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Reduction of cicatricial stenosis after canalplasty for auditory exostoses

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Abstract

Background. Canalplasty for auditory exostoses is reserved for symptomatic patients. This study reviewed the outcomes of our technique regarding cicatricial stenosis.

Method. A chart review was conducted on patients undergoing canalplasty for auditory exostoses between 2002 and 2017. The surgical technique is described.

Results. The study comprised 43 adults (50 operated ears). Exostoses were bilateral in 40 cases (94 per cent) and occlusive in 33 (66 per cent). After drilling, the external auditory meatus was covered with a graft in 34 cases (68 per cent) and a silicone sheet was used in 32 (64 per cent). Cicatricial stenosis appeared in eight cases (16 per cent). Skin grafts were not used in six of these eight cases ($p < 0.04$), and silicone sheets were used only in one of these eight ($p < 0.01$).

Conclusion. Canalplasty is challenging because of its potential complications. Our data showed that the use of skin grafts and silicone sheets to cover the bared external auditory meatus was associated with a lower rate of cicatricial stenosis.

Main Article

Dr X M Rojas takes responsibility for the integrity of the content of the paper

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Introduction

Exostoses of the external auditory meatus are benign bone proliferations, with an estimated incidence of 0.05–0.6 per cent in the otology clinic.[1,2] Various archaeological studies have published records of exostoses in populations of present-day Lithuania since the Neolithic period,[3] among other cultures.[4,5]

These exostoses are considered of irritative nature, but for a long time there has been speculation about their aetiology.[3,4] Currently, the most accepted theory is that the irritation caused by cold water (between 15°C and 19°C)[6,7] in the bony external auditory meatus, where cortical layer is close to the lumen, producing the successive apposition of compact bone sheets.[8] Exostoses are usually bilateral lesions of sessile morphology. They rarely appear in people aged under 20 years, but they frequently emerge in water-sports practitioners.[3,6,9] Their diagnosis should be differentiated from osteomas, which are isolated and pedunculated lesions on tympanosquamous or tympanomastoid sutures,[10] and are not related to cold-water exposure.

Exostoses are usually asymptomatic,[6] but when external auditory meatus stenosis is severe, ear fullness may appear, as well as wax accumulation, recurrent otitis and conductive hearing loss.[8] Previously, exostoses have been classified according to the percentage of external auditory meatus obstruction found on microscopic examination of the ear,[11] and based on both oto-endoscopic and radiological findings.[1] They have also been classified as 'obliterative' if no portion of the tympanic membrane is visible, and 'less obliterative' based on the estimated percentage of closure of the ear canal's lumen, using computer software.[12]

Canalplasty is a challenging technique because of the potential complications associated with it. It is performed to restore the lumen of the external auditory meatus in symptomatic patients.[11] The reported complication rate ranges from 5 to 12.5 per cent.[13,14] Cicatricial stenosis is the most frequent complication, and it has been related to the meatal skin loss during the procedure. Other complications include tympanic membrane perforation, infection,[1,2,9] facial nerve injury, osteomyelitis and temporomandibular joint lesion.[15]

We sought to describe and analyse the results of our canalplasty surgical technique for the treatment of auditory exostoses by performing a retrospective case–control study, focusing on the development of cicatricial stenosis.

Materials and methods

An institutional board approved chart review was performed on patients who underwent external auditory meatus canalplasty via a retroauricular approach for the treatment of auditory exostoses, at our institution, between 2002 and 2017. Data were obtained from electronic medical records, and included information regarding medical examinations, surgical care sheets, clinical courses and performed tests. All patients signed informed consent forms prior to surgery.

Patients who underwent external auditory meatus canalplasty, and who met at least some of the following criteria, were included: recurrent otitis externa, ear fullness due

to wax accumulation, conductive hearing loss and patients who requested the procedure. Patients with external auditory meatus exostosis who also suffered from other pathologies that contraindicated surgery because of high anaesthetic risk were excluded from the study.

