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Hearing results in patients undergoing canal wall down mastoidectomy with type III tympanoplasty

Canal wall down mastoidektomi ile birlikte tip III timpanoplasti ameliyatı geçiren hastalarda işitme sonuçları

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Abstract

Objective: Preoperative and postoperative hearing results were compared in patients undergoing hearing reconstruction through open mastoidectomy with type III tympanoplasty method in our center.

Methods: A total of 46 patients with chronic suppurative otitis media, who had undergone ossicular chain reconstruction by type III tympanoplasty with canal wall down mastoidectomy (CWDM) operation between January 2005 and 2009 were enrolled in the trial. The preoperative status of ossicular chain, the reconstruction methods on the ossicles, as well as the materials used in the reconstruction and the presence of stapes superstructure were recorded. Postoperative hearing gain of patients was evaluated by pure tone audiometry on an average of 6th months following surgery.

Results: Among enrolled patients, 18 were females (39%) and 28 were males (61%). In 30 patients (65%), cholesteatoma was seen to have extended to the attic, antrum, supratubal recess and sinus tympani, while in 16 cases, cholesteatoma was determined to have partly invaded the mastoid cavity and mesotympanum. A polypoid tissue, arising from mucosa of middle ear and sagging into the external ear canal was detected in 6 patients (13%). While the preoperative and postoperative mean air-bone gaps were determined as 33.96 dB and 28.21dB, respectively. Preoperative and postoperative audiological examinations revealed an air-bone gap of ≤25 dB in 26.1 and 47.8% of the cases respectively.

Conclusion: Type III tympanoplasty operation with canal wall down mastoidectomy provides eradication of the disease with cholesteatoma and enables reconstruction of hearing.

Key words: Canal wall down mastoidectomy, type III tympanoplasty.

Özet

Amaç: Merkezimizde açık mastoidektomiyle birlikte tip III timpanoplasti yöntemiyle işitme sistemine rekonstrüktif cerrahi uygulanan hastalarda ameliyat öncesi ve sonrası işitme fonksiyonları karşılaştırılmıştır.

Yöntem: Ocak 2005 ila 2009 arası *canal wall down* mastoidektomi ile birlikte tip III timpanoplasti ameliyatı ile kulak kemikçiklerine rekonstrüktif cerrahi uygulanmış kronik süpüratif orta kulak iltihabı olan toplam 46 hasta çalışmaya alınmıştır. Ameliyat öncesinde kulak kemikçik zincirinin durumu, kemikçiklere uygulanan rekonstrüksiyon yöntemleriyle birlikte rekonstrüksiyonda kullanılan malzemeler, üzengi kemiği üstyapısının varlığı kaydedilmiştir. Cerrahi sonrası ortalama 6. aylarda saf ton odyometrisiyle hastaların ameliyat sonrası işitme duyusundaki kazanımları değerlendirilmiştir.

Bulgular: Katılımcıların 18'i (%39) kadın, 28'i (%61) erkekti. Otuz hastada kolesteatomun kemik çatıya, antruma, supratubal çıkmaza ve timpanik sinüse uzandığı görülmüştür. On altı olguda ise kolesteatomun mastoid kavite ve mezotimpanik alanı kısmen etkilediği belirlenmiştir. Altı hastada (13%) orta kulak mukozasından kaynaklanan ve dış kulak yoluna sarkan bir polipoid doku saptanmıştır. Ortalama hava-kemik işitme eşikleri arasındaki farkın ameliyat öncesi 33.96 dB, ameliyat sonrasında ise 28.21 dB olduğu belirlenmiştir. Ameliyat öncesi ve sonrası odyolojik incelemeler hava-kemik açıklığı 25 dB'den daha az olan olguların oranlarını sırasıyla %26.1 ve %47.8 olarak belirlemiştir.

Sonuç: *Canal wall down* mastoidektomiyle birlikte tip III timpanoplasti ameliyatı kolesteatomlu hastalıkları eradike ettiği gibi işitme fonksiyonunun yeniden yapılandırılmasına da olanak tanımaktadır.

Anahtar sözcükler: *Canal wall down* mastoidektomi, tip III timpanoplasti.

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Chronic suppurative otitis media (CSOM) is a disease progressing with chronic inflammation of the middle ear cavity and mastoid cells and it is characterized by persistent or recurrent otorrhea and perforation of the tympanic membrane. CSOM may be managed by medical and surgical treatments. Two main surgical techniques used in the surgical treatment of CSOM may be stated as the open (canal wall down mastoidectomy, CWDM) and closed (intact canal wall mastoidectomy, ICWM) methods. The established surgical approach in chronic otitis media cases with diffuse cholesteatoma is the canal wall down mastoidectomy technique.[1] Even though investigators propose various clinical indications, the established consensus is to perform the open method in extensive attic cholesteatoma, adhesive otitis with cholesteatoma, recurrent cholesteatoma, unilateral hearing loss, pediatric cholesteatoma cases and in patients with extensive labyrinthine fistula, in addition to chronic otitis with extensive cholesteatoma.[2] Surgeons performing open mastoidectomy technique indicate that this method enables easy visualization of the anterior and posterior mesotympanum, reduces development of new retraction pockets and provides improved post-surgical outcomes.[3] While expectations associated with hearing were much lower among patients who had undergone CWDM in the past, successful application of new current tympanoplasty and ossiculoplasty methods enable the reconstruction of hearing with favorable hearing outcomes.

