Assessment of hearing disorders in a cleft palate population

Ladan Eslamian [a], Sara Youssefinia [b], Soode Mohseni [c]

Abstract

Aim: Hearing impairment is one of the associated problems to cleft palate; although it affects language development, it has rarely been noticed in literature. The aim of this study is evaluating cleft palate patients' hearing condition and the relationship of different incorporated elements with their hearing.

Materials and methods: Forty-two patients with cleft palate (23 males and 19 females) were selected among patients referring to orthodontic department of Shahid Beheshti university and Nime Sha'ban dental clinic of Kerman, their files were surveyed according to audiometric and tympanometric tests (A,B and C). Likewise the relationship of other factors including age, gender, type of cleft (unilateral, bilateral), history of previous reconstructive surgery and presence of oronasal fistula were studied on hearing. Chi-square and t-tests were used to analyze the data.

Results: Twenty-three patients (54.7%) had one ear or both ears mild conductive hearing loss; and tympanogram-B was observed in 38 ears from 84 ears. These disorders were mostly observed in younger patients. Gender and type of cleft had no relationship with hearing condition. The average of hearing threshold in patients who had cleft palate surgery and patients without oronasal fistula was lower than other groups.

Conclusion: Hearing problem was observed in more than %50 of the studied patients; which determines the need for proper examination and diagnosis following by predetermined treatment protocols.

Keywords: Cleft Palate, Hearing loss, Audiometry, Tympanometry

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Cleft lip and palate is the most common head and face disorder and it is a serious inborn defect. In general it happens 0.28 to 3.74 in every 1000 births.[1] Depending on the person's race it happens 1.03 in each 1000 birth in Iran, for instance, it is more common among Persian, Turkmen and Sistani races.[2,3]

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Hearing problem is one of the outstanding and particular problems among children with cleft palate. It has been stated that performance of Eustachian tube is the primary reason behind of this problem.[4] Furthermore, comparing other disorders happening in children with cleft lip and palate, hearing reduction or loss has rarely been noticed in literature. Ear deficit can result in well-known distinct speaking disorders.[5, 6]

The type of hearing reduction is conductive. And if this problem left untreated, due to serious damage of acoustic nerves, their condition cannot be improved by any treatment modalities thereafter. The impact of hearing problems is severe in affected patients and they may hear a sound 50 percent less than expected.[7]

The prevalence of deficiency of hearing ability of these patients have been reported in different countries. One study done in Ankara (2003) suggests that 37% of cleft palate people have hearing problem[8] and another one in Hong Kong (2005) showed that 13.4% have hearing problems.[9] For a research in Kolkata (2006) this figure was 76 % [4] and another study in India (2007) showed that 88.4 % of people with cleft palate have hearing problems.[5] In china (2009) the prevalence of hearing loss was reported about 30%10. Hearing problem in patients suffering from cleft palate differs in different societies due to various factors such as race.[9] To date, no clinical investigation on the burden of hearing problem has been reported in Iranian cleft palate children which might have a dramatic effect on their treatment modalities. Therefore, this study was aimed to assess hearing condition of a cleft palate population in Iran, with regard to their age, gender, type of cleft and presence or lack of oronasal fistula.

Methods and materials

The variables included in this retrospective study were gender, age, history of former operation, presence of oronasal fistula, cleft type and the side of involvement.The procedure of this study was based on article 27 of medical morality committee of Iran and approved by this committee.

The sample population in the study consisted of 2 groups:

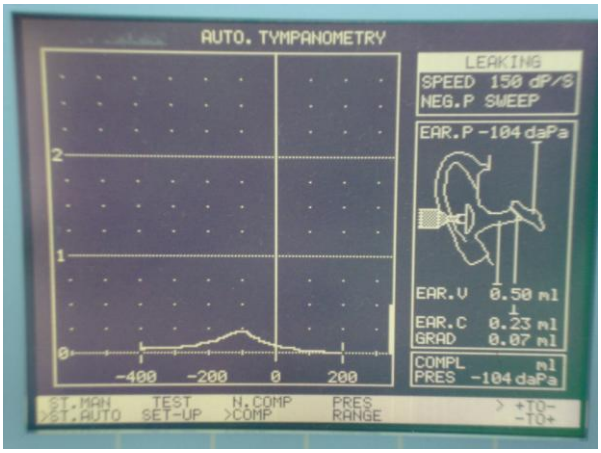
1-The patients who formerly had reconstructive surgery of cleft palate and referred to Shahid Beheshti dental school to perform orthodontic treatment and had a file in the orthodontic department from 2008 to 2010.

2-The cleft palate patients who referred to Nime Sha'ban dental clinic in Kerman and had a history of previous reconstructive surgery.

