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## HEARING FUNCTION IN CHILDREN WITH NASAL SEPTUM DEVIATION BEFORE AND AFTER SEPTOPLASTY

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**Summary.** Conducted was an investigation of hearing function in the conventional and extended frequency regions in 60 children with nasal septum deviations ranged in age from 6 to 17 years (45 male and 15 female). Conductive hearing loss was detected in 78.3% of cases according to the findings of hearing in the conventional frequencies and in 95% in the extended frequency region. Following a month and some later after septoplasty noted was positive hearing dynamics both in the conventional and extended frequency regions. The obtained data manifest that hearing tests in children with nasal septum deviations are advisable for refinement of indications to septoplasty.

**Key words:** children, nasal septum deviation, septoplasty, hearing function.

**Резюме.** Проведено дослідження слухової функції в звичайному і розширеному діапазоні частот у 60 дітей з викривленням перегородки носа у віці від 6 до 17 років, із них хлопчиків було 45, дівчаток 15. Зниження слуху по кондуктивному типу виявлено у 78,3% випадків в звичайному і у 95% в розширеному діапазоні частот. При дослідженні слуху після септопластики через 1 місяць і пізніше відмічено позитивну динаміку слуху як в звичайному, так і в розширеному діапазоні частот. Отримані дані дозволяють рекомендувати проведення обстеження слуху у дітей з викривленням перегородки носа для уточнення показань до септопластики.

**Ключові слова:** діти, викривлення перегородки носа, септопластика, слухова функція.

**Резюме.** Проведено исследование слуховой функции в обычном и расширенном диапазоне частот в 60 детей с искривлением перегородки носа в возрасте от 6 до 17 лет, из них мальчиков было 45, девочек 15. Снижение слуха кондуктивного характера обнаружено в 78,3% случаев в обычном и в 95% в расширенном диапазоне частот. При исследовании слуха после септопластики через 1 месяц и позже отмечено положительную динамику слуха как в обычном, так и в расширенном диапазоне частот. Полученные данные позволяют рекомендовать проведение обследования слуха у детей с искривлением перегородки носа для уточнения показаний к септопластике.

**Ключевые слова:** дети, искривление перегородки носа, септопластика, слуховая функция.

**Introduction.** Nasal septum deviations are rather common in children (1-9, 11-15, 17-21, 23 and others). Giving rise to airflow difficulties a deformation of the nasal septum quite often causes possible complications of inner organs and systems and affects mental health and intelligence of the child. Crests and spines of the nasal septum touching the mucous membrane of the lateral wall of the nasal cavity cause its irritation accompanied by edema and infiltration of the mucous membrane. Those processes can spread to the mucous membrane of the auditory tube which results in hearing loss. In spite of numerous studies devoted to deviated nasal septum in children, only in few reports the attention is paid to evaluation of hearing function by tone audiometry at conventional frequencies (0.125-8 kHz) (10, 20-22), but we did not succeed in finding any studies about the investigation of hearing function in the extended frequency region (9-16 kHz).

**Aim of the investigation.** To evaluate hearing function in children with nasal septum deviations before and after septoplasty employing tone audiometry both at conventional (0.125-8 kHz) and extended (9-16 kHz) frequencies.

**Materials and methods.** To achieve the set goals we investigated 60 children with nasal septum deviations aged from 6 to 17 (120 ears) and 27 children (54 ears) after septoplasty. The group of control was composed of 20 healthy individuals with no nasal pathologies. Audiometric tests were performed inside the soundproof acoustic booth with background noise below 30 dB by clinical audiometer AC-40 (Interacustics Denmark). The investigation included whispered and normal voice tests, Bing's test, Federichi's test, threshold tone audiometry with audible signals transmitted by air and bone conduction in the region of 0.125-8 kHz and by air conduction in the region of 9-16 kHz. The older children also underwent speech audiometry and over threshold tone

audiometry. To assess the pass ability of the auditory tube applied were Valsalva's method, Toinbe's and Politser's tests. Acoustic impedancometry was employed to evaluate the functional state of the ear drum and the auditory tube. Recorded were tympanograms and ipsi- and contra lateral acoustic reflexes of entotic muscles. Dynamic impedansometry was performed by impedance meter "Siemens SD 40" (Germany).

