ORIGINAL ARTICLE

Myringoplasties in Children: Our Results

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Abstract

Introduction and objectives: Myringoplasty, one of the most frequent surgical techniques in otology, is the repair of tympanic membrane when the ear has only a perforation without any ossicular damage. The main objective of our work was to study the outcome of myringoplasty in patients less than 15 years of age. We also reviewed the existence of prognostic factors, such as Eustachian tube functionality, surgical technique and the hearing outcome after surgery.

Method: We present a retrospective study (1994–2010) with a total of 81 children (under 14 years of age) who had undergone myringoplasty during that period of time. For these children, we analysed age, sex, technique, approach, type of graft, type of perforation, anaesthesia, hearing gain and perforation closure. We correlated these variables with the success of the surgery.

Results: The percentage of closure was 84% (n=68). The techniques used were underlay in 79.01% (n=64), overlay in 11.11% (n=9) and sandwich in 9.87% (n=8). The percentage of patients with hearing improvement was 88.40% (n=61).

Conclusion: Myringoplasty is a surgical technique that offers good anatomical and functional results in children. We did not find prognostic factors in our study. We found postoperative improvement of hearing but it was not statistically significant.

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PALABRAS CLAVE

Miringoplastia; Perforación timpánica; Edad pediátrica

Miringoplastias en niños: nuestros resultados

Resumen

Introducción y objetivos: La miringoplastia es una de las intervenciones más frecuentes en otología. Consiste en la reparación de la membrana timpánica cuando la única lesión existente es una perforación y la cadena de huesecillos está íntegra. El objetivo principal de nuestro trabajo es estudiar el resultado de la miringoplastia en pacientes menores de 15 años. También analizar la existencia de factores pronósticos asociados, como la funcionalidad de la trompa de Eustaquio, técnica quirúrgica empleada y resultado auditivo tras la cirugía.

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**Métodos:** Realizamos un estudio retrospectivo desde el año 1994 hasta el 2010 de un total de 81 niños menores de 15 años intervenidos de miringoplastia. Analizamos los siguientes datos: edad, sexo, técnica empleada, abordaje y tipo de injerto, tipo de perforación, tipo de anestesia, ganancia auditiva y cierre de la perforación. Correlacionamos dichas variables con el éxito de la cirugía.

**Resultados:** El porcentaje de cierre de perforación fue de 84% (n = 68). Las técnicas utilizadas fueron medial en el 79,01% (n = 64), lateral 11,11% (n = 9) y "sandwich" 9,87% (n = 8). El porcentaje de casos que presentan ganancia auditiva tras la intervención fue de 88,40% (n = 61).

**Conclusión:** La miringoplastia es una técnica quirúrgica que ofrece buenos resultados anatómicos y funcionales en niños. No encontramos en nuestro estudio ningún factor pronóstico asociado. Encontramos mejoria auditiva post-operatoria aunque no significativa.

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**Introduction**

Type I miringoplasty or tympanoplasty is a surgical technique involving the repair of the tympanic membrane by different grafts, in cases where the only existing lesion is a tympanic perforation and the ossicular chain is undamaged and mobile.

It is the technique of choice for the closure of tympanic perforations, and is the most common otological surgery after myringotomy. Nevertheless, its use in children remains a matter of debate regarding the optimal age, technique and surgical indications. This is due to the difficulties inherent to the paediatric population, which include Eustachian tube dysfunction, anatomical arrangement and higher frequency of infections of the upper airways, leading to a higher number of otitis and thus a higher rate of reperforations.

On the other hand, this technique offers numerous benefits in the paediatric population, such as prevention of cholesteatomatosus otitis media and its complications, as well as erosion of the ossicular chain, improvement of the auditory function and, therefore, development of language and water activities.

**Objectives**

The main objective of our work was to study the outcome of miringoplasty among patients aged less than 15 years. In addition, to analyse the existence of associated prognostic factors, such as Eustachian tube functionality, surgical technique employed and hearing outcome after surgery.

**Methods**

We conducted a retrospective study between 1994 and 2010, reviewing a total of 162 medical records of patients younger than 15 years who underwent miringoplasty.