The objective of this trial was to compare pre- and postoperative hearing outcomes of patients who had undergone hearing reconstruction by type III tympanoplasty with CWDM in our department.

Materials and Methods

A total of 46 patients with CSOM who had undergone ossicular reconstruction by type III tympanoplasty method with CWDM between January 2005 and 2009 who had regularly attended check-up visits were enrolled in the trial.

Preoperative status of the ossicular chain, reconstruction methods performed on the ossicles and materials used in reconstruction, peri- and post-surgical complications (if any), anatomical variations, dehiscence of the facial nerve (if any) and presence of stapes superstructure were recorded. We used autograft ossicles for ossiculer reconstruction in patients by reshaping incus or malleus without using ready replacement materials like plastipore prosthesis. Postoperative hearing gains evaluated by audiometric tests were expressed as air-bone threshold and air-bone gap. The first postoperative audiological check-up of the cases was performed at the 6th (5-8) postoperative months.

Hearing thresholds during the audiometric examinations were determined at 500, 1000, 2000 and 4000 Hz. Pre- and postoperative speech reception thresholds were implemented as per W-22 word list.

Results

Among the enrolled patients, 18 were females (39%) and 28 were males (61%). The mean age of the patients undergoing CWDM was calculated as 33 (range: 8-61) years. The operation had been performed on the right ear in 19 patients (41.3%) while 27 cases had been operated on the left ear (58.7%). In 30 patients (65%), cholesteatoma was found to be extending to the attic, antrum, supratubal recess and sinus tympani, while in 16 cases, the cholesteatoma was determined to partially invade the mastoid cavity and the mesotympanum. A polypoid tissue arising from the mucosa of the middle ear and sagging into the external ear canal was found in 6 (13%) and dehiscence of the facial nerve in 4 patients (8.7%), respectively.

The patients were classified into 4 groups based on the air-bone gaps as detected on the preoperative pure voice audiograms (Table 1).

Postoperative audiological examinations were performed at the 6th (5-8) postoperative months. Hearing results of the patients showed that the preoperative and postoperative mean air-bone gaps were 33.96 and 28.22 dB, respectively. Preoperative and postoperative audiological examinations determined an air-bone gap less than 25 dB in 26.1 and 47.8% of the cases, respectively (Table 1).

The rate of change in the postoperative air-bone gaps of the patients has been presented in Table 2. Changes of less than or equal to 5 dB were regarded as “no change”. Values marked with (+) indicated hearing gain while (-) indicated hearing loss.

The postoperative changes in the air conduction thresholds of patients have been displayed in Table 3. Changes of ≤5 dB were regarded as “no change”. (+) Values marked with (+) or (-) indicate hearing gain and hearing loss, respectively.

Pre- and postoperative hearing results of the patients were compared in terms of the presence (20 patients) or absence (26 patients) of stapes superstructure.

In patients with intact stapes in whom reconstruction was performed using cartilage and bone, the mean gains in air-bone gap according to the type of material used were determined as 1.7 dB and 8.8 dB, respectively.

Table 1. Classification of the patients according to preoperative and postoperative air-bone gaps.

Air-bone gap	Preoperative air-bone gaps n (%)	Postoperative air-bone gaps n (%)
<15 dB	2 (4.35%)	7 (15.2%)
15-24 dB	10 (21.75%)	15 (32.6%)
25-34 dB	12 (26.10%)	10 (21.75%)
>35 dB	22 (47.80%)	14 (30.45%)
Total	46 (100.0%)	46 (100.0%)

Table 2. Postoperative changes in the air-bone gaps of patients.

Postoperative changes in the air-bone gaps	n	%
<(+) 10 dB	6	13
(+) 10-19 dB	14	30.45
(+) 20-29 dB	2	4.35
≥(+) 29 dB	3	6.5
No change	13	28.3
<(-) 10 dB	3	6.5
(-) 10-19 dB	4	8.7
(-) 20-29 dB	1	2.2
≥(-) 29 dB	0	0
Total	46	100

Table 3. Postoperative changes in the air conduction thresholds of patients.

