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Effects of Rhinoplasty on Labyrinthine Function

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Abstract

Background: Rhinoplasty is a common surgical procedure that is requested and accepted by patients for cosmetic and functional reasons. Osteotomies are performed on nasal bone, maxillary crest, or vomer to fix the deviations of the nasal dorsum or septum. During the percussion of the osteotomes with the surgical mallet, the vibration energy diffuses to the cranium. Auditory and vestibular systems may be affected by these vibrations.

Objectives: To assess the effects of rhinoplasty, in which osteotomies were performed using a hammer, on the audiovestibular system.

Methods: Thirty adults who underwent rhinoplasty were included in the study group. Ten age and gender matched adults who had nasal surgery without surgical mallet or osteotome served as the control group. The patients in both groups were assessed using pure tone audiometry, tympanometry, distortion product otoacoustic emission testing, and vestibular-evoked myogenic potential, as well as video head impulse tests (vHIT) before the operation and 1 week after the operation.

Results: On auditory assessment, there was no significant difference between the study and control groups regarding pure tone thresholds at frequencies of 250 Hz to 8 kHz ($P > 0.05$) as well as otoacoustic emissions. The vestibular assessment performed by using vestibular-evoked myogenic potential and vHIT did not reveal a statistically significant difference between the groups, before surgery or after surgery ($P > 0.05$).

Conclusions: Rhinoplasty appears to be a safe operation in terms of audiovestibular functions, and osteotomy, in which a hammer is usually used, does not have an impact on hearing or balance functions of the ear.

Level of Evidence: 2

Therapeutic

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According to data gathered by the American Society for Aesthetic Plastic Surgery (ASAPS), rhinoplasty is one of the most common cosmetic surgery procedures, with over 140,000 procedures performed in 2016.[1] Osteotomies are performed on nasal bone, maxillary crest, or vomer to fix the deviations of the nasal dorsum or septum. During the percussion of the osteotomes with the surgical mallet, the vibration energy diffuses to the cranium. Auditory and vestibular system organs located in the temporal bone are affected by these vibrations.

Conditions affecting the inner ear, such as vestibular and cochlear fractures, bleeding in the inner ear, and damage of the cochleovestibular nerve manifest with vestibular and audiological symptoms.[2] Radiological assessment usually fails to identify these sorts of damages to the labyrinth in patients complaining of audiovestibular symptoms after head trauma. The underlying mechanism in these

