the remaining canal skin can line the ear canal as well. It is obvious that the type of lining does not affect the results of surgery adversely, as the results are satisfactory.

Modified mastoidectomy and canalplasty are the surgical treatments that are used for atresia of the external auditory meatus. Canalplasty has the advantage in that the size and shape of the ultimate auditory canal closely resemble those of a normal auditory canal, which promotes the development of a stable and self-cleaning canal. The bony widening is no longer visible postoperatively because the lumen becomes partially filled by the new fibrous lining. Fibrous meatoplasty is an essential part of the operation in order to achieve good ventilation of the auditory canal. According to McDonald et al.^[7], the essential step in canalplasty involves the generous widening of the posterior bony canal wall until mastoid cells are just encountered; the widening should be accomplished without creating any recesses that may later prevent proper cleaning of the ear canal. Cremers and Smeets^[13] prefer to widen the auditory canal as much as possible without opening the mastoid, to increase the chance of achieving a sufficiently wide and dry auditory canal. They also claim that the amount of exposure that is achieved using the endaural approach is less than that achieved with the retroaural approach. The transmastoid approach is considered to be a safer route regarding the facial nerve, especially in trauma patients. However, the type of approach is the surgeon's preference and this choice does not depend on the exposure that is required or the pathology that is present; it is just the type of approach that the surgeon is used to.

McDonald et al.^[7] emphasize the importance of using two pieces of split-thickness skin graft to cover the new ear canal and the de-epithelialized tympanic membrane, one being attached to the anterior margin, the other to the posterior margin of the new meatus. They use two separate strips of Silastic sheeting (Medasil, Leeds, UK) and antibiotic/steroid-soaked iodoform packs pressing the skin grafts against the bony canal wall. They operated on 22 patients with no restenosis.

Soliman et al.^[14] removed a wedge of skin from the meatal floor and achieved a good result in 13 of 16 patients. Adkins^[15] covered the skin-deficient canal with a transposition flap in eight cases with no recurrence. Moore et al.^[16] lined the canal with a full-thickness skin graft in one case with no recurrence. Bell^[17] used bilateral rotational skin flaps in nine cases with no recurrence. McCary et al.^[18] used split-thickness grafts in 18 cases with one recurrence.

Stucker and Shaw^[19] believe that failure stems from the fact that even when an adequate canal is fashioned, attempts at relining with either full- or partial-thickness skin grafts or allowing secondary-intention healing with a stent generally results in scar formation, which tends to circumferentially contract and reconstructs the canal. To break this recurrent cycle, they advocate relining the widened canal with a posteriorly based partially buried local flap. This has two advantages.

First, a pedicled flap carries its own blood supply. Inflammation with subsequent scarring is greatly reduced when non-diseased vascularized tissue is used, especially when placed in an area that has undergone chronic inflammation. Second, owing to the flap being posteriorly based during the healing process, the scar contracture tends to pull the repaired canal open, thus avoiding restenosis. The postauricular flap may be based either superiorly or inferiorly, but the tip should overlie the mid-conchal area.

Stucker and Shaw ^[19] indicate that most meatal canal stenosis tends to be posterior, and postauricular flaps not only easily line any posterior defect from the meatus to the annulus but also, during healing, tend to produce a posteriorly directed vector that keeps the canal open. It is unusual to have anterior skin involvement, and it is rarely necessary to resect any anterior canal skin. Generally, there is no need to widen the anterior canal wall unless there is an anterior bony overhang ^[7], although it is of utmost importance to perform an adequate canalplasty and meatoplasty ^[20].

In conclusion, acquired atresia of the external auditory canal is easily diagnosed, but its surgical treatment can sometimes be challenging. Both the surgeon and patient must have patience to obtain the desired result. Split- or full-thickness skin grafts or pre- or postauricular skin flaps may be used to line the ear canal, but preserved healthy canal skin should be preferred. Although longer follow-up is desirable, the results of surgery are generally satisfactory and complications are few if the surgical principles already discussed are followed.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written informed consent has been obtained from all participants.

Peer-review: Externally peer-reviewed.

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