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Results of ossicular chain reconstruction with glass ionomer cement in pediatric patients

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ABSTRACT

Objective: The aim of our study was to analyze the hearing results of ossicular chain reconstruction in incus long process defects in pediatric patients.
Methods: This retrospective study included 15 pediatric patients that had incus long process defect due to chronic otitis media or adhesive otitis, and repaired with glass ionomer cement between 2009 and 2015. The audiological tests (air conduction thresholds, bone conduction thresholds, air bone gap) obtained preoperatively and one year after surgery were compared. In addition, preoperative and postoperative air bone gap differences were estimated to determine hearing gain.
Results: Mean air conduction and air bone gaps decreased significantly one year after surgery when compared to the preoperative values ($p < 0.001$ for both). Mean hearing gain was 20.33 ± 6.36 dB one year after surgery.
Conclusion: Use of glass ionomer cement to repair incus long process defects is a suitable method that improves hearing in pediatric patients. Further large studies that compare glass ionomer cement ossiculoplasty with other ossicular reconstruction methods are needed.

1. INTRODUCTION

Long process of incus is the most frequently involved part of the ossicular chain in chronic otitis media, adhesive otitis, and trauma since its vascular supply is limited compared to other ossicles. Therefore, ossicular reconstruction is usually necessary for incus long process defects [1]. Various materials and methods have been used to repair incus long process defects including incus interposition, partial ossicular replacement prosthesis (PORP), cortical bone, cartilage, and glass ionomer cement (GIC) [2].

GIC is a hybrid material that contains aluminum fluorosilicate in a hydrogel mattress. Its advantages are ease of use, low cost, and a high biocompatibility [3,4]. GIC was first used for repair of dental defects, however it is currently frequently used in otological and neuro-otological surgery. Apart from ossicular chain reconstruction, it is used for repair of tegmen defects, outer ear canal reconstruction, mastoid obliteration, and stabilization of some hearing prostheses [5].

Various studies in current English literature reported different hearing results for incus long process defect repair with GIC in adults [6–9]. However, to our knowledge, no studies in the current English literature investigated hearing results with this material in children in case of incus long process defects. In this study, we aimed to present hearing results of pediatric patients that had incus long process repair with GIC, and discuss our results in the light of the current literature.

2. MATERIALS AND METHODS

2.1. Subjects

This retrospective study included 15 pediatric patients that had incus long process defect due to chronic otitis media or adhesive otitis, and repaired with glass ionomer cement between 2009 and 2015. The ages of the patients ranged between 10 and 16 years. Adhesive otitis was considered if the tympanic membrane was adhered to incus, stapes or promontorium. Chronic otiti media was considered in presence of middle ear infection for more than 3 months together with tympanic membrane perforation.

Exclusion criteria were revision ear surgery, stapes fixation due to otosclerosis, tympanosclerosis, or congenital factors, presence of cholesteatoma, or any ossicular chain defect except for an incus long process defect.

The patients with incus long process defect due to adhesive otitis or chronic otitis, and normal stapes and malleus were

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selected. Bone cement was used when the length of incus long arm defect was 3 mm at maximum. The tympanoplasty procedure was performed under general anesthesia, using a postauricular incision. The tympanomeatal flap was elevated, and the middle ear was exposed. The posterosuperior wall of the outer ear canal was removed with a curette if necessary, to see long process of incus and head of stapes. Mastoidectomy was not performed in any of the patients. The defect in long process of incus was repaired using GIC (Ketac-Cem, Espe Dental AG, Seefeld, Germany) (Figs. 1 and 2). GIC is composed of a sterile powder and a liquid. Two components are mixed on a metal surface in sterile conditions for 10 s during surgery. The mixture must be used within 2 minutes. The mixture is placed between the defective incus long process and stapes head using a thin pick to form an incudostapedial bridge. The GIC gets hard 5 min after its application.

Temporal muscle fascia was used as a graft in patients with chronic otitis media. The posterosuperior wall of the outer ear canal was supported with a piece of cartilage in patients with adhesive otitis, and the defective tympanic membrane was repaired with cartilage graft when needed. The grafts were placed using underlay technique. Gelfoam was placed into the outer ear canal. There were no major postoperative complications in any of the patients, and they were discharged on postoperative day 1.

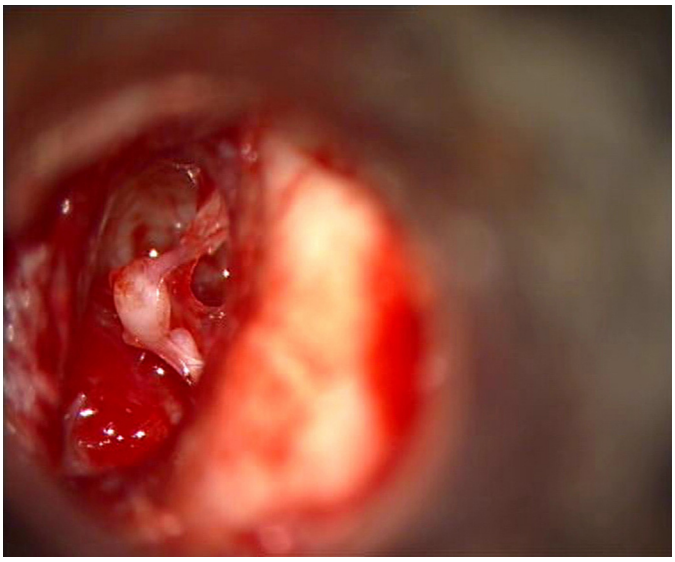

Fig. 1. Incus long process defect in a patient with adhesive otitis.