*Results and discussion.* Assessing hearing function at conventional frequencies 0.125-8 kHz found was that hearing for the tones transmitted by bone conduction in all children with nasal septum deviations and in the group of control was within normal limits which are the evidence of unimpaired sound perception.

47 (78.3%) examined children with nasal septum deviations showed slight impairment of sound conduction due to the malfunction of the auditory tube which was confirmed by presence of the air-bone gap and tympanogram type C.

Table 1 exhibits the results of conductive hearing loss depending upon the side of nasal septum deformation. In the majority of cases either a crest or a spine of the nasal septum touched the maxilloturbinal bone (deformation level III). Only 7 patients had deviation level II according to G.S. Protasevych (16) classification.

*Table 1*

**DISTRIBUTION OF EXAMINED CHILDREN WITH NASAL SEPTUM DEVIATIONS  
ACCORDING TO THRESHOLDS OF AIR-CONDUCTED SOUNDS IN THE  
CONVENTIONAL REGION OF FREQUENCIES AT THE SIDE OF DEFORMATION AND  
WITH NO DEFORMATION (n- number of ears)**

Side	n	Thresholds of air-conducted tones			
		absolute		%	
		norm	elevated	norm	elevated
nasal septum deformation	93	19	74	20.4	79.6
no deformation	27	15	12	55.6	44.4
Total	120	34	86	28.3	71.7

Table 1 demonstrates impaired sound conduction at the side of nasal septum deformation in the conventional region of frequencies in overwhelming majority of cases (79.6%). Only in 20.4% of cases the thresholds of air-conducted tones showed no abnormalities, whereas elevation of air-conducted tones thresholds in examined children at the side with no deformation was observed in 44.4% of cases and it was less marked. At the same time the majority (55.6%) demonstrated perception of air-conducted tones at the side with no deformation within normal limits (figure 1).

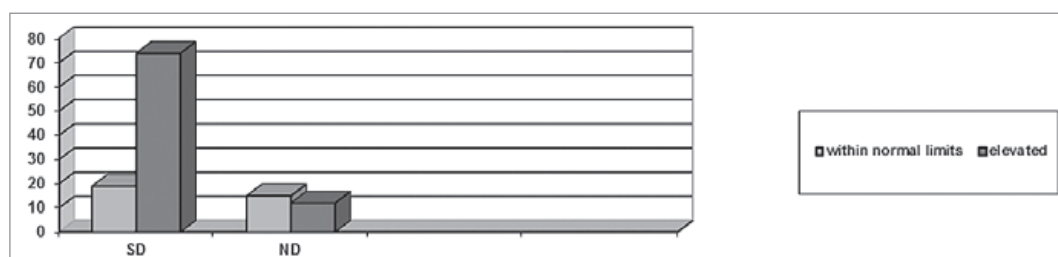


Fig. 1. Distribution of examined children with nasal septum deviations according to thresholds of air-conducted sounds in the conventional region of frequencies at the side of deformation (SD) and with no deformation (ND) (n- number of ears).

The results of tone audiometry by air conduction in the region of 0.125-8 kHz are presented in table 2.

Table 2

HEARING THRESHOLDS OF AIR-CONDUCTED TONES IN THE CONVENTIONAL REGION OF FREQUENCIES IN CHILDREN WITH NASAL SEPTUM DEVIATIONS (NSD), AT THE SIDE OF DEFORMATION (SD), AT THE SIDE OPPOSITE DEFORMATION (SOD) AND IN HEALTHY CHILDREN FROM THE GROUP OF CONTROL (C), (M+m).

