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Short- and long-term results of stapedectomy in children

Otosclerosis in children and teenagers is very uncommon. Typical otosclerosis presents as a slowly progressive conductive hearing loss and tinnitus in the third to fourth decade of life. Stapedectomy is a well-established procedure for correction of conductive hearing loss in patients with otosclerosis. It is an effective and safe operation in adults. Controversy exists if it is the same in younger patients. Several authors reported good early results of stapedectomy in children (9, 10). Few studies with long-term results are available. The aim of this study was to assess early and late hearing results of stapedectomy performed in patients under 20 years of age.

MATERIAL AND METHODS

During the last 20 years 270 stapedectomies were carried out in our institution. 10 patients (3.7%) of the group were less than 20 years of age. Clinical charts were reviewed for patients' age, sex, middle ear abnormalities and hearing results. The group included 6 girls and 4 boys, at the age of 11 to 19 years. Pure-tone audiometry for bone and air conduction threshold was performed in all the patients at the frequencies 0.5 kHz, 1 kHz, 2 kHz, 3 kHz, 4 kHz. Hearing tests were carried out by the same technician before surgery, 6 (4-9) months and 7 (5-13) years after the operation. The patients' audiograms were analysed for pre- and postoperative air-bone gap (ABG), postoperative air conduction (AC) improvement. Preoperative and postoperative air-bone gaps were computed at 0.5, 1, 2, and 3 kHz according to Committee on Hearing and Equilibrium guidelines (7). The air-bone gap was calculated as the four-tone pure-tone average for air conduction minus the same average for bone conduction. The mean changes of BC and AC thresholds were analysed statistically using t-Student test.

RESULTS

2 patients had positive family history for otosclerosis. Bilateral otosclerosis was diagnosed in 8, and unilateral in 2 patients. 9 of 10 patients were operated in local anaesthesia. In the youngest boy, lightly mentally retarded, general anaesthesia was applied and adenotomy was performed at the same

time with stapedectomy. In 3 patients the whole footplate and in 7 patients one third of stapes footplate was removed. Teflon piston prosthesis was used in 9 patients. In 1 patient with tympanosclerosis malleovestibulopexy was performed using autoincus. Very narrow oval window niche was found in 1 patient. Another patient had incus anomaly. The incus had broad shortened long process and doubled short process. In 1 patient average bone conduction threshold of 40 dB suggested cochlear otosclerosis. Preoperative and early postoperative hearing thresholds are shown in Table 1.

Table 1. Mean preoperative and early postoperative air and bone conduction thresholds (mean ± SD)

Thresholds	Frequency (kHz)				Mean of four frequencies
	0.5	1	2	3	
Preoperative AC	56.0 ± 12.8	61.5 ± 7.8	50.0 ± 11.2	48.5 ± 9.0	54.0 ± 6.4
Postoperative AC	27.0 ± 13.0	27.5 ± 15.9	26.5 ± 17.5	29.0 ± 12.4	27.5 ± 13.8
Preoperative BC	16.0 ± 14.5	22.5 ± 15.4	20.0 ± 12.6	21.0 ± 12.8	19.9 ± 12.3
Postoperative BC	6.0 ± 9.4	13.5 ± 9.1	17.5 ± 12.1	19.5 ± 12.1	14.1 ± 9.2

Preoperative mean air conduction (AC) pure tone average (PTA) was 54 dB, and ranged from 45 to 66 dB. 6 months postoperatively 7 patients had socially acceptable hearing (PTA less than 30 dB) in the operated ear. The mean improvement of AC was 26.5 dB and it was statistically significant ($p<0.0001$) – Table 2.

Table 2. Air conduction (AC) improvement 6 months after stapedectomy

AC	Frequency (kHz)				Mean of four frequencies
	0,5	1	2	3	
Mean of all patients	29	34	23.5	19.5	26.5
SD	6.14	17.60	25.39	20.33	15.56
t - value	14.9	6.10	2.92	3.03	5.38
p	p<0.001	p<0.001	p<0.02	p<0.02	p<0.001

6 of 10 young patients (60%) had postoperative air-bone gap (ABG) of 10 dB or less, 2 patients 10-15 dB and 2 patients 15-20 dB. Mean ABG closure was 22.5 ± 11.5 and ranged from 5 to 35 dB. The average bone conduction (BC) threshold improved postoperatively by 5.9 dB. Bone conduction deteriorated slightly with time and after 7 years it was still better by 2.8 dB than average preoperative BC. The BC changes were statistically not significant. Long-term results regarding air conduction thresholds were comparable with short-term results. 5 patients had ABG of 10 dB or less, 3 patients had ABG of 10-15 dB and 2 patients had ABG of 20-30dB.

