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Comparison of Right and Left Ear Hearing of Violinists With Audiological Tests

Keman sanatçılarının sağ ve sol kulak işitmesinin odyolojik testlerle karşılaştırılması

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Abstract

Aim: The violin, which can produce high-intensity musical sounds, transmits more sound due to its proximity to the left ear, especially the way it is held. To determine with audiological tests whether this situation creates a significant hearing difference between both ears and to monitor if there is hearing loss and prevent it in a timely manner.

Material and Methods: In this study, the male and female individuals between the ages of 18-55 violinists who have been playing violin for many years, a graduate of the Conservatory of music, music/noise-exposed by exercising every day, and also control group of 25 subjects that have nothing to do was included. An audiological evaluation was performed by pure sound audiometry, high-frequency audiometry, auto-acoustic emission, and tympanometry tests for all individuals in both working and control groups.

Results: In our study, data in violinist and control groups were compared separately according to gender, right and left ear. 9kHz high frequency in all left ear (p=0.001, p<0.01), 10000Hz (p=0,018, p<0.05), 11200Hz (p=0,006, p<0.01), 12500Hz (P=0.002, p<0.01), 14000Hz (p=0,050), p<0.05) and 16000Hz (p=0,010, p<0.01) in the study and control groups, there were significant differences in the measurements. In all left ear High-Frequency 9kHz, 10kHz, 11.2kHz, 12.5kHz, 14kHz, and 16kHz measurements, it was understood that the working Group's average was higher than the control group's average.

Conclusion: Significantly lower values were observed in the violinist participants' left ear high-frequency thresholds compared to the same ear thresholds of the control group. Compared to the left ear thresholds of the control group, lower values of the left ear airway 4kHz threshold, estimated to be due to music sound, were observed. In the comparison of the

Öz

Amaç: Yüksek şiddette müzik sesi üretebilen kemanın özellikle tutuş şekli ile sol kulağa yakınlığı nedeniyle sağ-sol kulak arasında anlamlı bir işitme farkı varlığının odyolojik testlerle araştırılması ve önlenebilmesine yönelik düzenlemelerin yapılması amaçlanmıştır.

Gereç ve Yöntem: Bu çalışmaya, uzun yıllar keman çalan, konservatuar mezunu, günlük çalışma programı ile müzik/gürültü sesine maruz kalan, 18-55 yaş arası kadın ve erkek keman sanatçısı bireyler ile müzikle ilgisi olmayan ve enstrüman çalmayan 25 kişilik kontrol grubu dahil edilmiştir. Tüm katılımcılara saf ses odyometri, yüksek frekans odyometri, Transient Evoked otoakustik emisyon ve timpanometri testleri ile odyolojik değerlendirme yapılmıştır.

Bulgular: Çalışmamızda keman sanatçısı ve kontrol gruplarında veriler cinsiyete göre, sağ ve sol kulağa göre ayrı ayrı karşılaştırılmıştır. Sol kulak Yüksek Frekans 9 kHz (p= 0,001, p<0,01) ,10000 Hz (p= 0,018, p<0,05), 11200 Hz (p=0,006, p<0,01), 12500 Hz (p=0,002, p<0,01)), 14000 Hz (p=0,050, p<0,05) ve 16000 Hz (p=0,010, p<0,01) ölçümlerinde çalışma ve kontrol gruplarında anlamlı farklılıklar bulunmuştur. Sol kulak Yüksek Frekans 9 kHz ,10 kHz, 11.2 kHz, 12.5 kHz, 14 kHz ve 16 kHz ölçümlerinin tamamında çalışma grubunun ortalamasının kontrol grubunun ortalamalarından daha yüksek olduğu anlaşılmıştır.

Sonuç: Keman sanatçısı katılımcıların sol kulak yüksek frekans eşiklerinin tümünde kontrol grubunun aynı kulak eşiklerine göre anlamlı düşük değerler gözlenmiştir. Sol kulak havayolu 4 kHz eşiğinin kontrol grubu sol kulak eşiklerine göre müzik sesi kaynaklı olduğu tahmin edilen düşük değerler izlenmiştir.. Keman sanatçılarının sağ-sol

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right-left ear of the violinists, a weaker threshold was recorded in the left ear than in the right at high-frequency 14kHz. Therefore, it is thought that it is necessary to look at high-frequency audiometry thresholds and standard audiometry to determine the risk of early hearing loss in musicians.

Keywords: *Violinist, high-frequency hearing loss, left ear, noise-related hearing loss.*

kulak karşılaştırmasında yüksek frekans 14 kHz' de sol kulakta sağa göre daha zayıf eşik kaydedilmiştir. Müzisyenlerde erken dönem işitme kaybı risk tespiti için standart odyometri ile birlikte yüksek frekans odyometri eşiklerine bakılmasının gerekliliği düşünülmektedir.

