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Soft-wall reconstruction of the canal wall with retrograde bone work for pediatric cholesteatoma: Long-term results

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ABSTRACT

Objective: To retrospectively evaluate the long-term results of surgery for retrograde bone work, using soft-wall reconstruction of the canal wall, for pediatric cholesteatoma.
Methods: We retrospectively evaluated a series of 25 consecutive ears of 24 patients who were ≤16 years of age. All children underwent cholesteatoma surgery between October 2002 and August 2008. The type of cholesteatoma, the length of follow-up, the incidence of residual and recurrent cholesteatoma, postoperative hearing results, and the form of the reconstructed external canal wall and tympanic membrane were assessed.
Results: There were 21 males and 3 females. The procedure was performed on both ears of one patient who had bilateral congenital cholesteatoma (CC). At the initial surgery, 16 cases (64%) had CC and nine (36%) had acquired cholesteatoma (AC). The mean age at surgery was 8.2 years and 10.4 years for CC and AC cases, respectively. The mean postoperative follow-up period after the initial surgery was 90 months for CC cases and 108 months for AC cases. Cholesteatoma recurrence occurred for 6% and 56% of cases with CC and AC, respectively. Successful serviceable hearing was achieved for 93.8% with CC and 100% with AC. Cases with inadequate hearing after surgery were characterized by disease extension to the mastoid and the protympanum. The long-term forms of the reconstructed external canal wall changed depending on their middle ear aeration. Some cases of tympanic membrane perforation and otitis media with effusion were occurred during the follow-up period.
Conclusion: Overall, the retrograde approach with soft-wall reconstruction of the canal wall achieved a low recurrence rate for cholesteatoma and good hearing outcomes during long-term follow-up for the pediatric case. However, in cases with eustachian tube dysfunction and/or cholesteatoma involving the protympanum, the hearing outcomes were less favorable.

1. Introduction

Cholesteatoma surgeries are performed in order to prevent recurrence of the disease and to preserve or improve hearing. The canal wall down (CWD) procedure was modified using soft-wall reconstruction (SWR) techniques for the external auditory canal (EAC) to avoid the complications of the CWD techniques and achieve a lower recurrence rate compared with use of the canal wall up (CWU) technique in the pediatric population. CWU technique maintains the normal anatomy of the ear canal by preserving the bony canal wall and this ensures normal skin migration helps to reduce the healing time. Although this technique helps to reduce the healing time, the exposure of the epitympanum, facial recess and tympanic sinus is limited during the surgery, which can lead to cholesteatoma recurrence. Open method tympanoplasty in CWD techniques, as this provides excellent exposure for cholesteatoma removal and thus leads to lower residual rates. When using this procedure, however, the cavity is incompletely cleaned and this can lead to subsequent bowl infections, or the so-called cavity problem. In an attempt to find a solution that does not lead to the above problems, a method that uses several graft materials during CWD technique to reconstruct the posterior wall of the EAC has been

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developed. Tos described an inside-out CWD mastoidectomy technique and called it retrograde mastoidectomy [1]. The surgeon usually followed the cholesteatoma posteriorly and performed an atticotomy, aditotomy, and antrotomy, as necessary, avoiding excess bone removal and a larger mastoidectomy, if the cholesteatoma did not extend into the antrum or mastoid air cells. The case of tympanic sinus cholesteatoma extending into the posterior attic and aditus ad antrum is another common situation which is suitable for retrograde bone work. Depending on the extent of the cholesteatoma and the pneumatization, we conducted retrograde bone work in our cholesteatoma cases. After the enlargement of the EAC bony wall by retrograde bone work, the canal wall was reconstructed by simultaneously performing myringoplasty using a large piece of fascia. The advantages of this procedure are the excellent surgical exposure of the posterior tympanum, the simplicity of the reconstructive technique of the canal wall, and the short recovery period. Since the surface area of the skin defect is as small as that found for the CWU technique, this leads to early wound healing. We previously reported relatively short-term outcomes for a series of pediatric cholesteatoma cases for which we performed retrograde-type bone work followed by SWR [2]. This reports documents in detail the long-term outcomes of this procedure in congenital cholesteatoma (CC) and acquired cholesteatoma (AC) of the pediatric population.