Groups of examined children	Hearing thresholds to air-conducted tones (dB) in the region of								
	0.125 kHz	0.25 kHz	0.5 kHz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
C	5.28± 0.32	5.21± 0.43	6.31± 0.56	6.45± 0.48	6.56± 0.56	7.89± 0.76	7.34± 0.67	7.51± 0.98	7.99± 0.76
NSD	14.96± 0.68	16.61± 0.96	14.91± 0.87	14.01± 0.92	13.19± 0.99	13.68± 0.92	14.48 ±1.03	19.14 ±1.15	16.77 ±1.09
SD	16.85± 1.14	17.82± 1.07	18.44 ±1.22	19.55 ±1.48	18.91 ±1.23	20.44 ±1.16	19.88 ±1.12	23.21±1.15	20.15± 1.48
ND	10.45± 0.98	12.82± 1.09	13.36 ±0.94	13.84± 1.18	12.81± 1.08	13.69± 1.03	14.58± 1.06	15.41±1.12	14.12± 1.11
t/p (C-NSD)	12.87 <0.001	10.84 <0.001	7.99 <0.001	7.28 <0.001	5.83 <0.001	4.85 <0.001	5.81 <0.001	7.70 <0.001	6.61 <0.001
t/p (C-SD)	9.78 <0.001	10.94 <0.001	9.04 <0.001	8.41 <0.001	9.13 <0.001	9.05 <0.001	9.61 <0.001	10.39 <0.001	7.31 <0.001
t/p(C-ND)	5.01 <0.001	6.49 <0.001	6.44 <0.001	5.80 <0.001	5.14 <0.001	4.53 <0.001	5.77 <0.001	5.31 <0.001	4.56 <0.001
t/p (SD-ND)	4.26 <0.001	3.27 <0.01	3.29 <0.01	3.03 <0.01	3.72 <0.001	4.35 <0.001	3.43 <0.01	4.85 <0.001	3.26 <0.01

Table 2 demonstrates that hearing thresholds of air-conducted tones are significantly elevated in all studied frequencies ( $p < 0.001$ ) in children with nasal septum deviations as compared to the group of control. That difference appeared to be more marked through comparison of data of the control group and children with nasal septum deviations at the side of deformation (SD) in comparison with the side with no deformation (ND). Having compared hearing thresholds of air-conducted tones in the frequency region of 0.125-8 kHz at the side of deformation and with no deformation found was significant difference ( $p < 0.001$ ).

The obtained data are depicted in figures 2 and 3.

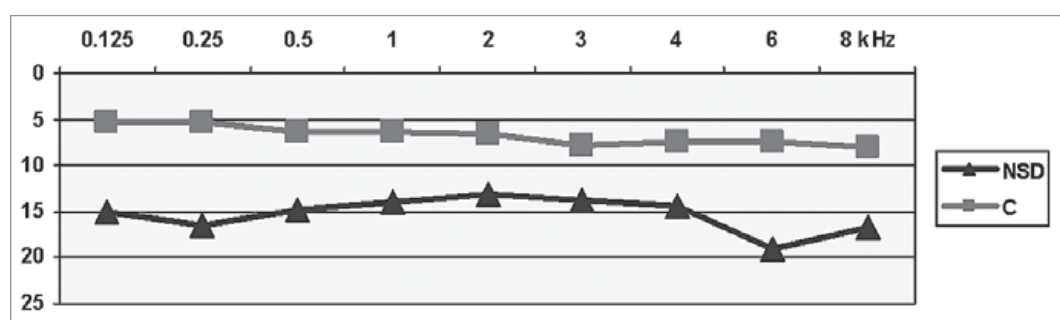


Fig. 2. Indices of air-conducted tones in the region of 0.125-8 kHz in children with nasal septum deviations (NSD) and in the group of control (C).

