ORIGINAL ARTICLE

Ossiculoplasty With Titanium Prosthesis☆

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KEYWORDS
Middle ear; Ossiculoplasty; PORP; TORP; Titanium prosthesis

Abstract

Objectives: The goal of this study was to make a review of the patients who underwent ossicular chain reconstruction with titanium prosthesis during an 8-year period in our Department.

Methods: A retrospective study was made on the ossiculoplasty cases over a period of eight years in a Public Hospital District. The information was extracted by clinical process consultation. Between 1999 and 2008, 124 ossiculoplasties using Kurz® titanium prosthesis for chronic otitis media were performed (78 partial ossicular chain reconstructions and 46 total ossicular chain reconstructions). The single stage, staged and revision ossicular chain reconstruction were included in the analysis. All patients had a minimum of 6-month postoperative follow-up (mean 3 years and 4 months). Comparisons of preoperative and postoperative pure tone averages were performed. Air-bone gap and implant extrusion rates were measured. The success of the reconstruction was defined as a postoperative air-bone gap (ABG) of 20 dB or better.

Results: Successful ossiculoplasty was obtained in 73.1% of partial ossicular chain reconstructions and 30.4% of total ossicular chain reconstructions (P<.05). The postoperative pure-tone average air-bone gaps was 16 dB in partial reconstructions and 26.7 dB in total reconstructions (P<.05). There were five cases of prosthesis extrusion.

Conclusions: The majority of the ossiculoplasties improved the hearing status satisfactorily. There was no difference in hearing results in one-stage and two-stage partial ossicular chain reconstruction, but there were better hearing results in the cases of two-stage total ossicular chain reconstruction.

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PALABRAS CLAVE
Oído medio; Ossiculoplastia; PORP; TORP; Prótesis de titanio

Resumen

Objetivos: Revisión de los pacientes sometidos a una reconstrucción de la cadena osicular con prótesis de titanio durante un periodo de ocho años en nuestro Servicio.

Métodos: Hemos revisado retrospectivamente las ossiculoplastias realizadas durante un periodo de ocho años en un hospital público de distrito. La información se ha obtenido mediante consulta del proceso clínico. Entre 1999 y 2008, se realizaron 124 ossiculoplastias usando la prótesis...
de titanio de Kurz® en casos de otitis media crónica (78 reconstrucciones parciales y 46 reconstrucciones totales de la cadena osicular). Se incluyeron en el análisis las reconstrucciones en un solo tiempo y dos tiempos quirúrgicos, así como las cirugías de revisión. Todos los pacientes tuvieron un seguimiento mínimo posquirúrgico de 6 meses (un promedio de 3 años y 4 meses). Se realizaron comparaciones del promedio de tonos puros óseo y aéreo pre y posquirúrgico. Se midieron los porcentajes de la brecha aérea-ósea y los casos de extrusión de la prótesis. Utilizamos como criterio de éxito la brecha aérea-ósea inferior o igual a 20 dB.

Resultados: Se lograron osiculoplastias con éxito en el 73,1% de las reconstrucciones osiculares parciales y en el 30,4% de las reconstrucciones osiculares totales (p < 0,05). El promedio de la brecha aérea-ósea posquirúrgica fue de 16 dB en las reconstrucciones parciales y de 26,7 dB en las reconstrucciones totales (p < 0,05). Se produjeron cinco casos de extrusión de la prótesis.

Conclusiones: La mayoría de las osiculoplastias mejoró satisfactoriamente la audición. No se produjo diferencia alguna en los resultados audiométricos de la reconstrucción de la cadena osicular parcial entre uno o dos tiempos quirúrgicos, aunque se obtuvieron mejores resultados audiométricos en los casos de reconstrucción de la cadena osicular total en dos tiempos quirúrgicos.