Postoperative changes in air conduction thresholds	n	%
<(+) 10 dB	7	15.2
(+) 10-19 dB	8	17.4
(+) 20-29 dB	5	10.9
≥(+) 29 dB	3	6.5
No change	14	30.5
<(-) 10 dB	2	4.3
(-) 10-19 dB	4	8.7
(-) 20-29 dB	3	6.5
≥(-) 29 dB	0	0
Total	46	100

Discussion

Parallel to the increase in technical resources, a great progress has been achieved in CSOM surgery in recent years; however, surgery of CSOM with cholesteatoma is still regarded as a debatable issue. CWDM is an alternative surgical treatment modality, primarily performed in CSOM cases with cholesteatoma and it is being preferred more frequently in current clinical practice.

Defects of varying degrees may develop in the ossicular chains of CSOM patients with or without cholesteatomas. Most frequently seen ossicular chain defects in order of frequency may be stated as necrosis of the long process of incus, loss of incus accompanied by loss of stapes superstructure and loss of all ossicles except the footplate of stapes.[2]

Due to favorable hearing results obtained in the postoperative period and low recurrence rates, CWDM has been reported as the preferred approach in previous trials, especially in cases with diffuse cholesteatoma or in patients with sclerotic mastoid where removal of the cholesteatoma is problematic.[4-6] Moreover, it is regarded as the preferred surgical method in pathological cases where a second-look is considered. However, the second operation is rejected by the patient, or it is not recommended in patients having difficulty in complying with check-up visits during the long-term follow-up. It is preferred in the single hearing ear and in patients with a poor general health status.[7] Not only the eradication possibility is higher with ATT, rates recurrence or development of residual cholesteatoma are decreased.[7] In our study group, indications of CWDM were diffuse cholesteatoma, adhesive otitis with cholesteatoma, recurrent cholesteatoma and the pediatric hearing problems.

In type III tympanoplasty operation where the ossicular reconstruction is provided by various methods, in cases with intact stapes or intact footplate, the graft is placed over the stapes or on the reconstruction material. In cases with intact stapes, ossiculoplasty methods may be implemented, namely applications of Spandrel II prosthesis, autograft or biocompatible ossicle, cartilage cap over the stapes or partial ossicular replacement prosthesis (PORP). In cases where only the footplate is intact, reconstruction methods include total ossicular replacement prosthesis (TORP) and placement of bone columella over the footplate and cartilage of 0.5×0.5 cm diameter on top. In the current trial, bone or cartilage cap was used in cases with intact stapes and reconstruction with autograft bone columella and bone or cartilage cap was utilized in cases without stapes superstructure.

In ossicular reconstruction, the choice of the method to be implemented is based on the presence of stapes superstructure.[8] Hearing outcomes of reconstruction is directly correlated with the amount of damage incurred on the ossicular chain. In the series of Cook et al., the air-

bone gap was shown to have decreased to 20 dB in 69% of the patients with intact stapes undergoing CWDM. In cases with absent stapes, the corresponding rate of hearing gain was observed in 30% of the cases.[9] On the contrary, the respective rates were determined as 57% and 54% in the case series of Shelton and Sheehy.[10] Kalcıoğlu et al. have evaluated 56 patients. The authors administered ATT according to the results obtained in the postoperative 3rd month and hearing gains of 17 dB and 5dB in patients with or without stapes superstructure were achieved.[7] We evaluated our patients in the postoperative 6th month and achieved hearing gains of 5.25 dB and 4.81 dB in patients with or without stapes ultrastructure. In our trial, consistent with the literature, there were no significant differences between cases with or without stapes superstructure in terms of hearing gains; however, the hearing outcomes were less favorable among cases with absent stapes superstructure.

Aydar et al. performed type III tympanoplasty on 115 patients undergoing CWDM. TORP was used in 107 of these cases, while autograft conchal or tragal cartilage was utilized in 5 and autograft incus in 3 patients. In the same trial, the success rate of the grafting was reported as 87.8% (101 patients).[11] In the current trial, conchal or autograft tragal cartilage was placed in 10 of 20 patients with intact stapes and autograft cortical bone was used in 5 cases. In 5 patients, autograft incus was reshaped and placed over the stapes head. In the remaining 26 patients, reshaped autograft incus, malleus or cortical bone were placed on and over the columella as conchal or tragal cartilage caps. Furthermore, we did not encounter any graft failure in any of our patients during the postoperative check-up visits.

Özdek et al. performed ATT on 15 of their 44 patients who had undergone ossicle reconstruction and found the postoperative air-bone gap less than 20 in 9 patients.[12] Bayazit et al. performed CWDM in 43 cases with chronic otitis media and showed that the air-bone gap decreased up to 20 dB in 55.7% of their patients.[13] In our trial, the postoperative air-bone gap decreased to ≤25 dB in 48% of the cases. Moreover, the mean air-bone gap at the postoperative 3rd month was determined to decrease from 33.96 dB to 28.21 dB.

