Persistent benign paroxysmal positional vertigo: our experience and proposal for an alternative treatment

Marco Alessandrini, Alessandro Micarelli, Isabella Pavone, Andrea Viziano, Domenico Micarelli & Ernesto Bruno

European Archives of Oto-Rhino-Laryngology
and Head & Neck

ISSN 0937-4477

Eur Arch Otorhinolaryngol
DOI 10.1007/s00405-013-2620-z

Springer

Eur Arch Otorhinolaryngol
DOI 10.1007/s00405-013-2620-z

SHORT COMMUNICATION

Persistent benign paroxysmal positional vertigo: our experience and proposal for an alternative treatment

Marco Alessandrini · Alessandro Micarelli · Isabella Pavone · Andrea Viziano · Domenico Micarelli · Ernesto Bruno

Received: 5 March 2013 / Accepted: 27 June 2013

Abstract Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo. Despite the great efficacy of canalith repositioning procedures (CRPs), BPPV may persist (PBPPV). The aim of the study was to evaluate whether a prolonged and self-assessed temporal bone vibration (TBV) could change the outcome of PBPPV after 12 months of repeated treatments, in order to avoid further invasive and/or drug therapies. This evaluation was also conducted with respect to the entire BPPV population treated with CRPs. Seventy-two patients affected by PBPPV were enrolled in the study: 51 and 21 of them suffering from posterior semicircular canal (PSC) and lateral semicircular canal (LSC), respectively. PBPPV patients underwent a twice-a-day self-assessed TBV, using a common low-intensity massaging cushion. Patients were re-tested 1 week later and they were considered free from disease as the results of the positioning tests continued to be negative after 1 month. 70.6 % of PSC PBPPV and 61.9 % of LSC PBPPV patients had positive and statistically significant ($P < 0.01$) outcomes not biased by "age" and "gender" variables. The recurrence rate of BPPV (RBPPV) was also studied in the BPPV and PBPPV groups after a 12/24-month follow-up and any statistically significant result was found in multiple regression analysis between nuisance variables and RBPPV patients previously treated by CRPs or TBV. The present study suggests that the self-assessed and prolonged TBV could be an alternative treatment in patients affected by PBPPV otherwise addressed to undergo more invasive procedures and pharmacological treatment that are not completely side effects free.

Keywords Benign paroxysmal positional vertigo · Recurrence · Vibration · Rehabilitation · Persistence

M. Alessandrini (✉) · A. Micarelli · I. Pavone · A. Viziano · E. Bruno
Medical Science and Translational Medicine Department, "Tor Vergata" University, Viale Oxford, 81, 00133 Rome, Italy
e-mail: ldcittadino@gmail.com

D. Micarelli
ITER Center for Rehabilitation, Rome, Italy

Introduction

Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo [1], in fact a population-based study has estimated that the lifetime prevalence in the adult population is 2.4 %, while the annual incidence is 0.6 %, the mean age of the onset is 49 years and the incidence increases over time and reaches 10 % at 80 years of age [2]. Commonly, BPPV is characterized by brief and repeated attacks of rotational vertigo, triggered by head movements, and by the appearance of paroxysmal positional nystagmus [3]. A possible explanation of this type of vertigo could be based on the detachment of fragments from the otolithic membrane of the utricle [4]. The particles detached from the utricle and accumulated in the semicircular canal may agglomerate and act like a *piston* on the endolymph, and cause a shift in the cupula, which could induce vertigo and nystagmus when the plane of the semicircular canal is situated so that the force of gravity moves the utricular particles [4]. Many studies show that the posterior semicircular canal (PSC) is the most engaged [5], accounting for up to 90 % of the patients, while the lateral (LSC) and anterior (ASC) canals may also be affected [6] with an incidence range of 5–15 % and 1–15 %, respectively [7]. The diagnosis of BPPV is confirmed by provocation maneuvers and the canalith

Published online: 02 July 2013

repositioning procedures (CRPs) represent, as well known, an effective therapy [2].

Despite the great efficacy of these maneuvers and the possible spontaneous resolution, BPPV may persist (PBPPV) for a long period [8]. Thus, Seok and colleagues [9] have considered that one possible explanation could be that the remaining otoconial material due to incomplete repositioning could produce mild positional vertigo.

The PBPPV does not respond to the repositioning maneuvers and this can be debilitating for patients, severely compromising their quality of life [10]. Many patients are in fact unable to perform activities of daily living such as bending over or lying supine; some of them complain about neck problems due to their head stiffness; others are referred to psychiatrists because of supposed panic attacks; still others have car accidents because of the sudden onset of vertigo when turning their head rapidly [11]. In these cases some additional strategies of treatment have been suggested, such as continuous rehabilitative therapies, long-term vestibular function suppressing drugs administration or surgical procedures with related risks and effects [12].

