



SUCCESSFUL REPOSITIONING PROCEDURE FOR BENIGN PAROXYSMAL POSITIONAL VERTIGO AFTER STAPEDOTOMY

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SUMMARY – This report aimed to investigate the relationship after successful left-sided stapedotomy and postoperative benign paroxysmal positional vertigo (BPPV) due to vitamin D deficiency. A 56-year-old woman presented with a complaint of progressive hearing loss and tinnitus in the left ear without dizziness. A successful left-sided stapedotomy was performed, confirming the diagnosis of otosclerosis and closing the air-bone gap to less than 10 dB. Seven days after the stapedotomy, the patient reported dizziness, usually when turning to her left side in the bed. An electrophysiological assessment was performed to investigate vestibular function. Dix Hallpike maneuver showed a typical response, about 5 seconds after repositioning the head, and geotropic, torsional rotary nystagmus of about 30 seconds was registered. Vitamin D deficiency in serum was found. Complete symptom remission was achieved after 7-day-treatment with Epley's maneuver. As a postoperative vertigo complication, BPPV often remains unrecognized after stapes surgery. Canalith repositioning maneuver is treatment for BPPV. Determining serum levels of total calcium and vitamin D may play a significant role in monitoring and reducing the recurrence of dizziness.

Key words: *rehabilitation; balance disorders; benign paroxysmal positional vertigo; otosclerosis; vitamin D deficiency*

Introduction

Otosclerosis represents a primary focal disease that affects the bony labyrinth. It is one of the most easily manageable causes of conductive hearing loss in adult patients¹. It is treated using stapes surgery². Balance

disorders in patients with otosclerosis are rare after the immediate postoperative period³. The coexistence of vestibular dysfunction and otosclerosis without a true cause in a certain number of patients has proven to be justifiably questioned⁴. In rare cases, persistent vestibular symptoms may be the result of surgical trauma. Vestibular disorders in patients with otosclerosis can manifest in different forms. Transient vertigo after stapedectomy is quite common. Persistent vertigo of the paroxysmal type has been described, but probably occurs in less than 3% of stapedectomies⁵. Benign paroxysmal positional vertigo (BPPV) is one of the most commonly diagnosed causes of peripheral vertigo⁶. It is characterized by short seizures, nausea, and posi-

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tional nystagmus associated with the changes of head and body position. The pathophysiological mechanism of this condition implies detached otoconia, usually floating inside the posterior semicircular canal or adhering to the cupula. Although the exact pathophysiological mechanism of its origin is still unknown, it is believed that it occurs spontaneously in 85% of cases as a result of degeneration of the neuroepithelium of the utriculus. In other cases, 25% of BPPV occurrences may be caused by other conditions and processes in the inner ear that can lead to secondary BPPV⁷. Vitamin D is a pleiotropic hormone that has recently been recognized as having a role beyond the homeostasis of bone tissue and calcium⁸.

More studies have shown a link between BPPV, osteoporosis, and vitamin D deficiency, emphasizing pathological calcium metabolism as a possible cause of detached otoconia⁹.

Kahraman *et al.*¹⁰ considered vitamin D deficiency and decreased ionized Ca level to be a risk factor for developing BPPV, not only in patients with osteoporosis.

There are several mechanisms through which low levels of 25(OH) D could have harmful effects on the appearance of BPPV. One of them is regulating Ca²⁺ binding proteins via vitamin D receptors in the inner ear¹¹. Studies have shown that vitamin D deficiency also contributes to the development of BPPV by abnormal calcium metabolism in the inner ear, resulting in otolith dysfunction¹².

Case report

The diagnosis of otosclerosis was based on the medical history, normal otoscopy result, conductive hearing loss with absent stapedial reflex, and surgical confirmation of fixed stapes footplate. The stapes footplate was fenestrated with a microdrill, and a K-piston prosthesis of 4.75 mm in length was placed. Audiometry testing included pure-tone test, impedance, and stapedial reflex measurements. The vestibular examination included a caloric test at 44 °C and 30 °C in videonystagmography (VNG). The bithermic caloric response was defined according to Jongkees' formula. Rotatory tests with a rotation amplitude of 180 degrees and an oscillation period of 20 seconds were conducted.

