

MYRINGOPLASTY – A REVIEW OF 438 CASES

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ABSTRACT

The medical records of 438 patients who underwent myringoplasty followed up for a minimum of one year in the period of 1980 and 2015 were revised. Examination under otomicroscope was done of the ear to be operated. This was carried out with a speculum under the operating microscope to be reliably assess the tympanic membrane, site of perforation, to rule out any other pathology and assess the status of ossicular chain. All the patients submitted primary myringoplasty surgery were operated under *postauricular, endaural and transcanal approach with overlay, underlay and inlay methods*. In the study the patients were divided into three groups depending upon the technique utilized to repair the tympanic membrane. When we compared overlay technique group with underlay technique group, it was observed that overlay technique was no statistically significant difference between these three groups in term of age wise distribution, gender wise distribution, duration of disease and cause of disease, due to matching at the time of selection. In this study the outcome in terms of graft uptake rate was slight better in the overlay technique (94%) as compared to the underlay technique (86.2%), though the difference was statistically insignificant, $P>0.05$. Patients selection may have had a role in the high success rate in the present study as patients presenting with middle ear pathology were excluded. The complications rate in the present study was quite low, no case in inlay group, three cases of graft lateralization in underlay group, and 19 cases in overlay group. In this study, better results were achieved with overlay technique may probably be due to less surgical manipulation and faster healing process.

Keywords: myringoplasty, onlay, overlay, inlay

INTRODUCTION

Tympanic membrane reconstruction one the most common surgical procedure in otological practice. Myringoplasty has been used for reconstruction of tympanic membrane for centuries. Surgery of the tympanic membrane head for restoration of drum continuity and protection of the middle ear is linked to the progress in eradication of infection of the middle ear and mastoid and prevent mortality. The ability to obtain a dry ear was a major factor in the quest to improve hearing with closure the membrane tympani. Major con-

tributions, both accidental and inspirational, led to the development of tympanoplasty techniques. These included the discovery of the significance of the eardrum and ossicle in hearing, attempts to develop an artificial eardrum, the search for an ideal graft material, the development and refinement of overlay and underlay techniques of tympanoplasty, the availability of antibiotics, specialized microinstruments and the operative microscope. It is considered to be a simple, easy-to complete otological surgery. Experience shows that this is

not the case. In fact, there are failures in myringoplasty, and some operations are more difficult than others. Therefore, in the present study, we would like to share our decades of experience in the treatment of perforated tympanic membrane.

In this study, medical records of 438 patients who underwent myringoplasty between 1976-2015 at University Clinic for Otorhinolaryngology of the Faculty of Medicine in Skopje, North Macedonia, were reviewed to identify patients, who were followed up for a minimum of one year. The review of records was undertaken in 2020. Written informed consent or personal agreement was obtained from patients or patient's parents who participated in this study.

Goals and expectations of myringoplasty

The two goals of myringoplasty are to achieve a dry ear by eradicating middle-ear disease and hearing improvement by grafting reconstruction. The results of myringoplasty are measured in terms of success of graft-take and hearing improvement. In order to obtain a fair assessment of the long-term success of ear surgery, it is the best to separate cases of benign central perforation from cases with cholesteatoma, previous tympanoplasty failure, severe mucosal disease, poor Eustachian tube function, and total loss of ossicular chain. Individuals with benign perforation and simple ossicular chain deficits have a very good-to excellent chance to obtaining a dry ear and hearing within the normal range. The chance that the graft will be accepted may expect in 90 to 95% of patients, and an 82 to 88% chance for a hearing gain go within 20 dB of bone level. We must be remembered that a myringoplasty may be considered partially successful if a dry, intact ear is obtained regardless of whether there is any hearing improvement. Patients with atelectasis ears and poor Eustachian function undergoing myringoplasty may benefited by insertion of long-term grommet prosthesis.

Indication for myringoplasty

Indication include tympanic membrane perforations and associated hearing loss, with or without middle ear pathology such as tympanosclerosis, retraction pockets, cholesteatoma, and congenital meatal atresia.

