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Original Article

Evaluation of Benign Paroxysmal Positional Vertigo in American Football Players

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OBJECTIVES: The aim of this investigation was to evaluate the association between posterior channel benign paroxysmal positional vertigo (BPPV) and trauma that is frequently experienced by American football players.

MATERIALS and METHODS: Participants were classified into the following two groups: (1) a study group consisting of 63 male participants aged 18-30 years who had been playing American football for more than 2 years and (2) a control group consisting of 49 male participants aged 18-27 years with no history of otologic/vestibular disease or acute/chronic trauma. Trauma, age, total duration of playing American football, and weekly training hours of subjects in the study group were analyzed to determine any relationship with BPPV occurrence. We performed otologic, audiologic, and vestibular assessments of pure sound audiometry, tympanometry, tandem walking test with eyes open and eyes closed, Romberg, head shaking, roll, and Dix-Hallpike tests to all participants.

RESULTS: A positive correlation between the total years of American football played and posterior channel BPPV frequency was observed in the study group. In addition, increasing weekly hours of training was shown to further increase the risk of BPPV. A total of 16 out of 63 athletes experienced BPPV, whereas none of the participants in the control group experienced BPPV. All participants completed the Vertigo Symptom Scale, which revealed that vertigo did not cause any significant negative impact on their training routine and activities of daily living.

CONCLUSION: Our results indicate that the weekly training hours and total years of training with American football increase posterior channel BPPV frequency.

KEYWORDS: American football, benign paroxysmal positional vertigo, sports, trauma, vertigo

INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo. BPPV is a vestibular system disease, which is characterized by episodes of vertigo with certain positioning of the head. It is accepted that dislodged otoconia detaching from the utricle macula slide into the semicircular canals and initiate vertiginous symptoms. BPPV can be clinically diagnosed by the provocation of semicircular canals (SCC) and the observation of peripheral nystagmus. Either one of the three SCC can be involved, corresponding to different characteristics of movement that provokes BPPV. The posterior canal is most frequently affected [1, 2].

Etiological factors of BPPV include trauma to the temporal bone, ear surgery, vestibular neuritis, Ménière's disease, migraine, hypertension, prolonged bed rest, upper respiratory tract infections, and long-distance travels. Despite numerous possible etiologies, BPPV is commonly seen as an idiopathic condition [1, 3, 4, 5].

American football is one of the most popular sports in the US. It is a high-impact collision sport and involves frequent physical contact between opponents [6]. Therefore, American football athletes frequently experience injuries that are mostly head traumas. In the present study, our main objective was to evaluate any association between frequent trauma and posterior channel BPPV.

MATERIALS and METHODS

Ethics Committee for Clinical Research at Turgut Özal University School of Medicine approved this clinical trial. This prospective study was conducted on American football athletes from March 2015 to May 2015 in the otolaryngology outpatient clinic.

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Written informed consent has been obtained from all participants. The physical examination methods and diagnostic tests were explained to all participants. Before undergoing the tests, all participants completed the Vertigo Symptom Scale that represented the effects of vertigo on the activities of daily living based on a scale from 0 to 4 [7].

Participants

Volunteers were divided into the following two groups: a study group with athletes and a control group. There were 63 male athletes aged between 18 and 30 years in the study group. The control group consisted of 49 male individuals aged between 18 and 27 years, who had no complaints regarding vertigo or dizziness during the evaluation, no clinical history of peripheral and/or central vestibular system disease, and no history of acute and/or chronic trauma. Individuals with peripheral and/or central vestibular system disease, otologic disease, and conductive or sensorineural-type hearing loss were observed in their pure sound audiometric examination. The exclusion criteria included any history of surgery and ages under 18 or over 30 years.

Clinical Analysis

We performed otologic examinations, pure sound audiometric test (Interacoustics AC40 Clinical Audiometer, Denmark), Dix–Hallpike maneuver with videonystagmography (VNG) goggles, Romberg test, tandem walking test with eyes open and eyes closed, and VNG (Micro Medical, USA) on all patients.