Anahtar Kelimeler: Keman sanatçısı, yüksek frekans işitme kaybı, sol kulak, gürültüye bağlı işitme kaybı.

INTRODUCTION

A violin that adapts to many types of music accompanies almost every piece of music with its voice and exists with its melody in every sound of music that we hear. However, it is an instrument that can produce a high level of musical sound, causing hearing loss. (1) When playing the violin, the sound intensity of the musician's right ear is 80-90 dB, while the sound intensity level of the left ear is in the range of 85-105 dB. This indicates that the left ear is exposed to higher sound intensity than the right ear. (2,3)

The intensity and duration of noise exposure determine the potential for damage to the hearing structure. Even sounds that are perceived as loud do not disturb the ear. Noise-induced hearing loss is sensorineural-type hearing loss that usually begins at high frequencies and develops gradually due to exposure to excessive sound levels. Loud, musical, or industrial sounds can lead to tinnitus (tinnitus) and hearing loss when listened to for a long time. (4) Although the sound of music is not the sound of noise, it can damage the ear when it is of high intensity. The sound intensity that a musician is exposed to during concerts and studies is in the average range of 79-98 dB. (5)

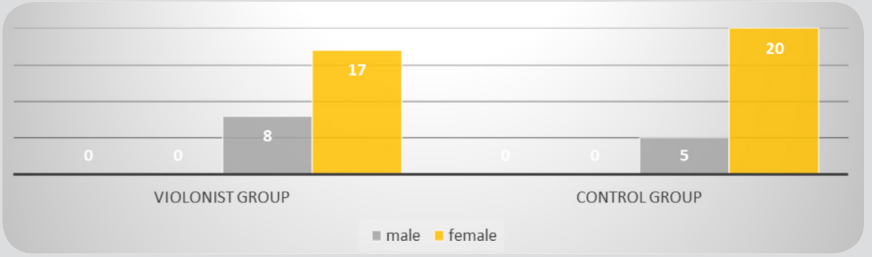
Hearing loss due to noise is a risk and essential in every professional group, but this risk increases in musicians, given that their success and abilities are good hearing and musical ears.

This study was approved by Istanbul Gelisim University Clinical Research Ethics Board with resolution 2021-14-31 dated 23.09.2020 and was conducted between September 2020 and April 2021. Participants were informed about the general purpose of the study and the tests to be performed and asked to read the "Informed Consent Form" and were included in the study with written permission from the approvers. The universe of this research consists of male and female adult individuals aged 18-55 who have played the violin for many years, are professionally interested in music, and are violin artists by profession. This study included 25 professional violin-playing musicians and a control group of 25 people who do not know how to play instruments and have nothing to do with music. Audiological tests to be performed in the study are pure tone Audiometry, Tympanometry, Otoacoustic Emission, and high-frequency audiometry. Audiometry, emission and Tympanometry device, and high-frequency headphones for high frequency audiometry were used for these tests. Hearing functions were evaluated by looking at the right and left ear separately. By comparing the results obtained with the right and left ears, it was possible to evaluate whether there was a significant hearing difference and the hearing of the control and violinist groups.

Statistical analysis: IBM SPSS 24.0 program was used for statistical analysis. Descriptive values number (n), percentage (%), average (Ort.), indicated as standard deviation (SD). The study and control groups, data were compared separately by gender, right and left side. Comparisons of the study and control group were also applied for all measurement values. Mann-Whitney U test was applied in binary group comparisons, and the Wilcoxon test was applied in repeated measurement comparisons. For all tests, the statistical significance level was considered $p<0.05$.

RESULTS

Out of the 50 participants included in the study, the number of female participants in the study group was 17 (68.0%), the number of male participants was 8 (32.0%), the number of female participants in the control group was 20 (80%), the number of male participants was 5 (20.0%). Findings on gender distribution are given in Graphic 1.



Graphic 1: Gender distrubition of participants

In the right-left ear Transient Evoked Otoacoustic Emission comparison, no difference was found in the results of the study and the control group. In addition, volume and pressure values in the results of tympanogram measurements of the right and left ear were obtained as a result of Type A in all participants, and no significant differences were found in the comparison of measurements of the right-left ear tympanogram.

No significant difference was found between the results of the suitable ear pure tone audiometry thresholds in the comparison of the violinist group and the control group.

In comparing the violinist and the control group, the mean value of 4000 Hz measurement in the left ear for the study group was higher than the average value of pure tone measurements of the left ear 4000 Hz measurement in the control group.

It was thought that this decrease in the 4000 Hz frequency threshold was caused by the loud music it was exposed to due to the way the violin was held and its proximity to the left ear (Table-1).