De Corso et al. performed CWDM in 142 patients in the period between 1995 and 2002.[14] Preoperative mean threshold for air conduction was reported as 50.97 dB, while the mean threshold for bone conduction was indicated as 22.14 dB. Following the operation, the mean threshold for air conduction was determined as 37.62 dB and the mean threshold for bone conduction was designated as 23.37 dB. In the same trial, air-bone gap decreased from 28.83 to 13.94 dB, with a hearing gain of 14.89 dB.[14] In the current trial, the mean value of the preoperative and postoperative air conduction thresholds were determined as 49.96 dB and 44.40 dB, respectively with a mean gain in the air-bone gap of 5.56 dB.

Type III tympanoplasty yields variable results in ossicular reconstructions. Factors like the status of the ossicles and the severity of the pathological condition in the middle ear may play a role in the success of the operation. The prosthesis placed between the graft and the stapes footplate should have a certain weight and exert a pressure with sufficient tension. The decision on the type of ossicular reconstruction is finalized during the operation based on the status of the middle ear and the ossicles.

CWDM is a suitable and useful surgical treatment method in chronic otitis cases with cholesteatoma, which do not respond to conservative treatment approaches. Since ossiculopathy may also be performed concurrently, their hearing outcomes are quite favorable. In the current trial, the best hearing gains were achieved by placement of reshaped cortical bone or incus on the intact stapes. In contrast, minimal hearing gains were observed among patients operated by placing conchal or tragal cartilage over the intact stapes. In cases with no stapes, hearing results obtained in cases with autotorp material formed by placement of cortical bone, incus or malleus on the footplate covered by cartilage cap were similar to the hearing results obtained in patients with intact stapes.

Conclusion

In cases operated for cholesteatoma with an open technique, CWDM both provides eradication of the disease with cholesteatoma and enables reconstruction of hearing. The type III tympanoplasty method provides favorable results in the reconstruction of hearing in ears with damaged ossicles.

References

1. Kanemaru S, Hiraumi H, Omori K, Takahashi H, Ito J. An early mastoid cavity epithelialization technique using a postauricular pedicle periosteal flap for canal wall-down tympanomastoidectomy. Acta Otolaryngol Suppl 2010;(563):20-3.
2. Sanna M, Sunose H, Mancini F, Russo A, Tacbah A. Middle ear and mastoid microsurgery. Stuttgart: Georg Thieme Verlag; 2003. p. 274-300.
3. de Zinis LO, Tonni D, Barezzani MG. Single-stage canal wall-down tympanoplasty: long-term results and prognostic factors. Ann Otol Rhinol Laryngol 2010;119:304-12.

4. Banerjee A, Flood LM, Yates P, Clifford K. Computed tomography in supurative ear disease: does it influence management? J Laryngol Otol 2003;117:454-58.
5. Blevins NH, Carter BL. Routine preoperative imaging in chronic ear surgery. Am J Otol 1998;19:527-38.
6. Jackler RK, Dillon WP, Schindler RA. Computed tomography in supurative ear disease: a correlation of surgical and radiographic findings. Laryngoscope 1984;94:746-52.
7. Kalcıoğlu MT, Öncel S, Aktaş D, et al. Açık kavite timpanoplasti erken dönem sonuçlarımız. Otoskop 2002;2:70-4
8. Felek SA, Islam A, Celik H, Demirci M, Samim E, Kose SK. The functional and anatomical results of the canal wall down tympanoplasty in extensive cholesteatoma. Acta Otolaryngol 2009; 129:1388-94.
9. Cook J, Krishnan S, Fagan P. Hearing results following modified radical versus canal-up mastoidectomy. Ann Otol Rhinol Laryngol 1996;105:379-83.
10. Shelton C, Sheehy JL. Tympanoplasty: review of 400 staged cases. Laryngoscope 1990;100:679-81.
11. Aydar L, Kandoğan T, Olgun L, Gültekin G, Alper S. Kronik otitis mediada kemikçik rekonstrüksiyonu. Turk Arch Otolaryngol 2004;42:158-63.
12. Özdek A, Kılıç R, Kızılkaya Z, Şafak MA, Göçmen H, Samim E. Plastipore TORP ve PORP ile kemikçik zincir rekonstrüksiyonunun fonksiyonel sonuçları. Türkiye Klinikleri J ENT 2004;4: 73-7.
13. Bayazit Y, Göksu N, Beder L. Functional results of plastipore prostheses for middle ear ossicular chain reconstruction. Laryngoscope 1999;109:709-11.
14. De Corso E, Marchese MR, Sergi B, Rigante M, Paludetti G. Role of ossiculoplasty in canal wall down tympanoplasty for middle-ear cholesteatoma: hearing results. J Laryngol Otol 2007; 121:324-8.

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