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Comparison of Hydroxyapatite Prosthesis and Incus Interposition in Incus Defects

İnkus Defektlerinde Hidroksiapatit Protez ile İnkus İnterpozisyonunun Karşılaştırılması

Original Investigation
Özgün Araştırma

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Abstract

Objective: Chronic otitis media most commonly causes an ossicular chain defect in incus. Different materials can be used for repair of this defect. In this study, the hydroxyapatite prosthesis, used for repair of the incus defect, was compared with the incus interposition.

Methods: Between 2010 and 2016, 27 female and 16 male patients who underwent ossiculoplasty due to an incus defect were studied retrospectively. Patients' hearing results at the sixth month were compared. The hydroxyapatite prosthesis was used in 24 patients (group 1) and incus interposition was used in 19 patients (group 2) for the ossicular chain repair. Hearing gain at 500, 1000, 2000, and 4000 Hz between the two groups and the success rates in the two groups were compared.

Results: Successful hearing reconstruction was performed on 10 patients in each group (group 1, 41.6% and group 2, 52.9%). There was no statistically significant difference between groups both in terms of successful hearing and hearing gain at 500, 1000, 2000, and 4000 Hz. There was no extrusion of the materials used in both groups.

Conclusion: As it does not have any additional cost and is easily shaped and biocompatibility problem is not encountered; we recommend using incus interposition primarily in incus defects.

Keywords: Tympanoplasty, hearing loss, incus, hydroxyapatite

Öz

Amaç: Kronik otitis media en sık inkusta kemikçik zincir defektine sebep olur. Bu defektin tamiri için farklı materyaller kullanılabilmektedir. Bu çalışmamızda inkus defektinin tamiri için kullanılan hidroksiapatit protez ile inkus interpozisyonu karşılaştırıldı.

Yöntemler: 2010 ile 2016 yılları arasında inkus defekti nedenli ossiküloplasti uygulanan 27 kadın ve 16 erkek hasta geriye dönük olarak incelendi. Hastaların altıncı aydaki işitme sonuçları karşılaştırıldı. Yirmi dört hastanın ameliyatında hidroksiapatit protez (grup 1), 19 hastanın ameliyatında inkus interpozisyonu (grup 2) ile kemikçik zincir tamiri gerçekleştirildi. İki grup arasında 500, 1000, 2000 ve 4000 Hz'deki işitme kazancı ve iki gruptaki başarı oranı karşılaştırıldı.

Bulgular: Her gruptan 10 hastada (grup 1, %41.6 ve grup 2, %52.9) başarılı işitme rekonstrüksiyonu gerçekleştirildi. Her iki grup arasında hem başarılı işitme hem de 500, 1000, 2000 ve 4000 Hz'deki işitme kazancı açısından istatiksel olarak anlamlı farklılık saptanmadı. Her iki grupta da kullanılan materyallerde atılma izlenmedi.

Sonuç: Ek maliyetin olmaması, kolayca şekillendirilmesi ve biyouyumluluk sorunu yaşanmaması nedeniyle inkus defektlerinde öncelikle inkus interpozisyonu uygulanmasını önermekteyiz.

Anahtar kelimeler: Timpanoplasti, işitme kaybı, inkus, hidroksiapatit

Introduction

The aim of the tympanoplasty operation is to achieve an acceptable hearing level as well as obtaining a healthy, dry, well-ventilated middle ear with intact eardrum. Because of chronic inflammation in chronic otitis media; ossicle chain defects can be observed most frequently in incus long process. In the reconstruction of these defects, materials such as autograft incus, teflon, hydroxyapatite, ceramic, bone cement, and metal prosthesis are used (1).

Hydroxyapatite prostheses have been used extensively since they were first produced by Grote in 1981. The surfaces of these prostheses, which are in the form of calcium apatite, are covered with mucosa over time and they can chemically be fused to

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the bone. Besides, advantages of these prostheses are flexibility, adjustable length, and non-magnetic composition (2).

The incus interposition and transposition method used in ossicle reconstruction has been widely used since its first description in 1957 by Hall and Rytzner (3).

In this study, we aimed to compare the hearing benefits of patients who underwent reconstruction with incus interposition and hydroxyapatite partial ossicular replacement prosthesis due to an incus defect.

Methods

From June 2010 to March 2016, 43 patients were retrospectively evaluated in whom incus defect was detected with intact malleus and stapes during tympanoplasty operation in our clinic and ossicular reconstruction was performed. After obtaining the approval of local ethics committee, an informed consent was obtained from all patients. Ossicular chain defect of 24 patients was reconstructed with hydroxyapatite partial ossicular replacement prosthesis (Medtronic, Jacksonville, USA) (Group 1), and in 19 patients ossicular chain reconstruction was performed with incus interposition (Group 2). The mean age of the patients in group 1 was 33.00±11.33 years, and 32.05±11.59 years for the patients in group 2.

A tympanoplasty operation was applied to all patients in the same way, and tragal perichondro chondral graft was used in tympanic membrane repair of all patients.

Before the procedure, detailed anamnesis of each patient was taken; and ear, nose, and throat and head and neck examinations and automicroscopic ear examinations were performed. Although thin-section axial and coronal plane temporal bone computed tomographic images were taken, anatomical plans and possible pathologies were also evaluated.