A total of 43 patients (50 operated ears) were identified consecutively from April 2002 to March 2017. The information collected included demographic data, surgical indication, lesion laterality, the operated side, exostosis severity, skin graft use, silicone sheet use, complications and recovery time. All patients underwent pre- and post-operative pure tone audiometry, which involved testing at 500, 1000, 2000 and 3000 Hz. Information regarding repeated exposure to cold water was attained.

Surgical technique

The surgical technique used for all patients was the same, with the only exception being the coating or non-coating of the bared portion of the external auditory meatus at the end of the procedure. Split-thickness free-skin grafts have been used in our department since 2005, because of the frequency of scar-tissue stenosis seen in our patients after canalplasty. Soon after that, silicone sheets were used to protect and stabilise the skin grafts.

We infiltrate the external auditory meatus and the retroauricular region with Svedocain (bupivacaine 5 mg/ml with adrenaline 0.005 mg/ml; Inibsa, Barcelona, Spain). Subsequently, we perform a retroauricular incision 1 cm from the sulcus and an endaural incision as medial as possible to preserve the greatest amount of skin. We extract a fragment of the temporal muscle fascia, as a preventive measure for a possible iatrogenic injury on the tympanic membrane. We make an incision on the external auditory meatus periosteum and merge the two incisions. Subsequently, a secondary surgical field is created using a Wullstein retractor, with stretched gauze, in the external auditory meatus.

If there is a pedunculated focus, we start the extraction with a chisel and hammer, and continue by drilling using the 'egg shell' technique. We start slowly drilling the posterior wall of the external auditory meatus until the tympanic membrane is identified, so that we can use it as a landmark for important, fragile structures (e.g. facial nerve or temporomandibular joint) (Figure 1).

Once the tympanic membrane is identified, we cover it with a 1 mm silicone sheet (Silastic; Suministros Hospitalarios, Madrid, Spain) (Figure 2). Next, a circumferential incision is made in the skin of the anterior wall of the external auditory meatus, on the anterior focus. The outer skin is pushed out, and the inner skin is detached from the focus and protected with Silastic during the drilling. The drilling ends when the tympanic membrane is completely visible. In most cases, a fragment of Silastic is placed on the tympanic membrane, enabling localisation of the eardrum in the case of cicatricial stenosis during the post-operative period. This way, we can eliminate this inflammatory tissue in the out-patient clinic without damaging the tympanic membrane.

The denuded part of the external auditory meatus is covered with a split-thickness skin graft from the antero-external thigh, or with an artificial dermis material (Integra; Integra LifeSciences, Plainsboro, New Jersey, USA). We place a circumferentially shaped Silastic sheet in the external auditory meatus (Figure 3). Finally, we place ear packing (Merocel; Medtronic Xomed, Jacksonville, Florida, USA) soaked with drops of ciprofloxacin (Laboratorios Salvat, Barcelona, Spain).

If, at the end of surgery, the remaining meatal skin covers most of the external auditory meatus, grafts and silicone sheets are not used; only Merocel packing is placed in the ear canal.

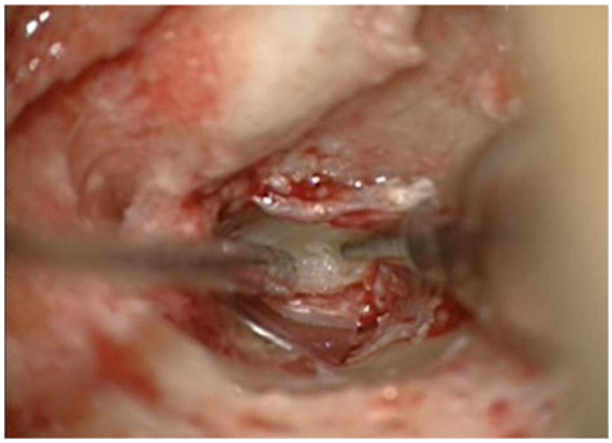

Fig. 1. 'Egg shell' drilling technique, starting at the posterior wall of the external auditory meatus.