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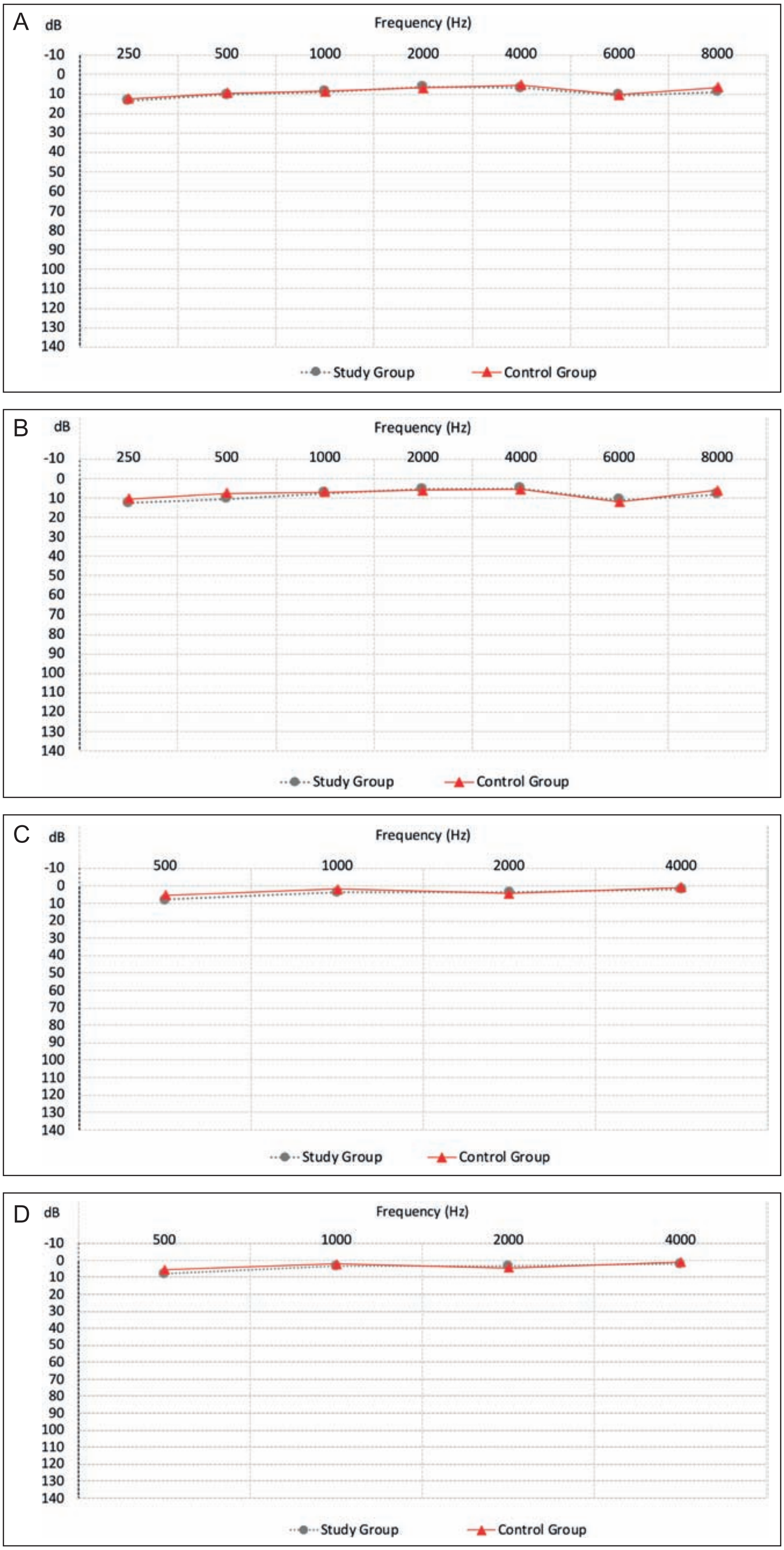

Figure 1. (A) Comparison of preoperative air conduction, (B) comparison of postoperative air conduction, (C) comparison of preoperative bone conduction, and (D) comparison of postoperative bone conduction.

Table 1. Results of Otoacoustic Emission

Otoacoustic emission S/N level		Study group		Control group		*P*
		Mean ± SD/n-%	Med	Mean ± SD/n-%	Med	
500 Hz	Preoperative	4.4 ± 6.1	6.4	6.2 ± 6.2	7.1	0.463*
	Postoperative	5.2 ± 5.8	6	7.1 ± 5.8	8.5	0.138*
1000 Hz	Preoperative	13.5 ± 4.9	13.2	15.4 ± 5.6	15.2	0.453*
	Postoperative	13.5 ± 5.7	12.9	17 ± 5.3	17.7	0.089*
2000 Hz	Preoperative	17.4 ± 5.4	18.4	18.6 ± 5.2	18.7	0.532*
	Postoperative	17.3 ± 5.1	18.1	20.3 ± 5.2	21.7	0.108*
4000 Hz	Preoperative	16.6 ± 6.1	18.4	17.9 ± 4.7	17.1	0.803*
	Postoperative	17.2 ± 4.7	17.7	16.9 ± 5.1	16.8	0.864*
6000 Hz	Preoperative	11.6 ± 6.9	11.9	11.4 ± 8.4	12.9	0.901*
	Postoperative	11.3 ± 6.5	11.8	10.5 ± 8.6	11	0.791*
8000 Hz	Preoperative	5.2 ± 6.7	5.3	3.4 ± 6.9	4.7	0.595*
	Postoperative	6 ± 7.1	6.8	4.2 ± 6.5	5.6	0.651*

* Mann-Whitney U test; med, median

patients is commonly assumed to be the concussion of the labyrinth, which is common after head trauma.[3]

Concussion of the labyrinth is defined as a sensorineural hearing loss that may accompany vestibular symptoms as a result of the reflection of intense pressure to the ear without an open labyrinth fracture after trauma.[4] Sensorineural hearing loss is characterized by high-frequency hearing loss that notches in the 4 kHz to 6 kHz range, like acoustic trauma.[5] In brief, concussion of the labyrinth may affect auditory and vestibular functions.[6]

To the best of our knowledge, there is no prospective or case control study in the literature in English in which the effects of rhinoplasty on audiovestibular functions were assessed. In this study, we aimed to illuminate whether rhinoplasty surgeries in which osteotomies were used would impact labyrinthine functions.