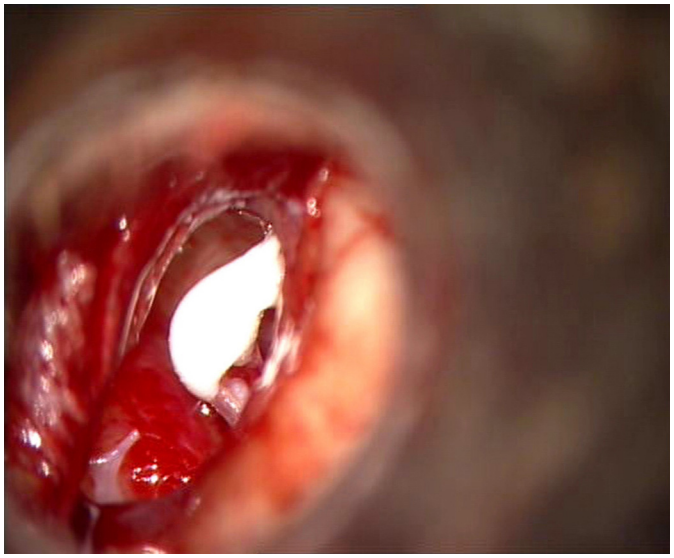

Fig. 2. GIC repair of the incus long process defect.

2.2. Audiometric Assessment

Pure tone audiometric analyses were performed using AC-40 clinical audiometer (Inter acoustic, Denmark). The mean bone and air conduction thresholds (500, 1000, 2000, 4000 and 8000 Hz) were calculated. The air bone gap (ABG) was calculated by subtracting the mean air conduction threshold (mean of the air thresholds at 500, 1000, 2000 and 4000 Hz) from the mean bone conduction threshold (mean of the bone thresholds at the same frequencies). In addition, the difference of preoperative and postoperative ABG was calculated to determine ABG gain. Postoperative audiological tests were performed one year after surgery.

The mean air thresholds, the mean bone thresholds, and mean ABG were calculated for every patient on preoperative and postoperative audiological tests. In addition, preoperative and postoperative ABG differences were calculated, and the patients were divided into 2 groups as the ones with a hearing gain <20 decibel Hearing Level (dB HL) and the ones with a hearing gain >20 dB HL, and the patients were analyzed.

Preoperative and postoperative data were compared statistically.

2.3. Statistical Analysis

Statistical analysis was carried out using SPSS, version 21.0 software program (SPSS Inc., Chicago, IL, USA). Continuous data were presented as mean ± standard deviation (SD). Categorical variables were presented as percentages. Continuous variables with a normal distribution were analyzed with Student t-test while Mann Whitney U was used for the variables that did not have normal distributions. P values less than 0.05 were considered as statistically significant.

3. RESULTS

There were 7 girls (47%), and 8 boys (53%) in the study group. The mean ± standard deviation (SD) age of the patients was 13.26 ± 1.90 (range: 10-16) years (Table 1).

The mean ± SD preoperative and postoperative air thresholds of the patients were 44.66 ± 10.19 dB HL and 21.93 ± 6.90 dB HL, respectively, and the difference was statistically significant ($p < 0.001$). The mean ± SD preoperative bone threshold was 10.53 ± 5.90 dB HL while this value was 8.66 ± 4.02 dB HL postoperatively. The difference was not statistically significant ($p= 0.160$). The mean ± SD preoperative and postoperative ABG were 34 ± 6.67 dB HL and 13 ± 5.90 dB HL respectively, and the difference was statistically significant ($p< 0.001$) (Table 2). It was evident that hearing of the patients improved significantly after surgery.

Table 1
The characteristics of the study population.

Patient characteristics	Mean ± SD	p value
Gender Male	8 (53%)	
Female	7 (47%)	
Age (years)	13.26 ± 1.90	
Preoperative air conduction PTA	44.66 ± 10.19	**< 0.001***
Postoperative air conduction PTA	21.93 ± 6.90	
Preoperative bone conduction PTA	10.53 ± 5.90	0.160
Postoperative bone conduction PTA	8.66 ± 4.02	
Preoperative ABG	34 ± 6.67	**< 0.001***
Postoperative ABG	13 ± 5.90	

PTA: Pure tone average, ABG: Air bone gap, SD: Standard deviation.
* $p < 0.05$ was considered significant.