Contraindications for myringoplasty

Absolute contraindication for myringoplasty include poor general health, malignant tumors of the outer or middle ear, uncontrolled cholesteatoma, unusual infection such as malignant otitis external, and complications of chronic ear disease such as meningitis, brain abscess, or sigmoid sinus thrombosis. Operative intervention is also contraindicated on the only or significantly better hearing order to avoid risk of irreversible conductive hearing loss. Operating on the better hearing ear with satisfactory results may be considered in selected cases. Any acute exacerbation of chronic otitis media, chronic mucous discharge associated with allergic rhino sinusitis, or chronic otitis external should be controlled with appropriate treatment prior the myringoplasty. A nonfunctioning Eustachian tube is a relative contraindication to myringoplasty; although this is not always easily determined preoperatively.

Patients selection and evaluation

Careful evaluation of the symptoms and findings allows to determine the need for surgery, its urgency, and the anticipated result. Only by completing evaluation can the patients be advised properly.

In children with abundant adenoid vegetation's, which harbors bacteria or an internal occlusion of the *Eustachian* tube it is necessary to perform curettage of the epipharynx. Furthermore, children are also more prone to upper respiratory tract infection. Special circumstances such a cleft palate and other oromandibular congenital deformities are also contributory.

Unless there is a cholesteatoma or bilateral tympanic membrane perforations, myringoplasty in children it is best to avoid elective surgery between the ages of 4 and 8 years when the incidence of otitis media decrease, especially serous otitis media, and a satisfactory outcome is more likely. If the problem is bilateral, there is a hearing problem, and the ears do not drain often, fitting with hearing aids in each ear may be preferable for children younger than 8 ears; however, the parents have to make decision. At age 8 and thereafter, the patients and child should be allowed to make the decision.

When surgery becomes necessary in young children the authors prefers using cartilage grafts,

which are resistant even to continuous Eustachian tube dysfunction. Indications for myringoplasty in the elderly patients should be individualize. With modern anesthetic techniques, an older individual in relatively good general health can be operated on without any significant risk. In cases of myringoplasty or when general anesthesia is contraindicated, local anesthesia with sedation can be used as well.

Patients counseling

Patients should be properly informed regarding the nature of their disease process, treatment opinions, and the proposed surgical procedure, postoperative care, including expected outcomes, potential risk and complications, and the possibility of a second-stage operation. The surgeon must explain that the likelihood of obtaining a permanently healed, dry ear, which may be treated normally, is better than 90%.

Preoperative protocol

During our decades of experience in ear surgery, regardless of whether there is an infection or not, we recommend preoperative and postoperative treatment with antibiotics for 10 days. Complete hemostasis is imperative in ear surgery. Discontinuation of aspirin and other anti-inflammatory medications 10 days prior to surgery, as well anticoagulant treatment.

SURGICAL APPROACH

The procedure is performed under local or general anesthesia. Injection of retro auricular incision and ear canal with *Lidocaine 2% (Xylocaine®)* with 1:100.000 epinephrine it is necessary to do it 15 minutes early.

Depending on our experience, nature and extent of the pathologic lesion of the middle ear and mastoid, operations can be done with *postauricular, endaural and transcanal approaches*. As grafting we used cartilage, perichondrium, and fascia.

The *postauricular incision* begins of the pinna and ends at the mastoid tip. The incision may lie either 0.5-1 cm behind the postauricular groove. In infants and children up to 2 years of age, the *postauricular incision* must be slanting posteriorly to avoid facial nerve section who is

placed superficially. In these children the mastoid process is not developed and stylomastoid foramen from where facial nerve emerges is located more superficially.

The incision employed for the *endaural approach* has two parts. The first semicircular horizontal incision is made at the bony cartilaginous junction in the posterior meatal wall. The incision extend from 12 o'clock to 6 o'clock position. Second curvilinear vertical incision begins from the first at 12 o'clock and passes upwards between tragus and the crus helix (*incissura terminalis*) without cutting the aural cartilage.

In the *transcanal approach* two external auditory canal incisions are performed. The first vertical incision begins at 12 o'clock position near the annulus. The second curvilinear incision around 5 mm away from the annulus begins at 6 o'clock position and meets the first incision in the postero-superior region of deep bony canal. This approach offers nice view of the middle ear and ossicle.

In this study we use three myringoplasty grafting techniques, *underlay, overlay, and inlay*. Graft placement in the *underlay* technique is medial to the tympanic membrane remnant (or annulus) and manubrium of the malleus, whereas in the *overlay* technique graft placement is the lateral of the tympanic membrane remnant and medial to the manubrium.