METHODS

The study was approved by the Istanbul Medipol University ethical committee. Forty patients who were operated on in our department between September and December 2015 were included in the study. Thirty patients who underwent rhinoplasty were included in the study group, and 10 patients who underwent nasal surgery without a surgical mallet or osteotome comprised the control group. A randomization technique was used by including patients who underwent operations on the second and fourth days of every week. Excluded were any patients who had a history of dizziness, ototoxicity, chronic systemic disease, head trauma, ear surgery, cervical disc problem, or any other problem such as anatomical morphological variations, which might impact audiovestibular functions. We performed preoperative nasal endoscopy on all patients to reveal such problems.

The patients in the study group had been admitted to the hospital due to difficulty in breathing, nasal deformity, and septal deviation. They all underwent an open rhinoplasty procedure. In surgery, after local lidocaine infiltration under general anesthesia, the nasal dorsum skin was elevated via mid-columellar V incision. The nasal dorsum was exposed via incision and elevation of the periosteum. Septal defects were repaired via a dorsal approach. Cartilage grafts suitable to the pathologies in the nasal dorsum were used. The dorsum was shaped by performing bilateral median and lateral osteotomies. The procedure was completed by bandaging and applying an external thermal splint and a silicone tampon after the surgery.

The patients in the control group had no deformity or problem in their nasal bones, and underwent nasal surgeries without osteotomy, such as endoscopic endonasal sinus surgery (n = 6), inferior turbinate (n = 2), and nasal columellar reduction (n = 2) surgery.

A total of 80 ears of the 40 patients were tested. Audiovestibular assessments were performed in both groups 2 hours before and 1 week after the surgeries. As our goal was to reveal the early impacts of osteotomy on audiovestibular functions, we did not add further assessments.