The exclusion criteria were as follows:

- Age over or equal to 15 years.
- Hearing loss of over 40% (percentage of hearing loss according to AMA).
- Undergoing ossiculoplasty.
- Reinterventions.
- Traumatic perforations.
- Incomplete records.

For each patient we analysed age, gender, condition of the affected and contralateral ears, the type of perforation and the main symptom. Regarding the surgical technique, we considered the following points: surgical approach, type of graft used and its placement, and type of anaesthesia applied. Success of the miringoplasty was defined as a closure of the perforation without lateralisations, retractions or serous otitis, after 12 months of postoperative evolution.

Auditory function was analysed by performing preoperative and postoperative tone threshold audiometry (TTA) (at 3–6 months and 1 year after surgery). We estimated the mean preoperative and postoperative differential hearing threshold (DHT) to calculate the hearing gain. Hearing success was defined as a gain over 5 dB.

Statistical analysis was performed using the software package SPSS® 15. We conducted a descriptive study of quantitative and qualitative variables, as well as univariate Chi-square study of qualitative variables.

**Results**

After applying the exclusion criteria, we obtained a total of 81 ears (37 right ears and 44 left ears), belonging to 35 males and 46 females. The mean age was 11.52 years ± 2.08 standard deviation (SD), ranging from 7 to 14 years, with the latter being the most common age (Fig. 1).

The percentage of closure of perforations was 84% (n=68), with no statistically significant relationship with gender or affected side.

Neither did we find any statistically significant association between age and the success rate of miringoplasty, but it is noteworthy that all patients aged 7 and 8 years presented a 100% rate of tympanic perforation closure (Table 1).

Regarding the condition of the contralateral ear, 53 were healthy and 28 were pathological (perforative otopathy, adhesive otopathy or seromucinous otitis). Among the latter we observed tympanic perforation in 15, retraction in 6 and serous otitis in 7 patients. The percentages of perforation closure were 88.7% and 75.3%, respectively, for healthy and pathological ears, with no statistical significance being found.

The main symptoms presented by patients in our study were as follows: otorrhea in 55.6%, hearing loss in 4.9%, otorrhea and hearing loss in 25.9% and no symptoms in 13.6%. We found no statistically significant relationship between both variables.
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In order of frequency, the types of perforation identified were posterior in 29.6% (n=24), central in 28.4% (n=23), anterior in 24.7% (n=20), subtotal in 23.1% (n=13) and total in only 1 case. Although we found no statistically significant relationship with the success of the surgery, in the case of anterior perforations only 1 case 5% (n=1) failed. This datum was relevant, since a higher failure rate has been described due to the scarce vascularisation of this area and its anatomical difficulty (Fig. 2). The rates of closure of central, posterior and subtotal perforations were 82.6%, 83.3%, and 76.9%, respectively. The only case of total perforation failed after the intervention.

We employed 2 types of anaesthesia: local infiltration and intravenous sedation in 33.3% (n=27) and general anaesthesia in 66.7% (n=54).

The approach routes to the surgical field were transmeatal in 86.4% (n=70) and retroauricular in 13.6% (n=11). We should note that in 2 cases with a transmeatal route we used an unloading incision. The closure rates of both pathways were very similar, 83.8% and 81.8%, with no statistically significant relationship being found.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Success Rate According to Age.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>Total</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
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<tr>
<td>10</td>
<td>12</td>
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<td>11</td>
<td>8</td>
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<tr>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>18</td>
</tr>
</tbody>
</table>

The type of graft used for surgery was tragal cartilage perichondrium in 77.8% (n=63) and temporal fascia in 22.2% (n=18). We found no statistically significant relationship between the type of graft and the success of myringoplasty, with the percentages being very similar, 82.5% and 88.9%.

We employed 3 types of graft placement: medial or underlay in 79% (n=64), lateral or overlay in 11.1% (n=9) and "sandwich" in 9.9% (n=8). The medial technique presented a success rate of 82.9% and the lateral of 77.8%. We did not find any statistical significance in relation to closure of the perforation.