In *overlay method* the squamous epithelium of the surface of the remnant tympanic membrane was careful remove by hook or forceps. It is important the graft should contact all parts of the margins of perforation. The entire middle ear was packed full of pieces of *Gelfoam* and several *Gelfoam* sponge gel were placed over the graft to keep it in position.

In *underlay technique* the free edges of the perforation are prepared using a right-angle hook. The intent is to separate the outer cutaneous layer from the inner mucosal layer. This develops a fresh edge for healing. No effort is made to remove the mucosa or the cutaneous layer. Several small pieces of *Gelfoam* are inserted through the perforation into the middle ear to support the graft. A patch of graft (fascia) just larger than the perforation is inserted and placed underneath the perforation with the bed of *Gelfoam* supporting it. The intima is placed toward the middle ear, and the adventitia upward against tympanic membrane. With the help of House hook the free edge of cutaneous layer

is shredded slightly and drawn outward onto the surface of the graft to encourage healing. There are often times the fascia graft placed under the tympanic membrane have a tendency to separate from remnant and fail (the *Eustachian* tube function plays a role in this problem). That's why the surgeon blocking *Eustachian* tube orifice with *Gelfoam* soaked in serum. According to the schedule of experiences, this technique requires opening of the middle ear which provide an opportunity to examine the ossicle and other middle ear structure.

In *inlay method* graft is placed in between the fibrous and mucosal layers of tympanic membrane.

MATERIALS AND METHODS

The medical records of 438 patients who underwent myringoplasty between 1980-2015 were reviewed to identify patients, who were followed up for a minimum of one year. The review of records was undertaken in 2020. Written informed consent or personal agreement was obtained from patients or patient's parents who participated in this study.

Preoperative record of age, gender, history of previous ear surgeries, size and location of perforation on the tympanic membrane, size of the canal, cause of perforation, status of other ear, and presence of atelectasis, tympanosclerosis or cholesteatoma were obtained from clinic's medical history. Ears were examined with a otomicroscope before the operation as well as the first, sixth and twelfth postoperative months. The tuning fork test was performed with a frequency of 512 Hz.

The aim of the study was to determine the rates of success of three different techniques of myringoplasty. The technique of overlay myringoplasty was used in one group, the technique of underlay myringoplasty was used in the other group of patients, and only twenty two patients with inlay method. We hoped to determine whether there was an optimal technique and compare the complications with each of the current techniques. To meet these goals, the overall group of patients are described, followed by those operated on with each technique.

Statistical analysis

The patients were divided into two groups, depending on the size of perforation (small and large), and into three group, depending on its location (anterior, inferior, and central). The size of perforations was calculated with *House* stapes instrument. Perforation size of 1-2.9 mm were defined as a small perforations (mostly anteriorly placed), and size of 3-6 mm were defined as large or central perforations.

Operation success was determined of the following two criteria: if there was full healing of tympanic membrane and an improvement of hearing. Audiogram was performed at the sixth and twelfth postoperative months to determine the hearing improvement. The postoperative success of the operation was measured by analyzing the average postoperative air-bone gap for the speech frequencies of 500, 1.000, and 2.000 Hz, and the postoperative air conduction was compared to the postoperative bone conduction.

Surgical techniques

438 patients submitted primary myringoplasty surgery were operated under *post auricular, endaural and transcanal approach with overlay, underlay and inlay methods*. The technique of *overlay myringoplasty group* was used in 114 patients, the technique of *underlay myringoplasty* in the other group in 302 patients, and 22 patients were operated on using *inlay* method. All patients were operated under general or local anesthesia with *Xylocaine®* 1:100.000 adrenaline.

Postoperative care

Mastoid dressing is removed the day following surgery. One week postoperative the stereo-strips are removed. To loosen the packing, the patient begins used antibiotic eardrops twice a day 3 weeks following surgery. The drops may be started sooner if drainage occurs. The second postoperative visit occurs 3 to 6 weeks following surgery, in which time the ear should be well healed.

RESULTS

Four hundred thirty eight patients (185 women and 253 men) meet the study inclusion

criteria. 438 patents submitted to primary surgery were divided in two groups of 124 patients and 314 patients, similar in terms of gender and age. The patients were followed with an average follow up of 1 years.