All positional tests were performed, and their results were recorded. Dix-Hallpike maneuver was performed using VNG goggles. All individuals were rapidly brought from sitting to a supine position, with the head turned 45° to one side and extended approximately 30° backward. Once supine, the eyes were typically observed for approximately 30 seconds. If no nystagmus was present, the person was brought back to a sitting position. After a 30-second pause, the other side was tested. Dix–Hallpike test was evaluated as positive if brief latency is observed between the onset of nystagmus and change of the head position and manifestation of a paroxysmal upbeat and torsional nystagmus accompanied with a sense of vertigo.

Pure sound audiometric tests were performed for measuring hearing sensitivity. Air and bone conduction thresholds were determined between 125-8000 Hz and 500-4000 Hz sound stimuli, respectively. Pure tone average is calculated at 500, 1000, and 2000 Hz frequencies for each participant.

Statistical Analysis

All data obtained in this study were interpreted using Statistical Package for Social Sciences version 20.0 (IBM Corp.; Armonk, NY, USA) statistical program. Kolmogorov-Smirnov and Shapiro-Wilk tests were used for evaluating normalization. Comparing tests between the groups were completed with Mann-Whitney U, Fisher's exact, and chi-squared tests. Statistical significance of variables in the study was assessed using logistic regression analysis.

RESULTS

The average age was 22.86±0.41 years for the American football athletes and 22.37±0.41 years for the control group. There was no statistically significant difference noted between the control and study groups according to age (p>0.05). Table 1 shows the average age, weekly training hours, and total years of practicing football for each group.

Table 1. Distribution of average age, time spent on training weekly, and total years of practicing football in the study and control groups

	Study group (n=63)	Control (n=49)
Age	22.86±0.41	22.37±0.41
Weekly training hours	9.10±0.21	0
Total years of practicing football	4.24±0.36	0

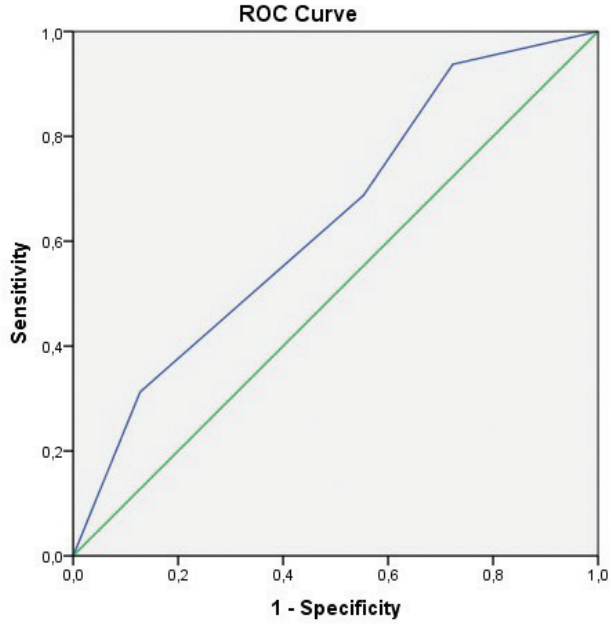

Figure 1. Receiver operating characteristic curve for hours of practice contributing significantly to posterior channel BPPV according to logistic regression analysis
SE: standard error, SD: standard deviation; BPPV: benign paroxysmal positional vertigo

The median score of the Vertigo Symptom Scale was 1.21 out of 4 for the control group and 1.33 out of 4 for the study group.

Results of the audiologic examination showed that pure sound average scores were 12 dB for 8, 8 dB for 27, 7 dB for 30, 5 dB for 22, and 3 dB for 25 of the participants. All participants had type A tympanogram. Results of Romberg, tandem walking, head shaking, and roll tests were negative for all individuals. All VNG results did not indicate any vestibular pathology.

Dix-Hallpike test was negative for all participants in the control group; however, it was positive in 16 out of 63 (25.4%) athletes in the study group. Overall, 9 of the athletes had left posterior canal BPPV, and 7 of them had right posterior canal BPPV. There was a statistically significant difference noted between the two groups (p<0.001).