2. Material and methods

2.1. Cases

We retrospectively evaluated a series of 25 consecutive cases who were 16 years old or younger. All children underwent cholesteatoma surgery in the Department of Otolaryngology of Kanazawa University Hospital between October 2002 and August 2008. The study has been reviewed and approved by the Kanazwa University Institutional Review Board (IRB). All patients were operated under general anesthesia, and retrograde mastoidectomy with widening the EAC was carried out on demand for the bone work, as a modified technique described by Tos [1]. The EAC was reconstructed using the soft-wall technique with a piece of temporal fascia. The type of cholesteatoma, age at the time of surgery, sex, follow-up time, surgical findings during the first operation, recurrence, ossicular reconstruction, and hearing outcomes were assessed.

2.2. Surgical procedure

The procedure used for retrograde bone work was dependent upon the extent of the cholesteatoma and mastoid pneumatization. Using a retroauricular approach, we performed an atticotomy if the cholesteatoma was restricted. Sufficient large otosclerosis drilling was performed to ensure a visual field if the cholesteatoma extended to the sinus tympani. Fig. 1 shows representation of cholesteatoma, which was found in the attic and the sinus tympani. In case the cholesteatoma which cannot be removed by removing the posterior superior annular bone, drilling was continued to the aditus. The small aditotomy can be closed with a piece of fascia and an ossiculoplasty can be performed after the cholesteatoma was safely removed. In addition, when the cholesteatoma extended beyond the antrum, a small to large CWD mastoidectomy was performed. After the cholesteatoma was removed, ossicular chain reconstructions were performed at the same time, if appropriate. If this was not possible, we performed a staged reconstruction. Temporal muscle fascia was used for the tympanic membrane (TM) reconstruction and to provide support for the skin on the posterior wall skin EAC. To achieve proper aeration of the middle ear, in nearly all planned surgery cases, a silicone sheet (KOKEN CO., LTD., Tokyo, Japan) of 0.3-mm thickness was placed into the tympanum. Fewer than half of the planned surgeries required a simultaneous tympanostomy tube (tympanic drain tube type B, KOKEN CO., LTD., Tokyo, Japan) insertion. Cases those were concerned about having eustachian tube dysfunction needed silicone sheet and simultaneous tympanostomy tube insertion. Cholesteatoma was limited in the tympanum, and we were confident of complete removal of the cholesteatoma during surgery; the second surgery was unplanned. At least six months after the initial surgery, the second surgery was conducted for the patient as planned. To achieve a good surgical visual field, some cases required revision mastoidectomies, depending upon the extent of the cholesteatoma recurrence. Revision mastoidectomy was also performed to remove the bone outgrowth. To reconstruct the ossicular chain, we used autologous ossicle as the first choice of graft material. Alloplastic graft materials (hydroxyapatite cement) were used the second choice of material. SWR was carried out same as the initial surgery. We used fibrin glue in all surgeries to reconstruct the posterior wall skin and the TM.

2.3. Evaluation of hearing outcome

Hearing results were assessed using the Japan Otological Society's 2010 Guidelines for Reporting Hearing Results in Middle Ear and Mastoid Surgery. The hearing was determined as successful if the postoperative hearing level meet at least one of the following three criteria: (1) Air-bone gap <15 dB (dB), (2) Hearing gain >15 dB, and (3) Hearing level <30 dB with pure-tone averages at three different frequencies (500, 1000, and 2000 Hz). The air-bone gap measurement used the preoperative bone conduction and postoperative air conduction. Cases with hearing improvement did not achieve the criteria (1) nor (2) were they classified as “inadequate” hearing cases, even though they had socially acceptable hearing in this study.

2.4. Data analysis

The following parameters were analyzed: the type of cholesteatoma, age at the time of surgery, sex, follow-up time, surgical findings during the first operation, recurrence, ossicular reconstruction, and hearing outcomes. Statistical analysis of the data between CC versus AC was performed using SAS version 9.4 (Cary, NC), and tests were performed using the Mann–Whitney *U* test and Mantel–Haenszel test. A difference was considered statistically significant at $p < 0.05$.

3. Results

3.1. Characteristics and surgical findings

Among the 25 cases, for which data were available, there were 21 males and 3 females. The procedure was performed on both ears of one patient that had bilateral CC. At the initial surgery, 16 cases (64%) had CC and 9 (36%) had AC (Table 1). The mean age at surgery was 8.2 years and 10.4 years for CC and AC cases, respectively. The proportion of cases that were male was similar in the CC and AC groups (87.5% and 88.9%, respectively). The mean postoperative follow-up period after the initial surgery was 90 months for CC cases and 108 months for AC cases. Fig. 2 shows the distribution of type of cholesteatoma among different age groups. CC was more common in younger cases, and the majority of the AC cases were in the older age groups. No significant differences were seen in mean age and follow-up time between CC and AC.