Their ages ranged from 8 to 69 years at time of surgery. Of the 438 ears reviewed, 66 were in *children* younger than 19 years of age. There were 39 girls and 27 boys. The youngest patient was 8 years old. The average age for this group patients was 14 years.

The middle ear status before surgery 394 were dry, 31 were moist, and eleven cases had purulent. Granulation tissue was found in the middle ear in 19 cases. Cholesteatoma has found but limited to the tympanic membrane in 24 ears (5.4%).

There were 390 *perforations* and *forty-eight retraction pockets* in the 438 ears. The dominant etiological factor of tympanic membrane was *infection* (315 cases), following *trauma* (40 ears), *ventilation grommet removal* (7 ears), *surgery* (41 ears), and *Eustachian tube dysfunction* (35 ears). The majority of perforations were *central* in 179 ears (39.3%), following by *anterior* with 110 ears (31.3%), and *inferior* 101 ears (23%).

In children group of 66 patients, anterior perforations were in 32 ears (47.8%), central perforations in 20 ears (21%), and inferior perforations in 14 ears (17.3%). Perforation were mostly *small* on 281 (64.2%), and 157 large (35.8%). *Site of perforation did not have a consistent effect on hearing level. The retraction pocket* were determined in 48 cases (13%), of which 27 are in the children' group.

In 27 children's, before myringoplasty, underwent adenoidectomy was realized. 65% of patients had *long duration of disease* (5-10 or more years).

There was not much difference about the involvement of side of the ear. In 29% cases bilateral involvement was present. This group of patients had duration of illness ranging from 3-5 years.

Healing of tympani membrane perforations in all 438 ears.

Without regard to any particular technique, myringoplasty resulted in a successful healing rate of 89.3% ears. *Granulations* of external auditory canal and granuloma formation were found in some patients where *retro auricular ap-*

proach was used. Twelve patients exhibited some degree of *atelectasis*, and six repaired tympanic membrane had varying degree of *tympanosclerosis*. *Perforation* developed or remained in 12 patients. Recurrent perforations were usually observed in the first three postoperative months in most cases. Recurrent cholesteatoma was found in eight patients.

Overlay Group. The overlay technique was used in 114 patients with ages ranging from 7 to 69 years. A successful grafting was achieved in 104 patients (94%). Of the healed tympanic membrane, five have some degree of retraction pockets and four membrane have some tympanosclerosis. Recurrent cholesteatoma was found in four cases.

Underlay Group. The underlay technique was used in 302 patients with aged ranking from 8 to 60 years. The underlay technique myringoplasty resulted in 86.2% (278 ears) success rate. Among these cases, varying degree of retraction pockets (teen cases) and tympanosclerosis (five cases) were noted. Recurrent cholesteatoma was found in one patients. The underlay graft myringoplasty failed in 13.8% (32 ears).

Inlay Group. A successful was achieved in all 22 patients.

Children group. Myringoplasty resulted in an 89% (58 ears) success rate. Among these children's, varying degrees of atelectasis were found (three cases). Five children had a recurrence of secretory otitis media in which in three cases resulting in an insertion of grommet prosthesis. Recurrent cholesteatoma was noted in one patient. The graft failed in 4 boys, 1 in underlay group and 3 in overlay group.

Preoperative and postoperative hearing results

Mean preoperative air conduction (dB)

All Group. 0-20 dB in 63.2% (276 ears), 21-40 dB in 25.4% (111 ears), and 41-60 dB in 11.4% (51 ears).

Overlay Group. 0-20 dB in 53.2% (71 ears), 21-40 in 41% (54 ears), and 41-60 dB in 5.8% (9 ears).

Underlay Group. (0-20 dB in 56.4% (180 ears), 21-40 in 30.6% (97 ears) and 41-60 in 13% (35 ears).

All Patients. Myringoplasty resulted in closure or over closure of the ABG in 43.7%

(191 ears) four weeks postoperative (PO), 64% (280 ears six months PO, and 53% (232 ears) one year postoperative.

Closure to within 10 dB of the ABG in 76% (332 ears) four weeks PO 79% (346 ears) six months PO and 80% (350 ears) one year postoperative.