As performing audiometry test was impossible in patients under 3 years old, they were excluded from the sample. Other exclusion criteria's including the patients, who had problems other than cleft palate such as congenital or craniofacial disorders, and the patients with hearing problem due to other reasons like trauma. In the next step, the questionnaires were provided according to study variables.

Group 1- demographic data of individual patient was extracted according to file of the patients at dental school; then they were introduced to audiometry center of Pars hospital to perform audiometry and tympanometry for free.(Figure 1) The data was completed according to the tests and the audiologist's opinion.

Group 2-The same procedures were performed for the cleft palate population of Nime Sha'ban clinic in Kerman and the questionnaires completed.



Statistical analysis: Data of the research was analyzed by SPSS (Version 15) software. The amount of central dispersion indices of the tests' result was determined for both ears of the individuals in different frequencies. As the data followed normal distribution, the results of the tests were

compared by student t- test for different confounding variables such as age and fistula. Chi-square test was used to compare the hearing condition by gender. The amount of first kind error in this study was considered 0.05 and P-value was estimated <0.05 to determine the significancy of the differences.

Results

The study was done on 42 operated and non-operated patients of dental faculty of Shahid Beheshti dental school in Tehran and Nime Sha'ban dental clinic in Kerman.

Eleven patients were from Shahid Beheshti dental school and 31 from Kerman dental clinic and 15 patients among them had reconstructive operation for the first time; and 16 other were re-operated due to surgical relapse or other problems. The patients were 3 to 25 years old. The findings of study variables are shown in Table 1.

From 31 patients examined in Kerman dental clinic, 15 had audiometry test before first operation and 16 had it before re-operation.

Central dispersion indices of hearing, both for air and bone conduction are shown in Table 2.

Table 1. The findings of study variables

Gender	Male: 23	Female:19	
operation	Former operation:27	Non-operated:15	
Cleft type	Type II:19	Type III:23	
Cleft side	Bilateral:16	Unilateral/Left:16	Unilateral/Right:10
Tympanometry	Right ear Type A:21 Type B:21	Left ear Type A:25 Type B:17	
Hearing status	Normal:19	conductive hearing deficit/unilateral :16	conductive hearing deficit/ bilateral :8
Oronasal fistula	Presence :23	Absence:19	

Table 2. Central dispersion indices of hearing threshold

Test	Side	Frequency	Mean	Standard deviation	Min	Max
Bone conduction	Right	250(Hz)	6.2857	3.40935	-3.0	18.0
		500(Hz)	5.9048	2.89499	-2.0	12.0
		1(KHz)	4.1905	3.35129	-3.0	10.0
		2(KHz)	3.7381	4.04885	-3.0	12.0
		4(KHz)	2.9524	4.51530	-4.0	15.0
	Left	250(Hz)	6.8571	3.63299	-3.0	18.0
		500(Hz)	5.9762	3.88548	-4.0	18.0
		1(KHz)	4.7619	4.30433	-4.0	18.0
		2(KHz)	3.1667	4.14327	-6.0	12.0
		4(KHz)	4.0238	4.71370	-7.0	15.0
Air conduction	Right	250(Hz)	16.5952	10.04638	2.0	39.0
		500(Hz)	14.50	8.13379	2.0	35.0
		1(KHz)	11.0714	6.74046	1.0	30.0
		2(KHz)	8.9762	5.12044	1.0	20.0
		4(KHz)	8.1429	5.75759	0.0	24.0
	Left	250(Hz)	16.1905	9.54383	4.0	35.0
		500(Hz)	13.8810	8.54315	0.0	35.0
		1(KHz)	11.4762	7.19159	0.0	30.0
		2(KHz)	8.3333	5.60343	0.0	20.0
		4(KHz)	8.4048	4.98319	-2.0	20.0

The hearing threshold in bone and air conduction tests which were performed regarding the type of cleft lip and palate were compared between the two groups and the difference in bone conduction test was significant between the 2 groups. In the right ear the differences were significant for 250 hertz ($p<0.006$), for 500 hertz ($p<0.003$) and for 4 kilohertz ($p<0.05$); and in the left ear the differences were significant for 500 hertz ($p<0.05$) and for 2 kilohertz ($p<0.006$) while for other frequencies the differences were not significant.

Comparison of hearing threshold of people in different frequencies in 2 tests (regarding presence or absence of oronasal fistula) was done by student t test which showed, there is a significant difference between individuals with and without oronasal fistula in air conduction test at right side. The result was ($p<0.03$) for 250 and 500 hertz and ($p<0.04$) for 2 kilohertz, while it was not significant for other frequencies.

Regarding having or not having reconstructive surgery of cleft palate, comparison of hearing threshold in different frequencies in bone and air conductive tests was done by student t test and the result was as follows: at right ear in air conductive, ($p<0.03$) for 250 and 500 hertz, ($p<0.02$) for 1 kilohertz and at left ear, ($p<0.05$) only for 250 hertz while, there was no significant differences for other frequencies.