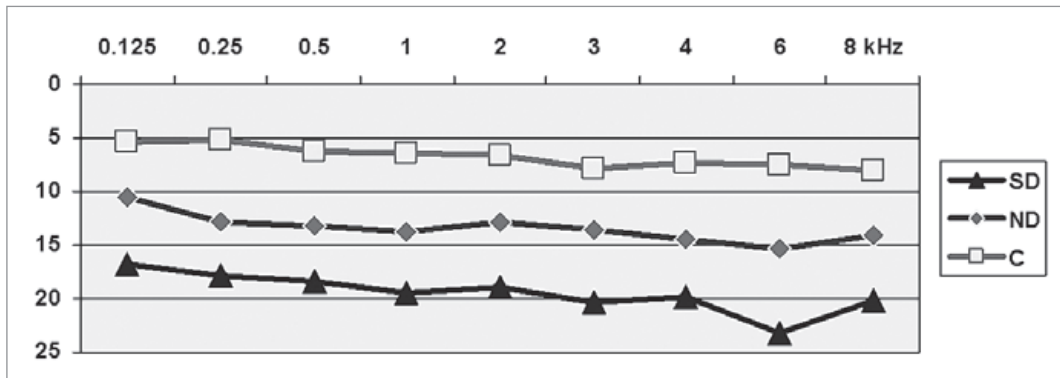


Fig. 3. Indices of air-conducted tones in the region of 0.125-8 kHz in children at the side of deformation (SD), with no deformation (ND) and in the group of control (C).

In the table 3 the average statistical data of the thresholds for hearing is presented acuity by air conduction in the 9-16 kHz region.

Table 3

HEARING THRESHOLDS OF THE TONES IN THE EXTENDED FREQUENCY REGION IN CHILDREN WITH NASAL SEPTUM DEVIATIONS (NSD), AT THE SIDE OF DEFORMATION (SD), AT THE SIDE OPPOSITE DEFORMATION (SOD) AND IN HEALTHY CHILDREN FROM THE GROUP OF CONTROL (C), (M+m).

Groups of examined children	Hearing thresholds of the tones (dB) in the region of					
	9 kHz	10 kHz	11.2 kHz	12.5 kHz	14 kHz	16 kHz
C	8.12± 0.80	8.31± 0.92	9.14± 1.28	9.14± 1.28	10.40± 1.31	10.91± 1.26
NSD	23.71± 1.29	25.09± 1.45	27.16± 1.51	29.35± 1.55	31.21± 1.61	19.09± 1.72
SD	21.12± 1.11	22.34± 1.10	21.45± 0.96	22.56± 1.12	23.95± 1.05	25.48± 1.09
ND	15.15± 1.48	17.38± 1.12	16.14± 1.08	17.48± 1.06	19.59± 0.98	20.37± 1.14
t/p (C-NSD)	10.26 <0.001	10.66 <0.001	10.05 <0.001	10.03 <0.001	10.01 <0.001	3.84 <0.001
t/p (C-SD)	9.50 <0.001	10.36 <0.001	7.69 <0.001	7.89 <0.001	8.07 <0.001	8.75 <0.001
t/p(C-ND)	4.19 <0.001	6.26 <0.001	4.18 <0.001	5.02 <0.001	5.62 <0.001	5.57 <0.001
t/p (SD-ND)	3.23 <0.01	3.16 <0.01	3.68 <0.01	3.29 <0.01	3.04 <0.01	3.24 <0.01

Table 3 demonstrates significant elevation of hearing thresholds ( $p < 0.001$ ) in children with nasal septum deviations in the extended frequency region along all the range of the scale as compared to the group of control. Elevation of hearing thresholds is more significant at the side of deformation in comparison with the side with no deformation ( $p < 0.001$ ).

In figure 4 hearing thresholds to the tones are presented in the extended frequency region in children with nasal septum deviations (NSD) and in the group of control (C).