The percentage of patients with hearing gain was 88.40% (n=61), 8 patients remained unchanged and in 1 case we recorded a slight worsening of hearing.

We analysed the DHT in order to study auditory function, obtaining a preoperative DHT of $27.98 \pm 8.1$ dB SD, and postoperative DHT of $15.40 \pm 15.1$ dB SD after 1 year of surgery. The mean hearing gain was $12.53 \pm 7.8$ dB SD (Fig. 3).

**Discussion**

The success rate for closure of perforations was 84%, comparable with that reported by other published series with
paediatric patients (Table 2). Moreover, the results were comparable to those reported in adult patients (Table 3).

At present, the age at which to perform surgery remains one of the main topics of discussion. In our study, the minimum age range stood at 7 years and we found no statistically significant differences compared to older age groups (14 years). The source of conflict lies in the age of maturity of the Eustachian tube. Several authors, such as Kotecha et al.15 and Kessler et al.,8 have reported a statistically significant relationship between age and the success rate of the surgery. More recently, Kumar et al.12 concluded that patients under 8 years of age presented a statistically significant relationship with the failure rate.

By contrast, multiple studies published in recent years did not find these results, such as Yung et al.,20 who concluded that patient age did not significantly influence the outcome of myringoplasty. Furthermore, this author advocates early surgery, since this does not only enable a rapid restoration of middle ear functions, but also helps to prevent deterioration and possible complications associated with chronicity of symptoms.1

The condition of the contralateral ear is an indirect indicator of Eustachian tube function and thus it is studied in various articles, as in the case of Manning et al., who reported that a good tubal function of the contralateral ear was a factor for good prognosis in the evolution of myringoplasty, although a poor function did not necessarily imply a poor outcome of surgery.21 Uyar et al.22 found that the success of myringoplasty was significantly higher among patients with a healthy contralateral ear.

When analysing the status of the contralateral ear, distinguishing between healthy (n=53) and non healthy (n=28) cases, our results agreed with those of various authors, such as Vartiainen et al.,23 Pignaro et al.,24 Singh et al.,25 Albera et al.26 and Lassaletta et al.6 Already in 1987, Ophir et al.3 reported that there was no applicable clinical method to evaluate tubal function accurately. Kumar et al.12 studied contralateral ears by measuring their preoperative airway conduction, categorising it as normal for cases >20 dB. However, they found no significant evidence which influenced the outcome of myringoplasty.

Due to the lack of consensus regarding the ideal age for surgery, we occasionally relied on the frequency of otorrhea of each patient to decide surgery, thus having cases in our service (not included in the study due to the exclusion criteria) of myringoplasties conducted on children under 6 years.

Among adults, myringoplasties are systematically performed with local anaesthesia and sedation. However, in our study there were a greater number of subjects operated under general anaesthesia (66.7%) than under local anaesthesia and sedation (33.3%), due to the age of patients.

Another amply debated topic regarding myringoplasties in children is the approach route, as well as the type of graft used. In our study we used the transmeatal or retroauricular route, depending on the anatomical conditions of the EAC and perforation (mainly a good visualisation of the tympanic margin). Our results agreed with those published in the literature, where no significant differences are reported between both pathways, as reflected in a recent work by Halim et al.10

Numerous types of grafts have been employed since Zoellner and Wildtstein first established this procedure in 1950, although temporal fascia and tragal perichondrium are the most common.27 We used these same grafts, depending on the approach route, and found no significant differences between them.

Regarding the technique employed for graft placement, we found an added anatomical peculiarity in children, especially in anterior and total perforations, since there was greater difficulty for access and placement of the graft support.28,29 According to Kumar et al.,12 anterior perforations have a significant association with failure of myringoplasty. It has been described that, in these cases, lateral placement or overlay of grafts would offer better results, although this would also carry a greater risk of complications (blunting, worse hearing and risk of iatrogenic cholesteatoma).28 Therefore, we mainly used the medial or underlay technique, obtaining a low failure rate (n=1). However, in recently published works, Singh et al.25 and Pignaro et al.24 found that the location of the perforation did not affect the success of the surgery or the hearing results.29

Although the fundamental objective of myringoplasty is to achieve an anatomical reconstruction of the tympanic membrane, occasionally we can also obtain a hearing improvement. Analysing the preoperative and postoperative DHT, we observed a mean hearing gain of 12.53 ± 7.8 dB SD. We obtained a success rate of 88.40%, similar to that reported in the literature (Table 4).