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Introduction

Ossicular chain reconstruction represents an attempt to restore the mechanical transmission of sound from the tympanic membrane to the oval window (inner ear) when the ossicular chain has been affected by a pathological process or trauma. Numerous biological and prosthetic materials have been used and developed since the beginning of ossicular chain reconstruction procedures in the decade of the 1950s: autologous bone or cartilage, polyethylene, ceramic hydroxyapatite, Plastipore-type microporous polymer and high strength metals such as titanium. Titanium reconstruction prostheses have been used in Germany since 1993, and at our institution since 1999. Titanium has proven to be an excellent material for ossicular reconstruction because of its high biocompatibility, biostability, low weight and high rigidity, which are the characteristics suitable for excellent sound transmission.

We used Aerial titanium prostheses produced by Kurz® Düsseldorf for total ossicular replacement prosthesis (TORP) procedures, and Bell prostheses for partial ossicular replacement prosthesis (PORP) procedures.

The aim of this study involved the review of patients undergoing ossicular chain reconstruction with titanium prosthesis at our department for a period of 8 years, as well as consideration of the results.

Materials and Methods

We performed a retrospective study of all data obtained from patients undergoing ossicular chain reconstruction with titanium prosthesis at our department from 1999 to 2008, which included 124 ossiculoplasties performed by different surgeons in our Department.

The most common mastoidectomy technique was the reconstruction of the canal wall, which was performed using conchal cartilage. In most cases, ossicular chain reconstruction was undertaken in a primary manner (that is, without staging), even in the presence of cholesteatoma. Staging was chosen in those cases where complete resection of the problem area was questioned, and in cases of severe mucosal stripping that could jeopardize the creation of a middle ear cleft with air occupation.

PORP prostheses were used in the absence of an incus, or when it was eroded, and there were stapedial superstructures. TORP prostheses were used in the absence of the incus and of stapes superstructures. Cartilage was used in all cases, placed between the tympanic membrane and the prosthesis. The prostheses were fixed using Gelfoam.

Diagnoses included mixed or conductive hearing loss, tympanic membrane perforation with cholesteatoma, and tympanic membrane perforation without cholesteatoma

Table 1

<table>
<thead>
<tr>
<th>Preoperative Diagnosis</th>
<th>PORP Group</th>
<th>TORP Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive or mixed auditory loss</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Perforation of the tympanic membrane with cholesteatoma</td>
<td>37</td>
<td>35</td>
</tr>
<tr>
<td>Perforation of the tympanic membrane without cholesteatoma</td>
<td>25</td>
<td>8</td>
</tr>
</tbody>
</table>
defined as a postoperative ABG of 20 dB or more, with a minimum follow-up of 6 months.

All group comparisons were analysed using SPSS software (version 18.0).

Results

In the PORP group (78 patients), 62 individuals (79.5%) underwent ossicular reconstruction in a single stage and 16 (20.5%) underwent treatment staging (Table 1). We performed 49 reconstructions of the ossicular chain without mastoidectomy and 30 mastoidectomies with ossicular reconstruction (Table 2).

The mean preoperative PTA-ABG was 29 dB and the mean postoperative PTA-ABG was 16 ± 9.9 dB, which represents a mean hearing increase of 13.2 ± 12.1 dB (Table 3).

In conducting the review of our results based on the ABG, we found that ossiculoplasty was successfully achieved in 57 of 78 patients (73.1%), corresponding to 46 cases of single-stage partial ossicular reconstruction (74.1%) and to 11 cases of reconstruction in two stages (68.8%) (Table 3). We had only 2 cases (2.5%) of review surgery due to recurrent cholesteatoma and extrusion of the prosthesis.

In general, there was an improvement of hearing in the majority of the PORP group (Figs. 1 and 2).

In the TORP group (46 patients), 26 individuals (56.5%) underwent ossicular reconstruction in one stage (43.5%) and 20 underwent a procedure in various stages (Table 2. We carried out 28 ossicular chain reconstructions without mastoidectomy and 18 mastoidectomies with reconstruction of the ossicular chain (Table 2).