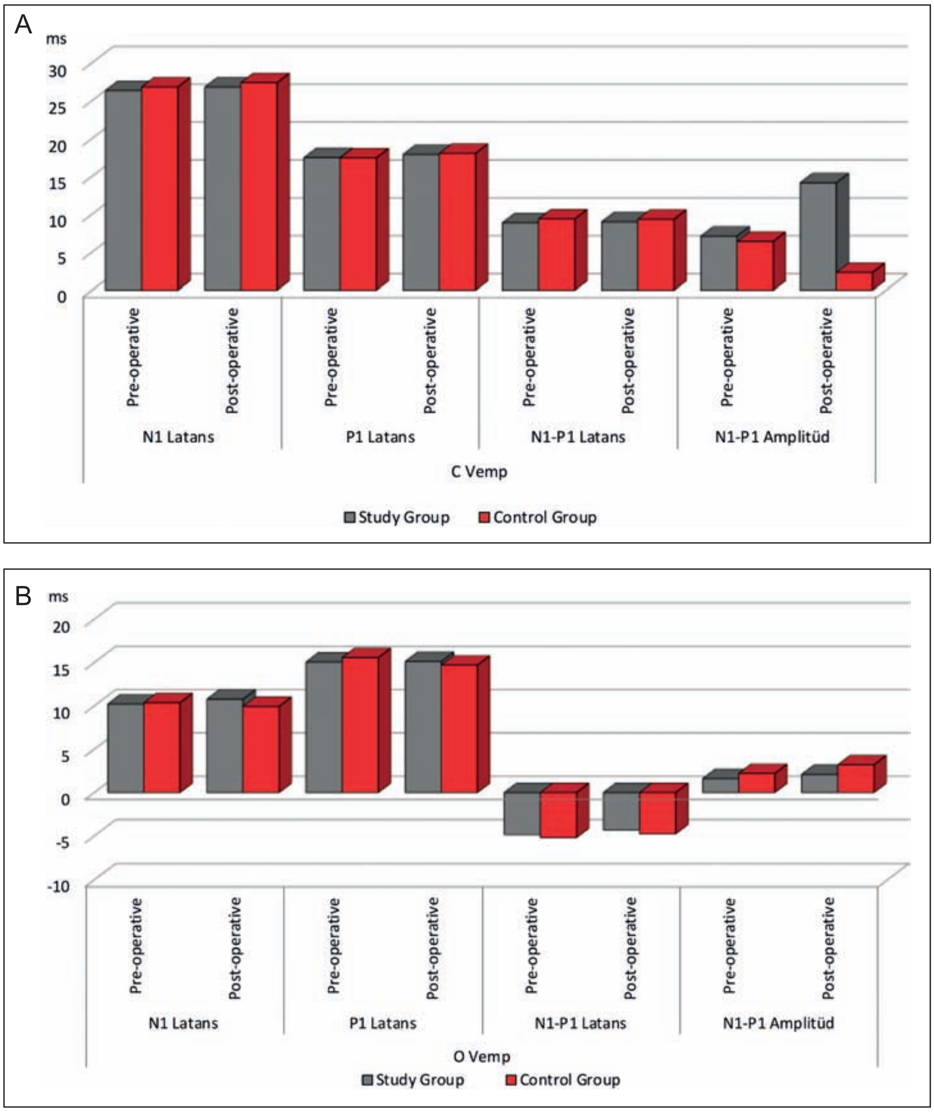

Figure 2. (A) Comparison of the results of cVEMP and (B) comparison of the results of oVEMP.

Pure tone audiometry (PTA), tympanometry, and distortion product otoacoustic emission testing (DPOAE) were used to assess the auditory functions. Vestibular-evoked myogenic potentials (VEMP) and a video head impulse test (vHIT) were used to assess vestibular functions (AC-40 audiometer, Titan, Eclipse EP 25 and EyeSeeCam, Interacoustics).

On audiometry, air, and bone conduction thresholds at the frequencies of 250 Hz to 8000 Hz were measured. DPOAEs were recorded at the frequencies of 500 to 8000 Hz. The VEMP testing included cervical VEMP (cVEMP) and ocular VEMP (oVEMP); and N1 latency, P1 latency, N1-P1 latency, and N1-P1 amplitude were recorded. Gain asymmetries, saccades, and semicircular canals were evaluated using vHIT.

SPSS 22.0 software was used to analyze the data. The distribution of the variables was measured by using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to analyze quantitative data. The Wilcoxon sign test was used to analyze repetitive measurements. The Chi-square test was performed to analyze qualitative data, and Fisher's exact test was used when the test conditions did not meet the assumptions. A P value less than 0.05 was accepted as statistically significant.

RESULTS

There were 14 men and 16 women aged between 21 and 50 years old (mean, 31 years) in the study group, and there were 5 men and 5 women aged between 20 and 45 years (mean, 29 years) in the control group. There was no statistically significant difference in patient numbers or demographic features of the patients between the study and control groups ($P > 0.05$).

On pure tone audiometry, preoperative and postoperative pure tone thresholds of the patients in both groups

Table 2. Results of vHIT

		Study group		Control group		*P*
		Mean ± SD/n-%	Med	Mean ± SD/n-%	Med	
Lateral gain	Preoperative	1 ± 0.1	1	1 ± 0.1	1	0.790*
	Postoperative	1 ± 0.1	1	1 ± 0.1	1	0.754*
Posterior gain	Preoperative	1.1 ± 0.1	1.1	0.9 ± 0.2	0.8	0.051*
	Postoperative	1 ± 0.2	1	2 ± 3.5	0.8	0.140*
Anterior gain	Preoperative	1.1 ± 0.1	1.1	0.9 ± 0.2	1	0.052*
	Postoperative	1.1 ± 0.1	1.1	1 ± 0.2	1.1	0.102*
Anterior/posterior gains asymmetry						
Preoperative, n (%)	No	23 (76.7%)		9 (90%)		0.653#
	Yes	7 (23.3%)		1 (10%)		
Postoperative, n (%)	No	19 (63.3%)		9 (90%)		0.231#
	Yes	11 (36.7%)		1 (10%)		
Anterior/posterior saccade						
Preoperative, n (%)	No	30 (100%)		10 (100%)		-
	Yes	0 (0%)		0 (0%)		
Postoperative, n (%)	No	30 (100%)		10 (100%)		-
	Yes	0 (0%)		0 (0%)		