Logistic regression analysis was used for determining the relationship between BPPV and weekly training hours and total years of practicing. Table 2 and Figure 1 present the results. When Beta scores for variables were examined, training hours and total years of practicing

Table 2. Logistic regression analysis of the association between BPPV, weekly training hours, and total years of practicing American football

							95% reliability limit	
Variables	**Beta coefficient**	**SE**	**Wald**	**SD**	**p**	**Odds ratio**	**Lower limit**	**Upper limit**
Hours of practice	0.696	0.298	5.451	1	0.020	2.006	1.118	3.598
Years in football	0.369	0.313	1.391	1	0.238	1.447	0.783	2.674
Invariable	3.052	4.856	0.395	1	0.530	21.148		

SE: standard error; SD: standard deviation

American football showed a positive correlation with BPPV occurrence. According to the calculations of odds ratio, the weekly training hours and total years of practicing American football are defined as risk factors for BPPV.

DISCUSSION

Vertigo is defined as a hallucination of motion, which can be a result of any pathology in the vestibular system [2]. BPPV is a vestibular system disease manifesting as sudden dizziness triggered by certain positions of the head and is accompanied with peripheral nystagmus. Epley et al. [8] reported that BPPV comprises 25% of all vertigo etiologies. Even though BPPV is perceived as an extremely irritating and frightening condition by the patient, it can be effectively cured with simple physical maneuvers or can even spontaneously resolve.

BPPV is triggered by head movements and is mostly idiopathic. However, its etiology includes head and temporal bone traumas, stapedectomy, chronic otitis media surgery, vestibular neuritis, Ménière's disease, migraine, hypertension, long bed rest, upper respiratory tract infections, and long-distance airway or overland travels. In literature, from 8.5% to 20% of all BPPV cases are associated with trauma [9]. Numerous studies have demonstrated that the most common reason for BPPV is motor vehicle accidents (MVA) with a ratio of 63% [10-14].

According to data from 2012, American football was the most popular sport in the US with 1.1 million high-school students and 70.000 university students practicing it every year. It was followed by the largest amount of audiences worldwide. American football is increasing in popularity in Turkey as well, with numerous universities participating; more than 20 teams and over 1200 athletes participate every year. American football players are known to experience frequent head trauma, which could lead to depression, confusion, and neurological malfunction [15-18]. In the present study, none of 49 people in the control group showed BPPV, whereas 16 out of 63 participants from the study group consisting of athletes experienced BPPV with posterior canal involvement. Total years of practicing American football and weekly training hours were positively correlated with BPPV. The outcome of the Vertigo Symptom Scale indicated that there was no significant impact on daily life in the study and control groups. The participants expressed that vertigo did not limit their social life and reported no interference with their training or daily activities. Vibert et al. [19] noted that the constant movement of the head is associated with BPPV as a result of their study on mountain bike riders. Similar to the results in our study, Hancı et al. [20] demonstrated that 18% of 97 boxers have BPPV caused by frequent head trauma.

According to a BPPV study on 30 swimmers, 4 of them showed unilateral involvement and 1 showed bilateral canal BPPV [21]. It was hypothesized that turning the head from side to side while swimming provokes otoconia to dislocate and then slide into SCC [21]. Gordon et al. [22] investigated 247 patient records with posterior canal BPPV and emphasized that minor head traumas and short and severe neck and head traumas during MVA cause traumatic BPPV. Patients with a history of MVA were treated with physical therapy, and 57% relapsed intermittently compared with those with idiopathic BPPV ($p<0.04$) [22].

Suarez et al. [23] assessed the significance of the age and gender of patients with light head trauma. The study on 325 patients with idiopathic BPPV and 51 with traumatic BPPV reported that traumatic BPPV is more common in the young population compared with idiopathic BPPV, presents generally bilaterally, and shows no gender difference unlike idiopathic BPPV [23].