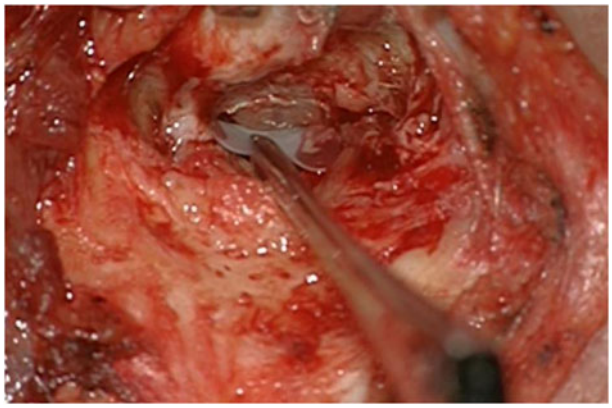

Fig. 2. Silicone sheet used to protect the tympanic membrane during surgery.

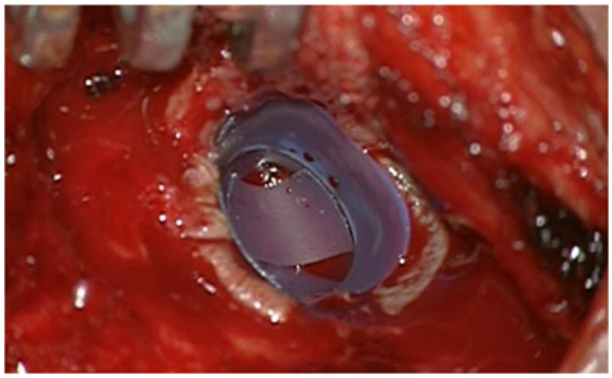

Fig. 3. Circumferentially shaped silicone sheet used to protect the skin graft.

Statistical analysis

Statistical analysis was performed using SPSS software, version 20 (IBM, Chicago, Illinois, USA). The chi-square statistical test was used for the analysis. A p-value of less than 0.05 was considered a statistically significant result.

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We compared patients in whom a silicone sheet and/or skin graft were placed in the external auditory meatus during surgery with those in whom they were not, in order to assess whether there was a statistically significant difference in the incidence of cicatricial stenosis of the ear canal during the post-operative period.

Results

A total of 43 patients were analysed, 7 of whom underwent bilateral canalplasty procedures, for a total of 50 ears. For patients in whom bilateral external auditory meatus recanalisation was performed, the minimum interval between interventions was six months. The same number of surgical procedures was performed on right and left ears.

Thirty-nine of the patients were men (90.6 per cent) and four were women (9.3 per cent). The mean age at the time of surgery was 49.9 years (standard deviation = 9.4), with an age range of 33–68 years. Obstruction severity was recorded for both ears, and was classified as occlusive in 33 cases (66 per cent) and non-occlusive in 17 cases (34 per cent). The indication for surgery was conductive hearing loss in 23 cases (46 per cent), followed by recurrent infection in 17 cases (34 per cent). Patients' exposure to cold water is summarised in Table 1.

Three tympanic membrane perforations occurred during canalplasty, which were immediately repaired using temporalis fascia. There was one case (2 per cent) of external auditory meatus infection, and eight cases (16 per cent) of cicatricial stenosis. All stenoses were treated in the out-patient clinic. No injuries to the facial nerve or temporomandibular joint were reported.

As seen in Table 2, the external auditory meatus had not been covered with a skin graft during surgery in six out eight cases (75 per cent) of cicatricial stenosis ($p = 0.04$), with an odds ratio of 9.6 (confidence interval = 1.67–55.56).This indicates that the risk of developing stenosis was 9.6 times higher if no graft was used. Similarly, when a Silastic sheet was not used (Table 3), the odds ratio was 19.61 (confidence interval = 2.17–166.67) ($p < 0.01$), implying that the odds of developing scar-tissue stenosis was 19.61 higher if no silicon sheet was used. Only 2 of the 34 patients (5.9 per cent) who received both a skin graft and a Silastic sheet (Table 4) developed cicatricial stenosis ($p = 0.05$).