* Mann-Whitney U test; # Ki-kare test; med, median

were not significantly different at the frequencies tested ($P > 0.05$). There was no significant difference between the pure tone thresholds of the patients and controls as well ($P > 0.05$) (Figure 1).

On DPOAE testing, preoperative and postoperative DPOAE test results of the patients in both groups were not significantly different at the frequencies tested ($P > 0.05$). There was no significant difference between the DPOAEs of the patients and controls as well ($P > 0.05$) (Table 1).

On cVEMP and oVEMP testings, preoperative and postoperative N1, P1, and N1-P1 latencies, and N1-P1 amplitudes of the patients in both groups were not significantly different ($P > 0.05$). There was also no significant difference between the VEMP values of the patients and controls ($P > 0.05$) (Figure 2).

On vHIT testing, preoperative and postoperative gains of the patients in both groups were not significantly different ($P > 0.05$). There was also no significant difference between the gains of the patients and controls ($P > 0.05$) (Table 2).

DISCUSSION

The effect of maxillofacial or dental surgeries on inner ear functions has been debated because some patients who underwent these sorts of interventions complained of dizziness or hearing problems. However, the information is limited to a few cases reported to date. Two possible mechanisms have been proposed to explain the inner ear symptoms of the patients who had maxillofacial or dental intervention. One is the transmission of mechanical vibrations to the inner ear, and the other is the hyperextension of the neck during general anesthesia.[7,8]

In maxillofacial and dental procedures, vibrations created during osteotomies or drilling are transmitted to the labyrinth, which may lead to inner ear trauma.[7-10] In addition, lying down in the supine position with the head and neck hyperextended during surgery and the noise generated by the drill may negatively affect the inner ear.[9] However, there is no objective evidence of either of these contentions.

Rhinoplasty has been a common surgery worldwide, and osteotomy has been an important step in the surgical procedure. There are different techniques of nasal osteotomy in rhinoplasty, such as percutaneous and internal osteotomy, which are widely used conventional techniques based on mechanical energy.[11] Piezo is a relatively new technique using piezoelectric micrometric ultrasonic vibrations for making bone incisions.[12] However, it is not evident whether rhinoplasty will lead to inner trauma due to transmission of vibrational energy.

In this study, objective audiovestibular tools helped us to evaluate the impact of rhinoplasty on the inner ear functions. The frequency specific audiological assessment up to 8 kHz did not reveal any effect of rhinoplasty on hearing. In addition, there was not even a subtle or subclinical effect of rhinoplasty on hearing as evidenced by DPOAE testing.

To date, there have been only a few cases in which patients had dizziness after rhinoplasty, and they were treated with repositioning maneuvers.[13,14] Still, the objective data are lacking regarding the effect of rhinoplasty on labyrinthine functions and association with dizziness. At this point, VEMP and vHIT are helpful. VEMP has been an important diagnostic tool to test the otolith organs.[15-18] Measurement of vestibulo-ocular reflex (VOR) gains by vHIT helps to evaluate the semicircular canals in the inner ear.[19] In our study, all patients were evaluated objectively using VEMP and vHIT tests. Our study is one of the studies in the literature encompassing a relatively higher patient number in evaluation of auditory and vestibular functions in rhinoplasty, and it is the only study in the literature using vHIT for this purpose.

According to findings of this study, osteotomy during rhinoplasty has no impact on inner ear or vestibular functions nor is associated with the occurrence of dizziness. However, the relatively small number of patients is a limitation of this study. Randomized controlled studies with large patient groups are needed to address this question more thoroughly.

CONCLUSION

Outcomes of our study show that osteotomy during rhinoplasty does not negatively affect audiologic or vestibular functions. Randomized controlled studies with large patient groups are needed to address this question more thoroughly.

Disclosures

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