Tinnitus was present before surgery in 8 patients and it disappeared in 5 patients after stapedectomy. In 2 patients tinnitus was less disturbing postoperatively, and in 1 patient this symptom did not change.

DISCUSSION

Although stapedectomy is very effective, serious complications including deaf ear may occur. Different opinions about management of otosclerosis in children are found in the literature. Some authors advocate the operation, others prefer to wait until the patient can participate in the decision-making process. The majority of surgeons advise stapedectomy in patients older than 5 years (4, 8). All risks associated with stapedectomy and other treatment options including hearing aid and observation have to be explained to the parents and the patient.

Many authors (1, 4, 5,) reported higher incidence of ossicules abnormalities in children than in adults. In our group 1 child had incus abnormality. In patients with juvenile otosclerosis obliteration of oval window is often found during the operation (2). Narrow oval window niche was present in 1 of our patients. Cochlear involvement can also develop in juvenile otosclerosis (2, 3). 1 patient in the present study presented with mixed hearing loss. Although postoperative ABG was satisfying in this child, sensorineural component of hearing loss increased with time and 9 years after stapedectomy hearing aid was advocated.

Stapedectomy was very effective at improving the hearing in all the children in the study. The mean AC improvement after the operation in children ranged between 22 and 33 dB (5, 6). The improvement of 26 dB in our group is comparable with those results. Other authors also reported very good early results. House (4) analysed a group of 14 children and showed results as good as in adults. De la Cruz (1) presented a large group with otosclerosis in 81 patients under 18 years. 82 percent of the patients obtained postoperative ABG of 10 dB or less. Few authors presented long--term results. In our group of patients the satisfying effect of stapedectomy was stable after mean follow-up period of 7 years. Millman (6) found no difference in air-bone gap measured 2 months and 25 years after stapedectomy. Long-term results reported by Lippy (5) indicate the development of sensorineural hearing loss. This gradual decrease in hearing was similar to that found in adults. These results show stable hearing improvement after stapedectomy in children and teenagers.

CONCLUSIONS

Stapedectomy in children provides good and stable hearing results.

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SUMMARY

Otosclerosis in children and teenagers is very uncommon. Typical otosclerosis presents as a slowly progressive conductive hearing loss and tinnitus in the third to fourth decade of life. Stapedectomy is a well-established procedure for correction of conductive hearing loss in adult patients with otosclerosis.

The aim of this work is to assess short- (6 months) and long-term (7 years) results after stapedectomy performed in 10 patients under 20 years of age. In 1 patient cochlear otosclerosis was diagnosed and in 1 patient incus anomaly was found during the operation. Pure tone audiograms obtained 6 months after stapedectomy showed air-bone gap closure to 10 dB in 6 patients, to 15 dB in 8 patients and in all patients to 20 dB. Average air conduction threshold improved by 26.5 dB and average bone conduction threshold by 5.9 dB. 7 years after stapedectomy air-bone gap was similar to the one measured 6 months postoperatively. Stapedectomy in children provides good and stable hearing results.

Wczesne i odległe wyniki stapedektomii u dzieci

Otoskleroza jest chorobą występującą najczęściej w trzeciej lub czwartej dekadzie życia. U dzieci i nastolatków jest rzadkością. Celem tej pracy jest analiza wczesnych (6 miesięcy) i odległych (7 lat) wyników słuchowych po stapedektomii wykonanej u 10 osób młodszych niż 20 lat. Chorzy ci stanowili 3,7 % wszystkich pacjentów operowanych z powodu otosklerozy w Klinice Otolaryngologii w Lublinie w latach 1980-2000. U jednej chorej stwierdzono otosklerozę ślimakową, u jednego chorego deformacje kowadełka. Badanie słuchu po 6 miesiącach wykazało zmniejszenie rezerwy ślimakowej do 10 dB u 6 pacjentów, do 15 dB–u 8 i do 20 dB u wszystkich chorych. Przewodnictwo powietrzne poprawiło się średnio o 26,5 dB, a przewodnictwo kostne–o 5,9 dB. Po 5–13 latach od stapedektomii rezerwa ślimakowa była podobna jak po 6 miesiącach od zabiegu. Operacyjne leczenie otosklerozy u dzieci i młodzieży zapewnia stabilną poprawę słuchu.