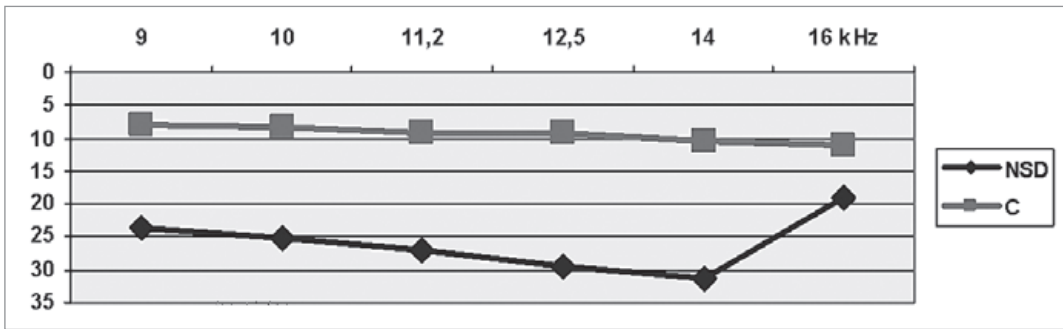


Fig. 4. Indices of air-conducted tones in the 9-16 kHz region in children with nasal septum deviations (NSD) and in the group of control (C).

In figure 5 hearing thresholds of the tones are shown in the extended frequency region in children with nasal septum deviations at the side of deformation (SD), at the side opposite deformation (SOD) and in the group of control (C).

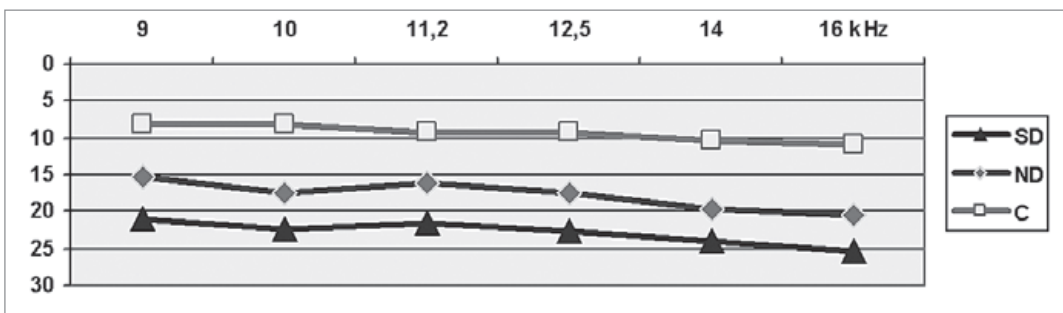


Fig. 5. Hearing thresholds of the tones in the extended frequency region (9-16 kHz) in children at the side of deformation (SD), at the side with no deformation (ND) and in the group of control (C).

Hearing loss measured in the extended frequency region is more marked as compared with the conventional one. Furthermore, the attention should be drawn to much earlier elevation of hearing thresholds to the tones in the extended frequency region in children with nasal septum deviations in comparison with conventional frequencies. It is proved by the fact that the elevation of hearing thresholds of the tones in children with nasal septum deviations was detected in 47 individuals (78.3%) in the conventional frequency region and in 57 persons (95%) in the extended frequencies.

However, out of 60 children with nasal septum deviations 27 persons (54 ears) came to the follow-up examination after septoplasty.

Later we carried on the comparative analysis of hearing function of children with nasal septum deviations according to the findings of tone audiometry in the conventional (0.125-8 kHz) and extended (9-16 kHz) frequencies before and after septoplasty.

The investigations showed that after septoplasty complete hearing renewal was observed in 33 (61.1%) of cases in the conventional and in 9 (16.7%) cases in the extended frequency regions. Lowering of hearing thresholds to air-conducted tones was recorded in 21 (38.9%) and 38 (70.4%), respectively.

In table 4 data regarding hearing to air-conducted tones are presented in the 0.125-8 kHz region in children with nasal septum deviations before and after septoplasty (groups A and B, respectively).

Table 4

HEARING THRESHOLDS OF THE AIR-CONDUCTED TONES IN CHILDREN WITH NASAL SEPTUM DEVIATIONS BEFORE (GROUP A) AND AFTER (GROUP B) SEPTOPLASTY AND IN HEALTHY CHILDREN FROM THE GROUP OF CONTROL (C) IN THE CONVENTIONAL FREQUENCIES, (M+m).