### Table 2 Closure of Perforations Reported by Different Authors Following Myringoplasty in Patients of Paediatric Age.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Sample</th>
<th>Closure rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ophir et al.3</td>
<td>1987</td>
<td>172</td>
<td>79</td>
</tr>
<tr>
<td>Caylan et al.4</td>
<td>1998</td>
<td>95</td>
<td>96.23</td>
</tr>
<tr>
<td>Denoyelle et al.5</td>
<td>1999</td>
<td>109</td>
<td>93.5</td>
</tr>
<tr>
<td>Lassaletta et al.6</td>
<td>1999</td>
<td>90</td>
<td>58</td>
</tr>
<tr>
<td>Bluestone et al.7</td>
<td>1979</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Kessler et al.8</td>
<td>1994</td>
<td>183</td>
<td>92</td>
</tr>
<tr>
<td>Pérez-Carro et al.9</td>
<td>2002</td>
<td>118</td>
<td>88</td>
</tr>
<tr>
<td>Halim et al.10</td>
<td>2009</td>
<td>180</td>
<td>78.9</td>
</tr>
<tr>
<td>Al-Khtoun et al.11</td>
<td>2009</td>
<td>35</td>
<td>85.7</td>
</tr>
<tr>
<td>Kumar et al.12</td>
<td>2010</td>
<td>132</td>
<td>67.3</td>
</tr>
<tr>
<td>Knapik et al.1</td>
<td>2011</td>
<td>201</td>
<td>84.9</td>
</tr>
<tr>
<td>Unapathy et al.2</td>
<td>2003</td>
<td>100</td>
<td>88</td>
</tr>
</tbody>
</table>

### Table 3 Closure of Perforations Reported by Different Authors following Myringoplasty in Adult Patients.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Sample</th>
<th>Closure rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albu et al.13</td>
<td>1998</td>
<td>544</td>
<td>79</td>
</tr>
<tr>
<td>Maeta et al.14</td>
<td>1998</td>
<td>109</td>
<td>90.4</td>
</tr>
<tr>
<td>Kotecha et al.15</td>
<td>1999</td>
<td>73</td>
<td>82.2</td>
</tr>
<tr>
<td>Williamson et al.16</td>
<td>1999</td>
<td>145</td>
<td>93.8</td>
</tr>
<tr>
<td>Raghavan et al.17</td>
<td>2000</td>
<td>106</td>
<td>96.23</td>
</tr>
<tr>
<td>Pérez-Carro et al.9</td>
<td>2002</td>
<td>25</td>
<td>85.59</td>
</tr>
<tr>
<td>Avilés et al.18</td>
<td>2008</td>
<td>83</td>
<td>75.9</td>
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<tr>
<td>Piedraola et al.19</td>
<td>2009</td>
<td>119</td>
<td>74.7</td>
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</table>
Table 4 Results of Hearing Improvement Percentage According to Different Authors.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Sample</th>
<th>Percentage of Hearing Improvement, %</th>
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<td>Lassaletta et al.</td>
<td>1999</td>
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<tr>
<td>Blanchard et al.</td>
<td>1990</td>
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<tr>
<td>Koch et al.</td>
<td>1990</td>
<td>64</td>
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<td>Umapathy et al.</td>
<td>2003</td>
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<td>Khotoum et al.</td>
<td>2009</td>
<td>35</td>
<td>77</td>
</tr>
<tr>
<td>Knapik et al.</td>
<td>2011</td>
<td>201</td>
<td>93.4</td>
</tr>
</tbody>
</table>

Conclusions

Myringoplasty is a surgical technique which provides good anatomical and functional results in children. We did not find any associated prognostic factors in our study. We found a postoperative hearing improvement, albeit not significant.

Conflict of Interests

The authors have no conflict of interests to declare.

References