Closure to within 20 dB of the ABG in 81.5% (357 ears) four weeks, 85.4% (357 ears) six months PO, and 87.6 (384 ears) one year postoperative.

Closure to within 30 dB in 39.6 (389 ears) four months postoperative, 93% (407 ears) six months PO and 88.5% (387 ears) one year postoperative.

Overlay Group. There was complete closure of the ABG to 5 dB 46.4% (57 ears) four weeks postoperative, 66.2% (82 ears) six months postoperative, and 60.4% (79 ears) one year postoperative.

Closure of the ABG to within 10 dB was seen in 77.4% (96 ears) four weeks postoperative, 80% (64.5 cases) six months postoperative, and 83% (104 ears) one year postoperative.

Closure of the ABG to within 20 dB was seen in 84% (104 ears) four weeks postoperative, 89% (110 ears) six months postoperative, and 86% (103 ears) one year postoperative.

Closure of the ABG to within 30 dB was seen in 91.8% (112 ears) four weeks postoperative, 94% (110 ears) six months postoperative, and 92.4% (114 ears) one year postoperative.

Underlay Group. There was complete closure of the ABG in 45% (142 ears) four weeks postoperative, 68% (212 ears) six months postoperative, and 63% (275 ears) one year postoperative.

Closure of the ABG to within 10 dB was seen in 76% (237 ears) four weeks postoperative, 79.4% (247 ears) six months postoperative, and 83% (260 ears) one year postoperative.

Closure of the ABG to within 20 dB in 84% (262 ears) four weeks postoperative, 90% (281 ears) six months postoperative, and 89.1% (278 ears) one year postoperative.

Closure of 30 dB was seen in 90.5% (282 ears) four weeks postoperative, 90.2% six month postoperative, and 91, 5% (285 ears) one year postoperative.

Children group. There was complete closure to within 10 dB in 74.4% (49 ears) and clo-

sure to within 20 dB in 94% (62 ears). In only 4 children ABG was greater than 20 dB. No significant relationships and difference were found between overlay and underlay group

Inlay group. There was complete closure of ABG to within 10 dB for all frequencies for a period of 12 months postoperative.

Air-bone gap at 4000 Hz 1 year postoperative.

All patients: 0-5 dB / 42% (183 ears)
0-10 dB / 76% (332 ears)

Overlay: 0.5 dB / 44% (35 ears)
0-10 dB / 76% (94 ears).

Underlay: 0.5 dB / 45% (140 ears)
0-10 dB / 75% (236 ears)

Complications

On the 438 ears, there were 21 failures (4.5%). There were teen *lateralization* of the tympanic membrane, (one in underlay group, and nine in the overlay group) and *anterior blunting* in seven patients in underlay group. There were four *recurrent cholesteatoma*, (one in underlay techniques and three in overlay method), eight *epithelial cysts*, twelve *perforations*, and twelve *recurrent retractions pocket*. Four children's developed *secretory otitis media* and three required grommet prosthesis. There were twelve *wound infections*, and eight cases of *external ear canal infections*.

DISCUSSION

The primary goal of any grafting technique is to consistently produce a thin, conicaly shaped, vibrating membrane resembling the original tympanic membrane as closely as possible. The goal is twofold: to eradicate and prevent infection and make the ear safe, and to restore the hearing mechanism. There is still no consensus about the optimal technique, which is often employed on the basis of the surgeons prefers and skills, and not on the type of the tympanic membrane perforation.

In the present study, which is based on 438 myringoplasty surgeries all the patients were divided into three groups depending upon the technique utilized to repair the tympanic membrane. When we compared overlay technique group with underlay technique group, it was observed that overlay technique was no statistically sig-

nificant difference between these three groups in term of age wise distribution, gender wise distribution, duration of disease and cause of disease, due to matching at the time of selection.

In this study the outcome in terms of graft uptake rate was slight better in the overlay technique (94%) as compared to the underlay technique (86.2%), though the difference was statistically insignificant, $p>0.05$ which was similar to those reported in literature by Kartush. This is in contrast to those reported in literature by Crovetto De La Tore et al. and Mishra et al. This results were comparable to Gupta who had 86.6% success in his overlay technique series and Wang and Lin who achieved a 82.1% and an 85% take rate with the overlay and the underlay techniques, respectively. Glasscock have reported a 91% success rate using overlay technique and a 95% success rate with undelay technique in a total of 273 ears. Sheehy and Andersen have reported a 97% take rate in 472 overlay myringoplasty surgeries.