Groups of investigated children	Air conduction hearing (dB) in the region of								
	0.125 kHz	0.25 kHz	0.5 kHz	1 kHz	2 kHz	3 kHz	4 kHz	6 kHz	8 kHz
A	14.66± 0.75	14.89± 1.52	15.00± 1.47	13.41± 1.46	12.59± 1.66	13.98± 1.42	12.95± 1.49	16.48± 1.69	13.86± 1.53
B	11.56± 0.79	12.11± 0.72	11.56± 0.79	9.78± 0.76	8.33± 0.62	9.44± 0.81	9.67± 1.06	12.44± 1.05	11.44± 1.15
C	5.28± 0.32	5.21± 0.43	6.31± 0.56	6.45± 0.48	6.56± 0.56	7.89± 0.76	7.34± 0.67	7.51± 0.98	7.99± 0.76
t/p (C-A)	11.51 <0.001	6.13 <0.001	5.52 <0.001	4.53 <0.001	3.44 <0.01	3.78 <0.001	3.43 0.01	4.59 <0.001	3.44 <0.01
t/p (C-B)	7.37 <0.001	8.22 <0.001	5.42 <0.001	3.70 <0.001	2.12 <0.05	1.40 >0.05	1.86 >0.05	3.43 <0.001	2.50 <0.05
t/p (A-B)	2.85 <0.01	1.65 >0.05	2.06 <0.05	2.21 <0.05	2.40 <0.05	2.78 <0.01	1.8 >0.05	2.03 <0.05	1.26 >0.05

In table 5 hearing findings before and after septoplasty are presented in the extended (9-16 kHz) frequency region.

Table 5

HEARING THRESHOLDS OF THE TONES IN CHILDREN WITH NASAL SEPTUM DEVIATION. BEFORE (GROUP A) AND AFTER (GROUP B) SEPTOPLASTY AND IN HEALTHY CHILDREN FROM THE GROUP OF CONTROL (C) IN THE EXTENDED FREQUENCY REGION, (M+m).

Groups of examined children	Hearing thresholds to the tones (dB) in the region of					
	9 kHz	10 kHz	11.2 kHz	12.5 kHz	14 kHz	16 kHz
A	21.82 ±1.93	20.80 ±1.88	22.61 ±1.92	26.82 ±2.05	29.89 ±2.18	32.27 ±2.44
B	17.56 ±1.62	18.56 ±1.39	20.78 ±1.51	21.89 ±1.29	23.89 ±1.85	24.11 ±1.58
C	8.12± 0.80	8.31± 0.92	9.14± 1.28	9.14± 1.28	10.40± 1.31	10.91± 1.26
t/p (C-A)	6.52 <0.001	5.97 <0.001	5.83 <0.001	7.31 <0.001	7.67 <0.001	7.77 <0.001
t/p (C-B)	5.22 <0.001	6.15 <0.001	5.88 <0.001	5.27 <0.001	5.94 <0.001	6.55 <0.001
t/p (A-B)	1.69 >0.05	0.96 >0.05	0.75 >0.05	2.04 <0.05	2.10 <0.05	2.81 <0.01

The data are depicted in figures 4 and 5, respectively for air-conducted tones in the regions of 0.125-8 kHz and 9-16 kHz.