In the retrospective analysis of 716 traumatic BPPV cases, 23.4% of BPPV cases were claimed to have been caused by trauma [24]. In our study, 16 out of 63 (25.4%) American football athletes showed positive results in Dix-Hallpike test, whereas in the control group, there were no positive test results. Similar to other hypotheses regarding the relationship between trauma and BPPV, we claim that head trauma leads to displacement of otoconia into SCC. As American football players are exposed to head trauma, they experience posterior channel BPPV. Liu et al. [25] outlined that 55% of patients with traumatic BPPV and 6.5% of patients with idiopathic BPPV experience single or double canal BPPV symptoms ($p<0.01$) following the comparison between 40 patients with traumatic BPPV and 46 patients with idiopathic BPPV. Bilateral SCC affected 25% of the traumatic BPPV cases [25]. Patients with BPPV were treated with a single Epley maneuver; however, 67% of the traumatic BPPV and 12% of the idiopathic BPPV had relapsed at 1 year follow-up ($p<0.001$) [25].

Ahn Seong-Ki et al. [26] reported a relationship between traumatic brain injury and BPPV. They described clinical characteristics of BPPV after traumatic brain injury and compared idiopathic BPPV cases between 2003 and 2009 [26]. Kerr et al. [17] stated that treating traumatic BPPV is more challenging and has a higher relapse risk than idiopathic BPPV ($p>0.05$). Gordon et al. [10] noted that only 2 out of 21 patients with post-traumatic BPPV have horizontal canal involvement. In our study, all of the patients with BPPV showed posterior canal involvement.

CONCLUSION

Numerous studies indicate that BPPV is associated with the practice of certain sports such as boxing, swimming, and mountain bike riding. To the best of our knowledge, a relationship of BPPV with American football has not been studied before our study showed a positive correlation between the two. Previous studies did not examine the relationship between frequency of exercise and BPPV. Our study

shows that weekly hours of training and number of years spent practicing are both risk factors for posterior channel BPPV in American football athletes.

The primary limitation of our study is the limited number of athletes who are recruited from only one team in Turkish Universities American Football League. In future research studies, we aim to obtain larger sample sizes for the study and control groups and try to identify the mechanisms that could induce BPPV in the incidents of trauma.

Ethics Committee Approval: Ethics committee approval was received for this study from Turgut Özal University School of Medicine Ethics Committee for Clinical Research (Approval Date: 20.02.2015/Approval No: 2015/03).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