Evaluation of mean hearing threshold in right ear and comparison of the cases with normal hearing and weak hearing showed that in all frequencies in air conduction test and only for 250 hertz frequency of bone conduction; there was a significant statistical difference (Figure 1). In left ear significant differences were seen in all frequencies for air conduction test (Figure 2).

Comparison of bone and air conduction in all frequencies for right and left ear showed no significant differences by gender.

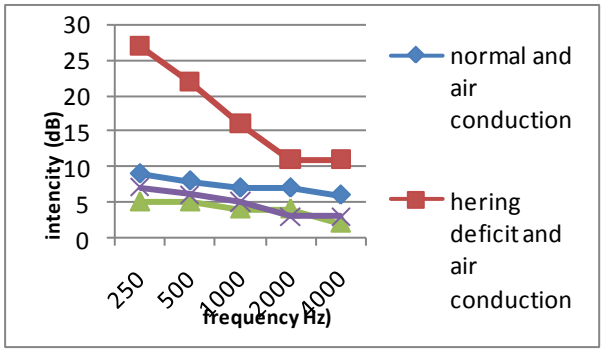


Figure 1. Mean hearing threshold in right ear

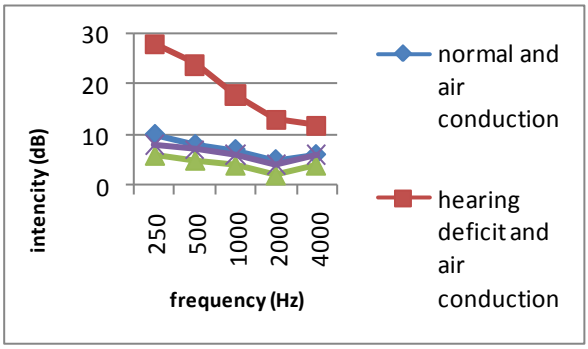


Figure 2. Mean hearing threshold in left ear

Comparison of hearing statue and gender regarding to type of cleft are shown in Table 3. There was no significant difference in hearing of cleft individuals by gender (chi-square test: $p=0.89$) while, cleft palate was more common in girls and cleft lip and palate in boys but, this difference was not statically significant (Chi-square test: $p=0.134$).

Regarding the age, the mean age of patients with normal hearing was 13.4 year(±5.97) while it was 8.7 year(±4.07) in patients with hearing deficit in one ear and 4.9(±2.23) in patients with hearing deficit in both ears. This difference was significant between normal and the other two groups ($p<0.001$ for one ear hearing deficit and $p<0.008$ for both ears hearing deficit).

The comparison between the age of the patients and type of tympanogram showed that mean age of patients with tympanogram A was 12.5(±6.21) while, it was 7.7(±4.17) in patients with tympanogram B which is statistically significant ($p<0.006$). In left ear, the mean age of patients with tympanogram A was 11.3(±5.57) and 8.3(±5.7) in patients with tympanogram B which was not statistically significant ($p=0.09$).

Comparison of patients' gender and type of tympanogram showed no significant difference between boys and girls in both ears regarding the type of tympanogram (table 4).

Table 3. Comparison of hearing statue and gender regarding to type of cleft

Cleft lip/palate statue	Hearing statue			Gender	
	Normal	Unilateral conductive hearing deficit	Bilateral conductive hearing deficit	Male	Female
Class II	9(47.4%)	7(36.8%)	3(15.8%)	8(42.1%)	11(57.9%)
Class III	10(43.5%)	8(34.8%)	5(21.7%)	15(65.2%)	8(34.8%)

Table 4. Comparison of patients' gender and type of tympanogram

Side	**Gender**	**Tympanogram**	**%**	**P value**
Right	Female	A	57.9	0.35
		B	42.1	
	Male	A	43.5	
		B	56.5	
Left	Female	A	63.2	0.66
		B	36.8	
	Male	A	56.5	
		B	43.5	

Surveying the relationship between hearing condition and involved cleft side showed that in people having normal hearing 5 cases had right side cleft(26.3%), 12 had left side cleft(63.2%), and 2 cases(10.5%) had bilateral cleft. In patients with unilateral hearing deficit, 5 cases (33.3%) had right side cleft, 4 had left side cleft(26.7%) and 6 had bilateral cleft (40%).All the patients(8 cases) who suffered from bilateral hearing deficit had bilateral cleft palate.