The Dix-Hallpike test was performed as a part of the VNG. Laboratory findings of total serum calcium and 25-hydroxy D vitamin were obtained. Densitometry of mineral spine density L1-L4 vertebrae and bone

mineral density in the area of both femurs were performed.

This case report was approved for publication by the Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital Centre Osijek, Croatia, after the patient gave her consent to publish the data.

A 56-year-old woman presented with a complaint of progressive hearing loss and tinnitus in the left ear, without dizziness. Hearing loss on the left side was conductive. The first audiometric examination registered a conductive hearing loss of 35-30-40 dB at 1, 2, and 4 kHz in the left ear and normal hearing in the right ear. A type A curve was observed in both ears on tympanometry, confirming normal admittance and tympanometric peak pressure. A successful left-sided stapedectomy was performed, confirming the diagnosis of otosclerosis, and closing the air-bone gap to less than 10 dB. Seven days after the procedure, an electro-physiological assessment was performed since the patient noticed dizziness, usually when turning to her left side while in bed.

Based on the patient's medical history, the Dix-Hallpike maneuver was also performed, and it showed a typical response when in the head-hanging-left position. About 5 seconds after repositioning the head, a geotropic, torsional rotatory nystagmus of about 30 seconds was registered. During the test, the patient complained of vertigo. After repeating the test, the response was significantly weaker. Complete symptom remission was achieved after 7-day-treatment with Epley's maneuver.

Due to the orthopedic history of calcification, laboratory findings of total serum calcium with slightly higher values and 25-hydroxy vitamin D deficiency were found (Table 1). Densitometry of mineral spine density L1-L4 vertebrae (T-score -0.4) and bone mineral density in the area of both femurs (T-score 1.8) were normal.

Table 1. Vitamin D values

25-OH D (nmol/L)	Meaning *
< 2 nmol/L	a severe deficiency of vitamin D

* < 30 nmol/L = a severe deficiency of vitamin D

< 50 nmol/L = deficiency of vitamin D

< 75 nmol/L = lack of vitamin D

≥ 75 nmol/L = normal values of vitamin D

Discussion

The connection between postoperative dizziness after stapedotomy or stapedectomy and BPPV has been reported in the literature, but there are unanswered questions regarding the pathophysiological mechanism, incidence, and time of recognition¹⁻³. In this clinical case report, we reported BPPV as a 7-day postoperative complication presumably provoked by a micro drill vibration during fenestration of the stapes footplate and vitamin D deficiency due to a predisposing factor and orthopedic history of the problem with calcification of the shoulder.

BPPV is easily treated, but in many cases it is not recognized when the first symptoms occur. Benign paroxysmal positional vertigo occurs more often after inner ear surgical procedures¹³. Surgical trauma can lead to otoconia detachment and cause positional vertigo. Stapedectomy may be regarded as an etiological factor in BPPV. Because the fenestra is located in the posterior part of the stapes footplate, the pathophysiology appears to be related to utricular rather than saccular trauma. The same author emphasizes the importance of proper distance measurement between the incus and stapes footplate in stapedectomy¹⁴.

According to research by other authors, the sleeping position may affect the occurrence of positional vertigo. In Meniere's disease, coexistence with BPPV on the same side is explained by the fact that patients with Meniere's disease usually sleep on the worse-hearing side. This allows the better-hearing ear to be free. During sleep, dislodged otoconia can fall into one of the semicircular canals¹⁵. After stapedotomy, patients usually sleep on the side opposite to the operated ear and protect the operated ear due to the fear of possible complications. Our patient slept on the side of the non-operated right ear.

Our patient's medical history of orthopedic disorders spanning several years was the reason for laboratory tests of total serum calcium and 25-hydroxy D vitamin. The patient's age and the data on hormonal status in menopause led us to additional examinations to test for osteoporosis.