Table 1: Left ear pure tone measurement results of all participants

	Group	U	P
Left ear pure tone 250 Hz	Violonist group	297,000	0,755
	Control group		
Left ear pure tone 500 Hz	Violonist group	312,000	0,992
	Control group		
Left ear pure tone 1000 Hz	Violonist group	247,500	0,170
	Control group		
Left ear pure tone 2000 Hz	Violonist group	251,000	0,181
	Control group		
Left ear pure tone 4000 Hz	Violonist group	214,500	0,042*
	Control group		
Left ear pure tone 6000 Hz	Violonist group Control group	278,500	0,481

*P<0,05

A working group of violinists compared the measurements of the left-right ear high-frequency Test with the right high frequency of 14000 Hz.of the measurement values; the left high frequency is 14000 Hz. Therefore, it is understood that it is higher than the measurement values (Table 2).

Table 2: Violonists left-right ear high frequency tests comparison

VIOLONISTS STUDY GROUP		Z	P
Left ear high frequency	8000 Hz	,000	1,000
Right ear high frequency	8000 Hz		
Left ear high frequency	9000 Hz	-1,789	0,074
Right ear high frequency	9000 Hz		
Left ear high frequency	10000 Hz	-1,224	0,221
Right ear high frequency	10000 Hz		
Left ear high frequency	11200 Hz	-1,213	0,225
Right ear high frequency	11200 Hz		
Left ear high frequency	12500 Hz	-1,197	0,231
Right ear high frequency	12500 Hz		
Left ear high frequency	14000 Hz	-2,14	0,032**
Right ear high frequency	14000 Hz		
Left ear high frequency	16000 Hz	-1,739	0,082
Right ear high frequency	16000 Hz		

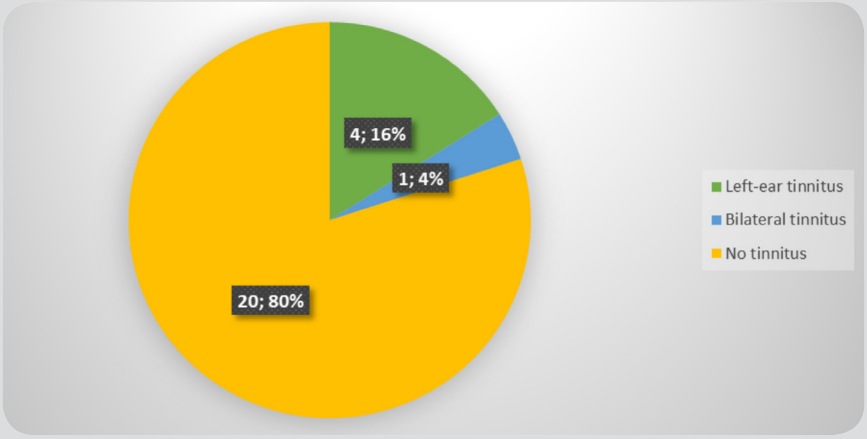
In the comparison of the Working Group with the violinists and the control group's left ear, it was found that the average of the working group in all high-frequency measurements (9000, 10000,

Table 3:

	Group	U	P
Left ear high frequency 8000 Hz	Violonist group	224,500	0,070
	Control group		
Left ear high frequency 9000 Hz	Violonist group	146,500	0,001**
	Control group		
Left ear high frequency 10000 Hz	Violonist group	194,000	0,018*
	Control group		
Left ear high frequency 11200 Hz	Violonist group	173,500	0,006**
	Control group		
Left ear high frequency 12500 Hz	Violonist group	153,500	0,002**
	Control group		
Left ear high frequency 14000 Hz	Violonist group	212,500	0,050*
	Control group		
Left ear high frequency 16000 Hz	Violonist group	180,500	0,010**
	Control group		

**P<0,01 *P<0,05

11200,12500, 14000, and 16000Hz) was higher than the control group's average. (Table3)



Graphic 2: Tinnitus

DISCUSSION

In a study conducted among 15 female and 80 male Danish royal theater symphony orchestra musicians aged between 22-64, 58% of the musicians were found to have hearing loss. They stated that among violinists, they observed significantly weaker hearing thresholds and decreased thresholds in the left ear at high frequencies. (6)

In our study, a high frequency of 14000 Hz was applied between the right and left ears of the participants. Although no significant difference could be found except for the frequency of 9000, 10000, 11200, 12500, 14000, and 16000Hz, weaker thresholds were obtained in the left ear compared to the control group. Furthermore, compared to the control group, which was not interested in music and was not exposed to loud sound, the threshold drops of violinists at high frequencies in the left ear were made sense by the proximity of the left ear to the instrument.