The comparison of tympanogram type in patients having and not having surgery showed that among 84 ears (in 42 patients), 27 patients had reconstructive surgery of cleft palate and there was tympanogram A in 35 ears(64.8%) and tympanogram B in 19 ears(35.2%). In patients who did not have surgery (15 patients), there was tympanogram A in 11 ears(36.7%) and tympanogram B in 19 ears(63.3%). This comparison showed no significant difference between the two groups (p=0.11)

Regarding hearing condition, all the patients with tympanogram A in right ear had normal hearing in the same ear while the patients with tympanogram B in right ear had normal hearing in 4 cases(19%) and deficit hearing in 17cases(81%). In the left side, the patients with tympanogram A had normal hearing in 24 cases(96 %) and deficit hearing in 1 case(4%).In tympanogram B there was normal hearing in 4 cases (23.5 %) and deficit hearing in 13 cases (76.5%). This difference was statistically significant in two sides (p<0.001).

Discussion

The relationship between cleft palate and hearing problems has been studied since 1950. Several studies support the probability of relationship between middle ear disorders and hearing deficit. The rate of hearing problems among cleft palate patients has been different in various parts of the world.

The results of audiometry test in this study suggested that 45.2 % of the patients had normal hearing threshold in two ears and the rest had slight conductive hearing deficit in one or two ears. The number of patients with normal hearing in this study was more than some former studies 4,5,11 and less than some of them.[8,9]

The result of tympanometry status of the patients demonstrated that 45% of ears have tympanogram B. This tympanogram, like previous studies [9,12] is more seen in younger persons, which indicated that, middle ear condition will be improved by increasing the age and its pressure status is flaring to be normal. The finding of this study about the proportion of patients having abnormal middle ear pressure and tympanogram B was coincident with the result of most of the research [5,8,12,13,] however conflicting results have been reported in other studies.[4,9]

Regarding the relationship between the age of patients and their hearing condition, the study showed 20% of patients from 3 to 7 years old, 30% of patients from 7 to 11 years, 50% of 11 to 15 age group and 90% of over 15 years old had normal hearing. In other words, the average age of people having hearing deficit was significantly less than those with normal hearing. So, like some of the former studies, there was a relationship between an increase in age and improvement of hearing condition [4, 14, 15]. However in some studies, no relationship was found between age and hearing condition [9].This study showed that there is no relationship between gender and hearing condition which is not in contrast with other studies.[9,16]

The surveyed patients in this study were in two groups regarding the type of cleft, Air conduction test showed no significant difference considering people's hearing threshold. This finding was against the

findings of study done by Handzic-cuk etal.(1996) and D'Mello etal. (2007) which suggested hearing condition of people with both cleft lip and palate was worse than those who have just cleft palate.[5,15] Nevertheless, in agreement with a study by Sheahan etal. (2003) and Katie etal. (2005), this study showed type of cleft had no effect on hearing condition.[9,17]

Some studies have claimed that reconstructing the cleft palate decreases hearing deficits considerably.[18,19] Gopalakrishna believes, performance of eustachian tube remains weak, in case cleft palate is not reconstructed. [20] In the present study, the average hearing threshold of patients who had reconstructive surgery of palate was less than those who did not in all frequencies. This difference in hearing threshold was statistically considerable in some frequencies in air conduction test. Some studies have also claimed that reconstructing of cleft palate in lower ages improves performance of eustachian tube and consequently reduces the hearing problems.[19-21]As we did not have the age at which the first surgery was performed, this point was not studied in the present study.

Survey of tympanogram in patients showed 63.3 % of patients who had not had surgery had tympanogram B while it was 35.2% in those who had surgery. It can be concluded that reconstruction of cleft palate can improve pressure on middle ear. This result was similar to Katie etal. [9]

The average hearing threshold of patients without oronasal fistula was less than those with oronasal fistula in all frequencies in our study. This difference in threshold was statistically significant just in 250Hz, 500Hz and 2 KHz in right side and in air conduction. So we can conclude that presence of oronasal fistula may slightly affect hearing in those who suffer from cleft palate. None of the former studies surveyed the effect of oronasal fistula on hearing.

The rate of reduced hearing of patients with hearing deficit in this study was similar to Katie in 2005 which was reported as mild.9 This was reported to be mild to mederate in studies by Sheahan and D'Mello and Ramana.[11,5,13]

It is important to note that even mild hearing deficit affects the child in relation to language development significantly.Proper diagnosis and early treatment will avoid the onset of irreversible hearing damage in children with cleft, which can affect the development of language, causing problems in learning and social life.

Conclusion

Evaluation of the results of audiometry and tympanometry tests in the studied population showed that more than 50% of the population had mild hearing deficit. The hearing loss was age related but was not gender related. Type of cleft had no effect on hearing condition but, all the patients who had bilateral hearing loss, had bilateral cleft palate. Palatal reconstructive surgery had effect on most of the frequencies for the right ear but, only had effect on 250 hertz for the left ear.

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