Our patient had normal serum calcium and reduced vitamin D levels. Densitometry results did not support osteoporosis as a predisposing factor for developing BPPV. Ding *et al.*¹⁶ reported a correlation between decreasing levels of 25(OH) vitamin D and BPPV, suggesting that low 25(OH) D may be a risk factor for BPPV.

We believe that BPPV was not a complication of surgery related to the insertion depth or length of the prosthesis, since the patient had a typical response for BPPV when turning to her left side while in bed, 7 days post-surgery. A correlation between the insertion depth, the length of the prosthesis, the ratio of insertion depth/vestibule depth, postoperative bone conduction, and the appearance of vertigo or tinnitus was not observed in the literature¹⁷. We wanted to emphasize the underreported correlation between stapes surgery and postoperative dizziness unrelated to stapes surgery, mimicking vestibular complications.

Conclusion

Researching the available literature in English showed a lack of publications on the incidence of BPPV after otosclerosis surgery provoked by the vibration of a drill during fenestration of the stapes footplate. Drill vibration may be the cause of otoconia dislodgement from the utricular otolithic sense, especially in patients with increased predispositions such as osteoporosis, vitamin D and calcium deficiency, previous head traumas, and road accidents.

As a postoperative vertigo complication, BPPV often remains unrecognized after stapes surgery. The initial treatment includes a repositioning procedure. Noninvasive and mostly without risk, the canalith repositioning maneuver should be considered an early treatment for BPPV. Determining levels of total serum calcium and vitamin D and their supplementation can play a significant role in monitoring and reducing the recurrence of dizziness.

Conflict of interest:

The authors have no funding, financial relationships, or conflicts of interest to disclose.

References

1. Shiao AS, Kuo CL, Wang MC, *et al.* Minimally traumatic stapes surgery for otosclerosis: Risk reduction of post-operative vertigo. *J Chin Med Assoc.* 2018;81(6):559-64. doi: 10.1016/j.jcma.2017.08.022.
2. Kuo CL, Li ACI, Shiao AS. Second ear surgery for patients with bilateral otosclerosis: recommended or not? *J Int Adv Otol.* 2013;9:303-12.
3. Grayeli AB, Sterkers O, Toupet M. Audiovestibular function in patients with otosclerosis and balance disorders. *Otol Neurotol.* 2009;30(8):1085-91. doi: 10.1097/MAO.0b013e3181b0fd5d.
4. Liston SL, Paparella MM, Mancini F, *et al.* Otosclerosis and endolymphatic hydrops. *Laryngoscope* 1984;94(8):1003-7.