In the present study, patients affected by PBPPV underwent a prolonged application of temporal bone vibration (TBV) with the aim of evaluating its effectiveness in order to treat patients otherwise eligible for the procedures mentioned above.

Materials and methods

Patients and diagnosis

Starting from January 2005 until September 2010, 2,100 patients (1,302 females; 798 males; mean age 52.4 years) suffering from BPPV were examined by means of a thorough otoneurological examination, consisting of:

- Anamnesis in order to exclude neurological pathology;
- Pure tone and impedance audiometry; and
- Video-nystagmoscopic observation during the performance of positioning maneuvers.

Diagnosis of BPPV engaging the PSC was performed triggering a direction-changing torsional nystagmus by Dix-Hallpike maneuver [13]. The nystagmus had a vertical component with the rapid phase up-wards, and a rotational component with the rapid phase towards the affected ear. The BPPV of LSC presented a direction-changing horizontal geotropic or apogeotropic nystagmus triggered by Mc Clure–Pagnini maneuver when the patient was placed in the supine position and the head was turned 90° toward the explored ear [14]. The BPPV of ASC presented a positional nystagmus with downward movements, with small torsional geotropic or non-geotropic component in response to Dix-Hallpike maneuver [5].

All the patients underwent CRPs (Epley, Baloh and "reverse" Epley maneuver for PSC, LSC and ASC BPPV, respectively [15]) and were re-tested 1–3 days later. Patients who were still presenting symptoms and nystagmus underwent CRPs again and were called back for further testing.

According to the literature [16], PBPPV condition was assessed from 1 year or more continuous presence of positioning nystagmus, despite adequate repeated CRPs. Cerebral magnetic resonance (MRI) was performed in order to exclude neurological diseases and/or malformations.

Experimental procedure

After having signed the informed consent form to participate in the study, enrolled PBPPV patients underwent TBV for 15 min twice-a-day, for 7 days. A common low-intensity massaging cushion (Sensuij 1565, 1–100 cm, Imetec, Azzano S. Paolo, Bergamo, Italy) vibrating at a frequency of about 60 Hz (3,500 rpm) was used.

The patients affected by PBPPV of PSC were instructed to undergo TBV by lying and placing the massager on the affected side for 7 min with the head placed out of the bed in an Epley-like starting position. Afterwards they had to turn the head on the bed to the opposite (healthy) side, while continuing TBV on the affected side until the end of the TBV time. The patients with a diagnosis of geotropic variant of PBPPV of LSC underwent TBV by lying supine, with the vibrating device placed on the affected side and the head placed on the bed and turned towards the same side for 7 min, in a Baloh-like starting position. At the end of this period they turned the head to the opposite side while keeping the massaging cushion on the affected one until the end of the TBV time. The patients with a diagnosis of apogeotropic variant of PBPPV of LSC underwent the TBV and the turning maneuver inversely. Before starting the domiciliary self-assessed procedures, all the participants performed an outpatient clinic training in order to assimilate the correct procedure.

Afterwards, patients were called back after 1 week and tested again for positional vertigo. We considered patients free from disease if positioning test results continued to be negative after 1 month (Fig. 1).

Statistical analysis

The present study considered a null hypothesis (H_0) that TBV application would not show any statistically significant outcome on PBPPV patients. Significant cut-off level (α) was set at a P value of 0.01. Thus, P levels were considered statistically significant if lower than 0.01.