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REFERENCES

1. Ardıç NF, Vertigo, İzmir, İzmir Güven Bookstore, 1st Edition, 2005; 5-26, p.201-10
2. İkiz A.Ö., Nonsurgical Treatment of Vertigo, Koc C. (Editor), Ear Nose Throat Diseases and Head Neck Surgeries, Ankara, Güneş Medical Houses, 2013; 325-327
3. Chang WC, Hsu LC, Yang YR, Wang RY. Balance ability in patients with benign paroxysmal positional vertigo. Otolaryngo Head Neck Surg, 2006; 135: 534-40. [CrossRef]
4. Atacan E, Sennaroglu L, Genc A, Kaya S. Benign paroxysmal positional vertigo after stapedectomy. Laryngoscope 2001; 111: 1257-9. [CrossRef]
5. Jason AT, Parne LS. Benign paroxysmal positional vertigo, mechanism and management. Otol Neurootol 2001; 9: 284-9.
6. Baugh CM, Kiernan PT, Kroshus E, Daneshvar DH, Montenigro PH, McKee AC, et al. Frequency of Head-Impact–Related Outcomes by Position in NCAA Division I Collegiate Football Players. J Neurotrauma 2015; 32: 314-26. [CrossRef]
7. Jacobson GP, Newman CW. The development of the Dizziness Handicap Invertory. Arch Otolaryngol Head Neck Surg 1990; 116: 424-7. [CrossRef]
8. Epley JM. New dimensions of benign paroxysmal positional vertigo, Otolaryngol Head Neck Surg (197) 1980; 88: 599-605.
9. Baloh RW, Honrubia V, Jacobson K. Benign positional vertigo: clinical and oculographic features in 240 cases. Neurology 1987; 37: 371-8. [CrossRef]
10. Gordon CR, Levite R, Joffe V, Gadoth N. Is post-traumatic benign paroxysmal positional vertigo different from the idiopathic form? Arch Neurol 2004; 61: 1590-3. [CrossRef]
11. Katsarkas A. Benign paroxysmal positional vertigo (BPPV), idiopathic versus post-traumatic. Acta Otolaryngol 1999; 119: 745-9. [CrossRef]
12. Motin M, Keren O, Groswasser Z, Gordon GR. Benign paroxysmal positional vertigo as the cause of dizziness in patients after severe traumatic brain injury diagnosis and treatment. Brain Inj 2005; 19: 693-7. [CrossRef]
13. Perhoarrocha M, Pérez H, Garciá A, Guarinos J. Benign paroxysmal positional vertigo as a complication of osteotome expansion of the maxillary alveolar ridge. J Oral Maxillofac Surg 2001; 59: 106-7. [CrossRef]
14. Longridge NS, Barber HO. Bilateral paroxysmal positioning nystagmus. J Otolaryngol 1978; 7: 395-400.
15. Didehbani N, Munro Cullum C, Mansinghani S, Conover H, Hart J Jr. Depressive symptoms and concussions in aging retired NFL players. Arch Clin Neuropsychol 2013; 28: 418-24. [CrossRef]
16. Guskiewicz KM, Marshall SW, Bailes J, McCrea M, Cantu RC, Randolph C, et al. Association between recurrent concussion and late-life cognitive impairment in retired professional football players. Neurosurgery 2005; 57: 719-26. [CrossRef]
17. Kerr ZY, Evenson KR, Rosamond WD, Mihalik JP, Guskiewicz KM, Marshall SW. Association between concussion and mental health in former collegiate athletes. Inj Epidemiol 2014; 1: 28. [CrossRef]
18. Kerr ZY, Collins CL, Mihalik JP, Marshall SW, Guskiewicz KM, Comstock RD. Impact locations and concussion outcomes in high school football player-to-player collisions. Pediatrics 2014; 134: 489-96. [CrossRef]
19. Vibert D, Redfield RC, Hausler R. Benign Paroxysmal Positional Vertigo in Mountain Bikers. Ann Otol Rhinol Laryngol 2007; 116: 887-90. [CrossRef]
20. Hancı D, Altun H, Özbilgen S. Benign Paroxysmal Positional Vertigo frequency and treatment in boxers. Prospective study. İstanbul Medicine Journal 2004; 1: 13-7.
21. Aksoy S, Sennaroğlu L. Benign paroxysmal positional vertigo in swimmers. Kulak Burun Bogaz Ihtis Derg 2007; 17: 307-10.
22. Gordon CR, Levite R, Joffe V, Gadoth N. Is Posttraumatic Benign Paroxysmal Positional Vertigo Different From the Idiopathic Form? Arch Neurol 2004; 61: 1590-3. [CrossRef]
23. Suarez H, Alonso R, Arocena M. Clinical characteristics of positional vertigo after mild head trauma. Acto Otorlaryngol 2011; 131: 377-81. [CrossRef]
24. Pisani V, Mazzone S, Di Mauro R, Giacomini PG, Di Girolamo S. A survey of the nature of trauma of post-traumatic benign paroxysmal positional vertigo. Int J Audiol 2015; 54: 329-33. [CrossRef]
25. Liu H. Presentation and outcome of post-traumatic benign paroxysmal positional vertigo. Acta Otolaryngol 2012; 132: 803-6. [CrossRef]
26. Ahn SK, Jeon SY, Kim JP, Park JJ, Hur DG, Kim DW, et al. Clinical Characteristics and Treatment of Benign Paroxysmal Positional Vertigo After Traumatic Brain Injury. J Trauma 2011; 70: 442-6. [CrossRef]