In some studies, it has been stated that perforations in the timpanic membran, middle ear disorders, TM abnormalities can disrupt sound transmission in the ear and that there may be changes in hearing thresholds due to these complications. (7,8)

In our study, participants with a type A curve were included in the tympanogram, whose otoscopic examination was regular in both the study and the control groups, thinking it could affect hearing thresholds. Accordingly, there were no statistically significant differences in the comparison of right-left Tympanogram measurements in the study and control groups.

In his study, in which he performed pure tone audiometry hearing measurement for 16 years with a total of 56 musicians, 13 female and 43 male, among classical orchestra musicians, he examined both the risk of hearing loss and possible hearing differences in male and female musicians and found that industrial noise that orchestra musicians are exposed to does not pose a risk. In addition, a decrease of 0.4 dB at the thresholds at 3-8 kHz frequencies was observed for female musicians and 0.7 dB at thresholds for male musicians. Wood-Wind (The Violin is an instrument from the Wood-Wind Group) has been cited as one of the reasons why high-volume-producing instruments such as brass and percussion instruments are most played by men, and these men show slightly worse hearing thresholds than women. (9,12)

Of the 50 participants included in our study, the number of female participants in the study group was 17 (68.0%), the number of male participants was 8 (32.0%), and the number of female participants in the control group was 20 (80%), the number of male participants was 5 (20.0%). Compared by gender in the study and control groups, there was no statistically significant difference between their measurements. Significant statistical differences in the measurements of the left ear 4000 Hz and high frequency 9000,10000, 11200,12500, 14000, and 16000Hz frequencies of the

violinist study group did not affect the hearing thresholds of the participants being female or male individuals.

In his study with 30 orchestra artists and 30 control groups, the orchestra artist and the control group applied audiological tests to all participants. When pure tone audiometry thresholds were compared between 250 Hz-16 kHz frequencies, the orchestra artists and the control group were compared between the pure tone hearing thresholds of 2000 Hz in the right and left ear. When comparing the TEOAE results of the orchestra artists and the control group, he stated that the emission responses obtained from the orchestra artists decreased significantly at all frequencies compared to the control group. Despite the better results than expected in audiometry pure tone audiometry thresholds despite the loud noise that orchestra artists are exposed to, decreases in TEOAE values were observed, and it was emphasized that the pure tone audiometry test might not be sufficient in the early diagnosis of noise-induced hearing loss. (10)

Our study determined that there was no statistically significant difference in the comparison of right-left OAE measurements in both the study and the control groups. While there was no significant difference in the measurements made between the right and left ears of the control group and violinists at pure tone audiometry thresholds of 250,500,1000,2000,6000 Hz, the mean calculated for the left ear 4000 Hz measurement of the violinists, on the other hand, was 4000 Hz in the left ear of the control group. This decrease in the 4000 Hz frequency threshold was found to be higher than the average value calculated for the measurement of the violin.

In their study to investigate the effects of age and noise on high frequency, pure tone audiometry and High-frequency audiometry tests were performed between 187 study groups working under industrial noise and 52 control groups not exposed to noise. He stated that the frequency with the highest threshold difference between the groups was 14000 Hz and that High-frequency audiometry was a more reliable tool for monitoring the hearing loss of individual cases over time. (11)

In our study, we found no statistically significant difference between right-left high-frequency measurements in both the study group and the control group when comparing the high-frequency measurements of the control group and the study group with the high-frequency responses of the right-left ears. Statistically significant differences were found in Frequency 14000 Hz and Right High Frequency 14000 Hz. ($p<0.05$). It was observed that the left ear High Frequency 14000 Hz threshold values were lower than the Right High Frequency 14000 Hz threshold values.

CONCLUSION

Since violinists are exposed to sound during long working hours and have practiced their profession for many years, research studies of hearing thresholds between 8000-16000Hz with high-frequency audiometry of musicians have not been encountered frequently. It is thought that performing audiological studies for the possible risk of hearing loss at high frequencies in the left ear and using the high-frequency audiometry test with the classical standard audiometry test may reveal the auditory effect at high frequencies in musicians, especially violinists.

It is thought that the possible difference in left ear hearing, which may cause a decrease in professional success and loss of quality of life, is vital in violinists, and regular follow-up at specified intervals is necessary to examine the effects of decreases observed in high-frequency hearing thresholds on pure tone and speech frequency thresholds in the future. Repeating the audiological tests in different periods and comparing the findings will contribute to the literature on the possible onset and progression of hearing loss in the left ear in the future. The obtained data can enable arrangements for early monitoring and timely prevention of hearing loss and to disseminate protective measures. With these studies, it will be possible to raise awareness of violinists who practice their profession by using their musical perception and talent.

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