Patients' hearing levels were measured in a soundproof booth with Interacoustics AC-40 (Interacoustics A/S, Denmark) clinical audiometry. The air-bone gap was calculated at 500, 1000, 2000, and 4000 Hz in decibel (dB). The results of the sixth-month postoperative audiometry were compared with those of the patients before surgery. Air-bone gap closure less than or equal to 20 dB was considered as successful.

Patients with cholesteatoma, dry middle ear mucosa, previous otological surgery, marginal perforation in tympanic membrane, air-bone gap less than 20 dB in preoperative audiometry evaluation, congenital ossicular anomaly, traumatic ossicular injury, postoperative non-intact ear membrane, and hearing reconstruction in multiple sessions were excluded.

Statistical analysis

Statistical analysis of data was made by using the Statistical Package for the Social Sciences 20.0 software (SPSS Inc.; Chicago, IL, USA). For the evaluation of the relationship between the study groups, Pearson chi-square test method and the Fisher Exact test were used and $p<0.05$ was accepted as statistically significant.

Results

Of the 13 female and 11 male patients in group 1, 11 patients underwent right-sided operation and 13 patients underwent left-sided operation. On the other hand, of the 14 female and five male patients in group 2, 11 patients underwent right-sided operation and eight patients underwent left-sided operation. Successful hearing reconstruction was performed in 10 patients each in group 1 (41.6%) and group 2 (52.9%) (Figure 1). There was no statistically significant difference between the two groups in terms of success in hearing reconstruction ($p=0.47$). Also, there was no statistically significant difference in hearing gain between groups 1 and 2 at 500, 1000, 2000, and 4000 Hz ($p>0.05$) (Table 1).

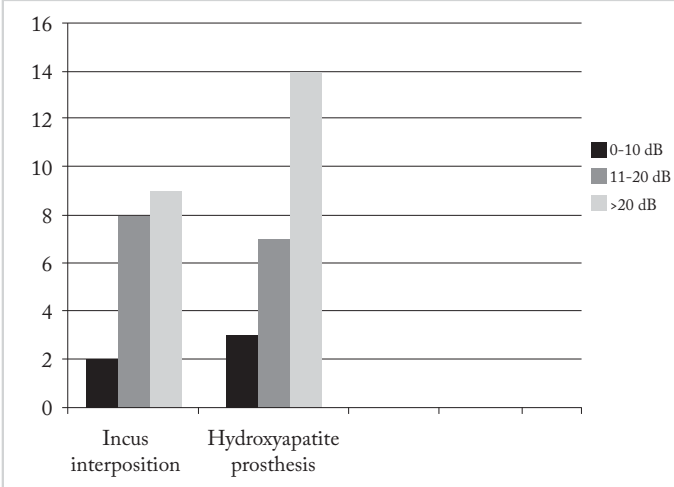

Figure 1. Comparison of postoperative success in patients in whom incus interposition and hydroxyapatite prosthesis was used

Table 1. Comparison of hearing gain according to frequency level in patients in whom incus interposition or hydroxyapatite prosthesis was used

	500 Hz	1000 Hz	2000 Hz	4000 Hz
Hydroxyapatite prosthesis	17.70+15.67dB	15+14.67 dB	11.04+13.59 dB	9.49+4.13 dB
Incus interposition	12.66+14.07 dB	16.84+10.16 dB	11.57+6.46 dB	9.74+7.01 dB
p	0.25	0.64	0.86	0.95

Discussion

Healthy ossicular chain allows sound to be delivered from the transmitted membrane to the cochlea. Because of chronic otitis media, defects occur in the ossicular chain especially in the long process of the incus. Because of these defects, the sound transmission between malleus and stapes is distorted and conductive hearing loss develops. This defect can be repaired by different ossiculoplasty methods (4, 5). Various materials can be used for the repairing of ossicular chain defects. These materials are divided into three groups: autograft, homograft, and allograft. Bones and cartilaginous tissues are used as autograft; the tissues taken from different individuals are called homografts; and the synthetic materials are called allografts. The graft to be used needs biocompatibility, good stability, and acceptable hearing (6).

Ho et al. (7) reported that they did not observe inflammation against hydroxyapatite in patients undergoing revision middle ear surgery. In many studies, the success rates for hearing results were reported between 46% and 83.3%. Biocompatibility results have also been reported between 79% and 96% (8). In our study, we found that the success rate for hydroxyapatite as 41.6%. We did not observe any prosthetic rejection during our 6-month evaluation.The advantages of incus used as autograft are its low rejection rate, high biocompatibility, and low virus infection risk; whereas, shaping during surgery and placement of the cholesteatomas at the microscopic level on the incus into the middle ear are some disadvantages. O'Reilly et al. (9) conducted a study with 137 patients in whom incus interposition was used and they reported that the air-bone gap of 26.8 dB before surgery was reduced to 18.6 dB after surgery. In the study by Galy-Bernadoy et al. (10) it was found that the post-operative air-bone gap was less than 20 dB in 45.45% of patients in whom incus interposition was used, and on the other hand, the post-operative air-bone gap was measured to be less than 20 dB in 75% of patients in whom hydroxyapatite prosthesis was used. In our study, we found that the success rate was higher in the patients in whom incus interposition was used.

Conclusion

There was no difference in hearing gain and postoperative success rate of patients undergoing ossiculoplasty with hydroxyapatite prosthesis and the incus interposition. Incus interposition should be used in incus defects, as it does not have any costs, is biocompatible, and has no problem of contamination by infection.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Tepecik Training and Research Hospital (Decision date: 05/12/2016, Decision no: 10).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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