Audiological analysis was conducted for all cases. No audiometric deterioration was reported in any patient; however, the post-operative air–bone gap improved by 10 dB in all patients who underwent surgery for conductive hearing loss.

Follow up

All patients were followed after the surgical intervention. The median follow-up time was 16 months (range, 6–47 months). No patients were lost to follow up.

Table 1. Exposure to cold water

Aquatic sport	Patients (*n*)
Canoeing	1
Swimming	15
Diving	11
Surfing	3
No aquatic practice	13
Total	43

Table 2. Relationship between skin graft use and scar-tissue stenosis

Scar-tissue stenosis appearance	Skin graft used*	No skin graft	Total
Cicatricial stenosis	2	6	8
No cicatricial stenosis	32	10	42
Total	34	16	50

Data represent numbers of cases. $P < 0.04$. *To cover the external auditory meatus

Table 3. Relationship between silicone sheet use and scar-tissue stenosis

Scar-tissue stenosis appearance	Silicone sheet used*	No silicone sheet	Total
Cicatricial stenosis	1	7	8
No cicatricial stenosis	31	11	42
Total	32	18	50

Data represent numbers of cases. $P < 0.01$. *To cover the external auditory meatus

Discussion

Auditory exostoses are mainly asymptomatic lesions. Surgical treatment is usually indicated only in symptomatic patients, and seeks to improve their quality of life. The surgical techniques for external auditory meatus recanalisation have evolved since the nineteenth century, and involve using osteotomes, drills, the recently reported piezoelectric saw[14] or combined techniques. Nevertheless, successful canalplasty is still a challenge because of the potential complications.[1,13,14,16]

In this study, we found a statistically significant and clinically relevant reduction in the incidence of post-operative canal scarring when a silicone sheet and/or skin graft were used (compared with their non-use).

We employ the 'egg shell' drilling technique.[9] We start drilling slowly at the posterior wall of the external auditory meatus until a portion of the tympanic membrane is identified, and we use this as a landmark for fragile structures. Only removal of anterior exostosis has been effectively described elsewhere.[17]

Table 4. Relationship between use of both materials and scar-tissue stenosis

Scar-tissue stenosis appearance	No materials used	Silicone sheet used	Skin graft used	Both materials used	Total
Cicatricial stenosis	6	0	1	1	8
No cicatricial stenosis	7	3	4	28	42
Total	13	3	5	29	50

Data represent numbers of cases

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External auditory meatus obstruction has a direct relationship with symptom onset, and therefore with the decision to perform surgery. When present, symptoms usually include ear fullness, conductive hearing loss and recurrent otitis externa.[8]

- Auditory exostoses present rarely in the otology clinic, but are frequently found in water-sports practitioners
- Exostoses are usually asymptomatic, but when canal stenosis is severe, symptoms include ear fullness, conductive hearing loss and recurrent otitis externa
- Canalplasty is challenging because of the risk of damaging important structures (e.g. facial nerve, temporomandibular joint) while drilling
- Furthermore, canalplasty is associated with post-operative complications including scar-tissue stenosis
- In this study, skin graft and silicone sheet use was associated with significantly less post-operative scar-tissue stenosis

Exostoses are frequently seen in water-sports practitioners. Interestingly, in our sample, 13 patients did not have a history of repeated water exposure. This finding could be related to the restraints of performing a retrospective study. Nevertheless, we hypothesise that the real prevalence in our population is higher, because of our geographic location near the north Atlantic coast.

Some of the study's limitations include those inherent to its retrospective profile, the relatively small sample size and the potential risk of bias regarding the heterogeneity of the follow-up period. However, to the best of our knowledge, this is the first study to analyse and find a decrease in cicatricial stenosis in cases where the bared external auditory meatus was covered with a skin graft and protected with a silicone sheet at the end of the surgery. This finding is clinically relevant; the odds ratios are clearly positive, which implies a protective role. It should be noted that the confidence intervals are wide, but this is because of the sample size. Further studies with larger sample sizes are needed to reduce these confidence intervals; however, this only affects the outer limits of the confidence intervals.