5. Birch L, Elbrønd O. Stapedectomy and vertigo. *Clin Otolaryngol Allied Sci.* 1985;10(4):217-23. doi: 10.1111/j.1365-2273.1985.tb00244.
6. Mendeš T, Maslovara S, Včeva A, et al. Role of Vestibular Evoked Myogenic Potentials as an Indicator of Recovery in Patients with Benign Paroxysmal Positional Vertigo. *Acta Clin Croat.* 2017;56(4):756-64. doi: 10.20471/acc.2017.56.04.25.
7. Aron M, Lea J, Nakku D, et al. Symptom Resolution Rates of posttraumatic versus Nontraumatic Benign Paroxysmal positional Vertigo. A systematic Review. *Otolaryngol Head Neck Surg.* 2015;153(5):721-30. doi: 10.1177/0194599815594384.
8. Domislović V, Vranešić Bender D, Barišić A, et al. High prevalence of untreated and undertreated vitamin d deficiency and insufficiency in patients with inflammatory bowel disease. *Acta Clin Croat.* 2020;59(1):109-18. doi: 10.20471/acc.2020.59.01.13.
9. Talaat, HS, Abuhadied G, Talaat AS, et al. Low bone mineral density and vitamin D deficiency in patients with benign positional paroxysmal vertigo. *Eur Arch Otorhinolaryngol.* 2015;272(9):2249-53. doi: 10.1007/s00405-014-3175-3.
10. Kahraman, SS, Ozcan O, Arli C, et al. ^{Calcium} Homeostasis During Attack and Remission in Patients With Idiopathic Benign Paroxysmal Positional Vertigo. *Otol Neurotol.* 2016;37(9):1388-92. doi: 10.1097/MAO.0000000000001167.
11. Yamauchi D, Raveendran NN, Pondugula SR, et al. Vitamin D upregulates expression of ECaC1 mRNA in semicircular canal. *Biochem. Biophys Res Commun.* 2005;331(4):1353-7. doi: 10.1016/j.bbrc.2005.04.053.
12. Yang CJ, Kim Y, Lee HS, et al. Bone mineral density and serum 25-hydroxyvitamin D in patients with idiopathic benign paroxysmal positional vertigo. *J Vestib Res.* 2017;27(5-6):287-94. doi: 10.3233/VES-170625.
13. Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *CMAJ.* 2003;169(7):681-93.
14. Atacan E, Sennaroglu L, Genc A, Kaya S. Benign paroxysmal positional vertigo after stapedectomy. *Laryngoscope.* 2001;111(7):1257-9. doi: 10.1097/00005537-200107000-00021.
15. Davcheva-Chakar M, Kopacheva-Barsova G, Nikolovski N. Simultaneous Presentation of Benign Paroxysmal Positional Vertigo and Meniere's disease – Case Report. *Open Access Maced J Med Sci.* 2019;14(21):3626-9. doi: 10.3889/oam-jms.2019.600.
16. Ding J, Liu L, Kong WK, et al. Serum levels of 25-hydroxy vitamin D correlate with idiopathic benign paroxysmal positional vertigo. *Biosci Rep.* 2019;4:30-9. doi: 10.1042/BSR20190142.
17. Gil Mun S, Scheffner E, Müller S, et al. Stapes piston insertion depth and clinical correlations. *Acta Otolaryngol.* 2019;139(10):829-32. doi: 10.1080/00016489.2019.1637019.

Sažetak

USPJEŠAN REPOZICIJSKI POSTUPAK DOBROĆUDNE PAROKSIZMALNE POLOŽAJNE VRTOGLAVICE NAKON STAPEDOTOMIJE

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Cilj ovog prikaza bio je istražiti povezanost postoperativne dobroćudne paroksizmalne položajne vrtoglavice (BPPV), nakon uspješne lijevostrane stapedotomije, zbog nedostatka vitamina D. Žena, 56 godina, upućena zbog progresivnog gubitka sluha i šuma u lijevom uhu bez vrtoglavice. Učinjena je uspješna lijevostrana stapedotomija, koja je potvrdila dijagnozu otoskleroze i postoperativno audiološka obrada pokazala je smanjenje kohlearne pričuve na manje od 10 dB. Sedam dana nakon stapedotomije primijetila je vrtoglavicu, obično pri okretanju na lijevi bok u krevetu. Provedena je elektrofiziološka procjena kako bi se ispitala funkcija vestibularnog osjetila. Dix Hallpike manevar pokazao je tipičan odgovor, nakon latencije od oko 5 sekundi, ageotropni, vertikalno rotatorni nistagmus u trajanju od 30 sekundi. Laboratorijski nalaz pokazao je nedostatak vitamina D u serumu. Potpuna remisija simptoma postignuta je nakon 7-dnevnog liječenja Epleyjevom manevrom. Kao postoperativna komplikacija vrtoglavice, BPPV, često ostaje neprepoznat nakon operacije stapesa. BPPV se uspješno liječi repozicijskim postupcima. Određivanje razine ukupnog kalcija i vitamina D u serumu može imati značajnu ulogu u praćenju i smanjenju ponavljanja vrtoglavice.

Ključne riječi *Rehabilitacija, Poremećaji ravnoteže, Dobročudna paroksizmalna položajna vrtoglavica, otoskleroza, nedostatak vitamina D*