Patients selection may have had a role in the high success rate in the present study as patients presenting with middle ear pathology were excluded. Our results confirm that better results achieved with overlay technique may be probably due to less surgical manipulation and faster healing process.

The complications rate in the present study was quite low, there were only three cases of graft lateralization in underlay group and 19 cases in overlay group. These results was consistent with *Sergi et al.* who reported no case of graft medialization in underlay group while 4 cases of graft lateralization in overlay group, but were not in accordance with a study by *Yigit et al.*, who reported the rate of complications with underlay to be greater than overlay technique. In contrast to the study by *Doyle et al.* blunting of anterior angle in the overlay method was not seen in the present study, which could be attributed to meticulous surgical technique to expose the anterior membrane remnants.

In this study, both techniques were associated with significant improvement in hearing, with both achieving statistically significant results when the mean preoperative ABG was compared to the postoperative ABG for each group. However, the underlay technique appeared a slightly higher gain then the overlay technique, but statistical analysis showed an insignificant correlation with $p>0.05$. *Sergi et al.* also reported

better results with underlays compared to overlay technique, but with a statistically significant difference. *Javid et al.* also reported postoperative mean reduction in air bone gap in underlay technique to be better than overlay technique.

CONCLUSION

By combining the benefit of both techniques, the over-under myringoplasty has become the preferred technique for various approaches to tympanoplasty. This technique places the tympanic membrane graft lateral to the malleus, but medial to the remnant of tympanic membrane or fibrous annulus. This allows excellent exposure to the anterior middle ear space and prevent medicalization of the graft to the promontory, and ossicular reconstruction may be placed directly to the underside of the malleus. Over-under myringoplasty has become author's preferred technique perforation that abut the malleus in both anterior and posterior perforations and for large ore near-total perforations.

Both patients and surgeons must be properly prepared for surgery. It is clear that the success of myringoplasty cannot be attributed to any single factor. Instead, success comes to patients who understand and care for their disease with teams of physicians and nurses who bring skill and compassion to the patient and problems. The progress of the last 30 year has been breathtaking, and the future of tympanoplasty will be astounding.

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Резиме**МИРИНГОПЛАСТИКА – АНАЛИЗА НА 438 СЛУЧАИ****Илија С. Филипче^{1,2}, Марина Давчева Чакар², Сијаваш Јавари²**¹ Македонска академија на науките и уметноста, Скопје, РС Македонија² Универзитетска клиника за оториноларингологија, Скопје, РС Македонија

Анализирани се постоперативните функционални резултати кај 438 пациенти оперирани со техниката мирингопластика, следени најмалку една година во периодот 1980–2015 година. За да се добие реален пристап до мембрана тимпани, местото на перфорацијата, постоењето на евентуален патолошки процес и процена на оскуларниот сндир, се изврши предоперативно отомикроскопско испитување преку ушен спекулум. Пациенти кај кои е извршена примарна мирингопластика, операцијата е реализирана преку ретроаурикуларен, ендаурален или трансканален пристап со техники *overlay*, *underlay* и *inlay*. За затворање на перфорацијата на тимпаналната мембрана, употребен е графт од перихондриум, картилаго и фасција.

Студијата во однос на стапката на прифаќање на графтоот беше малку подобра кај пациентите оперирани со техниката *overlay* (94 %) споредена со техниката *underlay* (86,2), иако разликата е статистички незначајна ($p > 0,05$). Самиот изборот на пациентите можеби има влијание во постоперативниот слушен и репаративен резултат на тимпаналната мембрана, од причина што пациентите со заболување на средното уво беа исклучени од студијата. Компликациите од операциите беа исклучиво ниски, без компликација во групата *inlay*, три случаи на латерализација на графтоот во групата *underlay* и 19 случаи во групата *overlay*. На мислење сме дека причината за подобрите функционални резултати кај случаите оперирани со техниката *overlay* е последица од полесната хируршка манипулација и побрзиот процес на исцелување.

Клучни зборови: мирингопластика, onlay, overlay, inlay