Conclusion

Auditory Exostoses predominantly occurs in middle-aged males. It is usually an asymptomatic lesion; surgery is indicated only when symptoms, such as hearing loss, repetitive infection and cerumen accumulation, appear.

Canalplasty is challenging to perform; its success depends on the particularity of each case and the surgeon's experience. Our data support the use of a silicone sheet and skin graft for significantly less scar-tissue stenosis during the post-operative period. Therefore, we believe that the recommendation to use a skin graft and silicon sheet is justified when the remaining skin does not cover the ear canal.

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Competing interests. None declared

References

1 Grinblat G, Prasad SC, Piras G, He J, Taibah A, Russo A *et al.* Outcomes of drill canalplasty in exostoses and osteoma: analysis of 256 cases and literature review. *Otol Neurotol* 2016;**37**:1565–72
2 Sanna M, Russo A, Khrais T, Jain Y, Augurio M. Canalplasty for severe external auditory meatus exostoses. *J Laryngol Otol* 2004;**118**:607–11
3 Okumura MM, Boyadjian CH, Eggers S. An evaluation of auditory exostoses in 621 prehistoric human skulls from coastal Brazil. *Ear Nose Throat J* 2007;**86**:468–72
4 DiBartolomeo JR. Exostoses of the external auditory canal. *Ann Otol Rhinol Laryngol* 1979;**88**:2–20
5 González Reimers E, Lorenzo de la Peña L, Sarmiento-Herrera R, Pérez Piñeiro B, Arnay de la Rosa M. Ear exostoses: a past and present lesion [in Spanish]. *Rev Esp Enferm Metab Oseas* 2008;**17**:112–13
6 Alexander V, Lau A, Beaumont E, Hope A. The effects of surfing behaviour on the development of external auditory canal exostosis. *Eur Arch Otorhinolaryngol* 2015;**272**:1643–9
7 Van Gilse PHG. Subsequent observations on the genesis of external auditory canal exostoses by cold water irritation [in French]. *Acta Otolaryngol (Stockh)* 1938;**26**:343–52
8 King JF, Kinney AC, Iacobellis SF, Alexander TH, Harris JP, Torre P *et al.* Laterality of exostosis in surfers due to evaporative cooling effect. *Otol Neurotol* 2010;**31**:345–51
9 Altuna Mariezkurrena X, Vea Orte JC, Camacho Arrioaga JJ, Algaba Guimerá J. Surgical treatment of exostosis in the external auditory canal [in Spanish]. *Acta Otorrinolaringol Esp* 2006;**57**:257–61
10 Hutchinson DL, Denise CB, Daniel HJ, Kalmus GW. A reevaluation of the cold water etiology of external auditory exostoses. *Am J Phys Anthropol* 1997;**103**:417–22
11 House JW, Wilkinson EP. External auditory exostoses: evaluation and treatment. *Otolaryngol Head Neck Surg* 2008;**138**:672–8
12 Hetzler DG. Osteotome technique for removal of symptomatic ear canal exostoses. *Laryngoscope* 2007;**117**(1 Pt 2 suppl 113):1–14
13 Fisher EW, McManus TC. Surgery for external auditory canal exostoses and osteomata. *J Laryngol Otol* 1994;**108**:106–10
14 Puttasiddaiah PM, Browning ST. Removal of external ear canal exostoses by piezo surgery: a novel technique. *J Laryngol Otol* 2018;**132**:840–1
15 Barrett G, Ronan N, Cowan E, Flanagan P. To drill or to chisel? A long-term follow-up study of 92 exostectomy procedures in the UK. *Laryngoscope* 2015;**125**:453–6
16 Mudry A, Hetzler D. Birth and evolution of chiselling and drilling techniques for removing ear canal exostoses. *Otol Neurotol* 2016;**37**:109–14
17 Longridge NS. Exostosis of the external auditory canal: a technical note. *Otol Neurotol* 2002;**23**:260–1

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