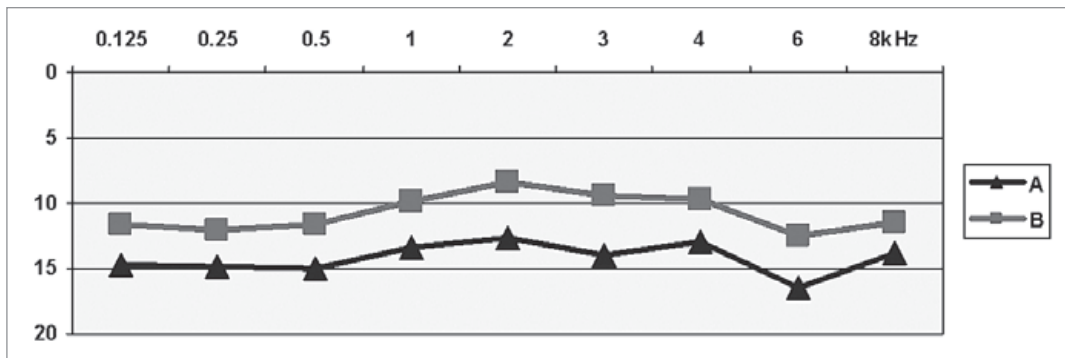


Fig. 6. Hearing thresholds to the air-conducted tones in the region of 0.125-8 kHz in children with nasal septum deviations before (A) and after septoplasty (B).

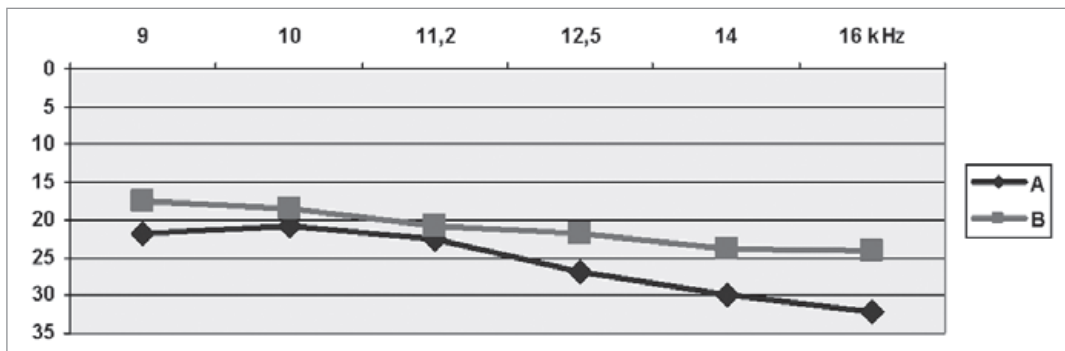


Fig. 7. Hearing thresholds of the tones in the extended frequencies in children with nasal septum deviations before (A) and after septoplasty (B).

Tables 5 and 6 and figures 6 and 7 illustrate the significant lowering of hearing thresholds to air-conducted tones after treatment in the majority of investigated frequencies ( $p < 0.005$ ).

None of the children experienced worsening of hearing function after septoplasty.

Postoperative follow-up examinations noted further lowering of hearing thresholds.

*Conclusions:*

1. Conductive hearing loss in children with nasal deviations appears to be present in 78.3 % while measuring in the conventional region of frequencies (0.125-8 kHz) and in 95% in the extended region (9-16 kHz).

2. Hearing loss is at the side of nasal septum deviation. At the side with no nasal septum deviation impairment of sound conduction was less marked or hearing function was within normal limits.

3. In a month after septoplasty hearing function assessed at the conventional frequency region is practically back to normal in 61.1% and improved in 38.9% of cases, at the extended region – 16.7% and 70.4%, respectively.

4. None of the patients experienced worsening of hearing.

5. It is advisable to perform the assessment of hearing function both in the conventional (0.125-8 kHz) and extended (9-16 kHz) frequency regions in children with nasal septum deviations. Audiometry findings should be considered as an additional criterion for specification of indications to septoplasty in children.

**References**

1. Ahmet Kemal Firat, Murat Cem Miman, Yezdan Firat, Muammer Karakas, Orhan Ozturan, Tayfun Altinok. Effect of nasal septal deviation on total ethmoid cell volume. The Journal of Laryngology & Otolaryngology, 120: 200-204, 2006.

2. Aktas D., Kalcioğlu M.T., Kutlu R., Ozturan O., Oncel S. The relationship between the concha bullosa, nasal septal deviation and sinusitis. Rhinology, 41: 103-106, 2003.

*Повний список літератури знаходиться в редакції.*