<table>
<thead>
<tr>
<th>Table 2 Type of Surgery Performed in the TORP and PORP Groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PORP</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Single-stage</td>
</tr>
<tr>
<td>Two stages/review</td>
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<tr>
<td><strong>TORP</strong></td>
</tr>
<tr>
<td>Single-stage</td>
</tr>
<tr>
<td>Two stages/review</td>
</tr>
</tbody>
</table>

Figure 1 Comparison of the preoperative and postoperative air-bone gap (ABG) in single-stage PORP surgery.

Figure 2 Comparison of the preoperative and postoperative air-bone gap (ABG) in PORP surgery in various stages (below the line, there is improvement).

The group that underwent TORP implantation had a mean preoperative PTA-ABG of 37 dB, with the mean postoperative PTA-ABG being 26.7 ± 11.3 dB, representing a hearing increase of 10.3 ± 12.4 dB.

<table>
<thead>
<tr>
<th>Table 3 Preoperative Versus Postoperative PTA-ABG.</th>
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</thead>
<tbody>
<tr>
<td><strong>Preoperative PTA-ABG, dB</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>PORP</strong></td>
</tr>
<tr>
<td>No.=78</td>
</tr>
<tr>
<td>Various stages No.=16</td>
</tr>
<tr>
<td><strong>TORP</strong></td>
</tr>
<tr>
<td>No.=46</td>
</tr>
<tr>
<td>Various stages No.=20</td>
</tr>
</tbody>
</table>

PTA-ABG: pure-tone audiometry air-bone gap.
Table 4  Results of the Air-Bone Gap With TORP and PORP.

<table>
<thead>
<tr>
<th>ABG, Postoperative dB</th>
<th>Successful Auditory Results, % (Number of Patients)</th>
<th>PORP</th>
<th>TORP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–10</td>
<td>Single-Stage Various Stages</td>
<td>43.5 (27/62)</td>
<td>25 (4/16)</td>
</tr>
<tr>
<td>11–20</td>
<td>Single-Stage Various Stages</td>
<td>30.6 (19/62)</td>
<td>43.8 (7/16)</td>
</tr>
<tr>
<td>21–30</td>
<td>Single-Stage Various Stages</td>
<td>19.4 (12/62)</td>
<td>18.7 (3/16)</td>
</tr>
<tr>
<td>&gt;30</td>
<td>Single-Stage Various Stages</td>
<td>6.5 (4/62)</td>
<td>12.5 (2/16)</td>
</tr>
</tbody>
</table>

ABG: air-bone gap.
Figures in bold represent successful ossiculoplasties.

Discussion

The primary goal of surgery for chronic otitis media is the achievement of a safe, dry ear, disruption of recurrent ear drainage, and hearing improvement. Primary surgery consists in eradication of the disease (cholesteatoma and/or irreversibly diseased mucosa), which creates a middle ear fistula with air occupation, restoring the integrity of the tympanic membrane. In our service, ossicular chain reconstruction with titanium prostheses is performed in a single surgical stage in all cases, except in those in which complete resection of the problem is questionable, and when there is severe mucosal stripping.

In terms of hearing results, there is no difference between partial ossicular chain reconstruction (PORP) in one stage or in various stages.

Ossiculoplasty was achieved successfully in 14 of 46 patients (30.4%) of the total ossicular reconstructions, corresponding to 4 cases of single-stage reconstruction (15.4%) and 10 cases of the 2-stage procedure (50%) (Table 4). In the latter group, we had two review surgeries (4.3%) due to recurrent cholesteatoma and displacement of the prosthesis. In the TORP group, we obtained hearing improvement in most patients (Figs. 3 and 4), with better results in the 2-stage reconstruction (Fig. 4).

Considering both groups, the mean preoperative PTA-ABG was 32.1 dB and the mean postoperative PTA-ABG was 19.9 dB. These measurements represented a significant improvement over the preoperative values (P<.05).

There were 5 cases (4%) of extrusion of the prosthesis.

Conclusions

Most ossiculoplasties improved hearing conditions satisfactorily.

We obtained better results with partial implants than with total implants. The rate of extrusions of prostheses was higher than that reported in the literature.1,9–12
References