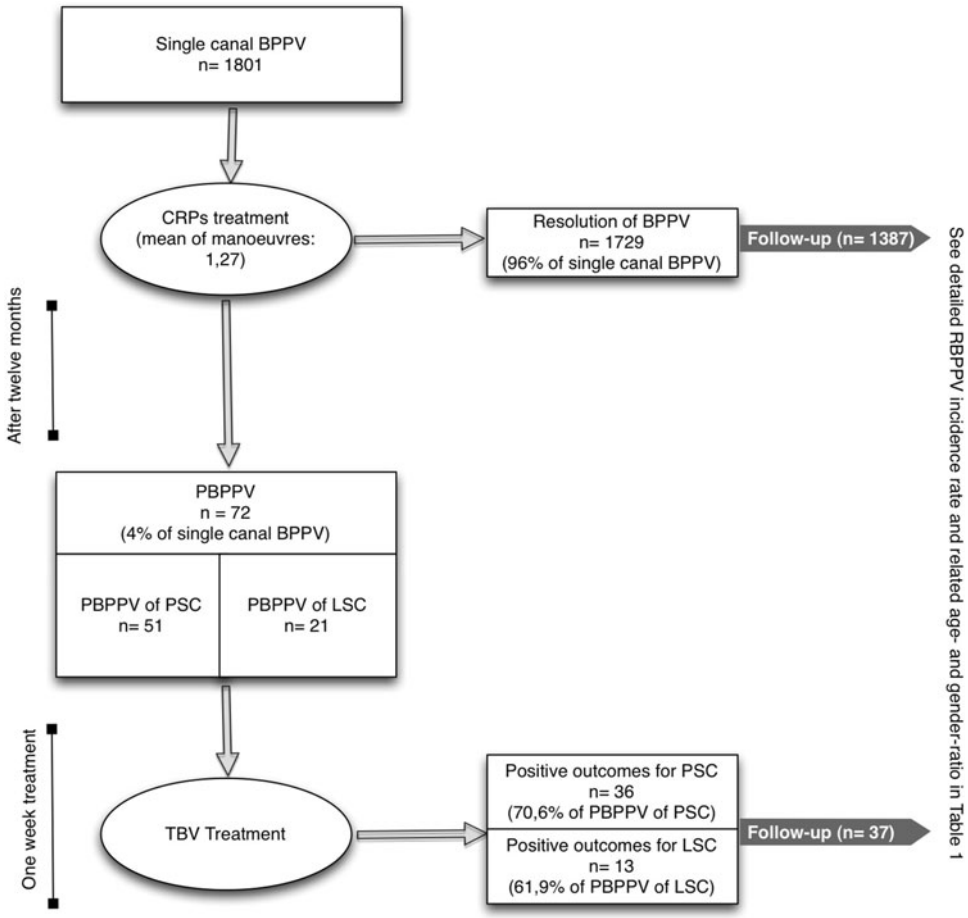

Fig. 1 Flow diagram of participants in the study. *BPPV* benign paroxysmal positional vertigo, *PBPPV* persistent benign paroxysmal positional vertigo, *CRPs* canalith repositioning procedures, *PSC* posterior semicircular canal, *LSC* lateral semicircular canal, *TBV* temporal bone vibration

Statistical comparisons were performed with Chi-Square test (STATISTICA 7 for Windows). Moreover, in order to explore experimental procedure in relation to age and gender, these variables were used as regressors in the cohort of treated PBPPV patients with positive outcome using a multiple regression analysis. Finally, the same multiple regression analysis was implemented in the BPPV patients with positive outcome after CRPs as well as in all patients affected by recurrence rate of BPPV (RBPPV) and previously treated by CRPs or TBV.

Results

In our study PSC, LSC and ASC were singularly involved in 1,279, 515 and 7 patients, respectively, accounting for the 85.7 % of total BPPV cases. In the remaining cases a multicanalar form (4.1 %) and a non-specific semicircular canal involvement (10.1 %) were found.

After CRPs, 1,729 patients with a single semicircular canal involvement (96 %) had resolution of the nystagmus and vertigo; in average 1.27 CRPs (from 1 to 3) were necessary in order to resolve the BPPV. In only 72 cases (4 %) positional vertigo and nystagmus were not suppressed after repeated treatment during 1 year of observation. These patients (45 female; 27 male) were enrolled in the study, and PSC PBPPV and LSC PBPPV diagnoses were posed in 51 and 21 patients of them, respectively (Fig. 1).

The patients were examined 1 week after TBV: overall, 49 patients (68 %; 29 female; 20 male) presented resolution of symptoms, 36 of them (70.6 %; 21 female; 15 male) affected by PBPPV of PSC and 13 patients with PBPPV of LSC (61.9 %; 8 female; 5 male) had positive and statistically significant ($P < 0.01$) outcomes (absence of vertigo and nystagmus during positioning test) (Fig. 2).

Multiple regression analysis between cohort of patients with positive treatment outcome and "age" and "gender" regressors did not provide any statistically significant result ($r = 0.15$ and $r = 0.28$ for PSC and LSC PBPPV group, respectively).

Only 28 (17 female; 11 male) of 36 patients treated for PBPPV of PSC (77.7 %) and 9 (5 female; 4 male) of 13 patients treated for PBPPV of LSC (69.2 %) continued to be followed after 1 week and monthly for a period of 24 months. After 12 and 24 months it was possible to

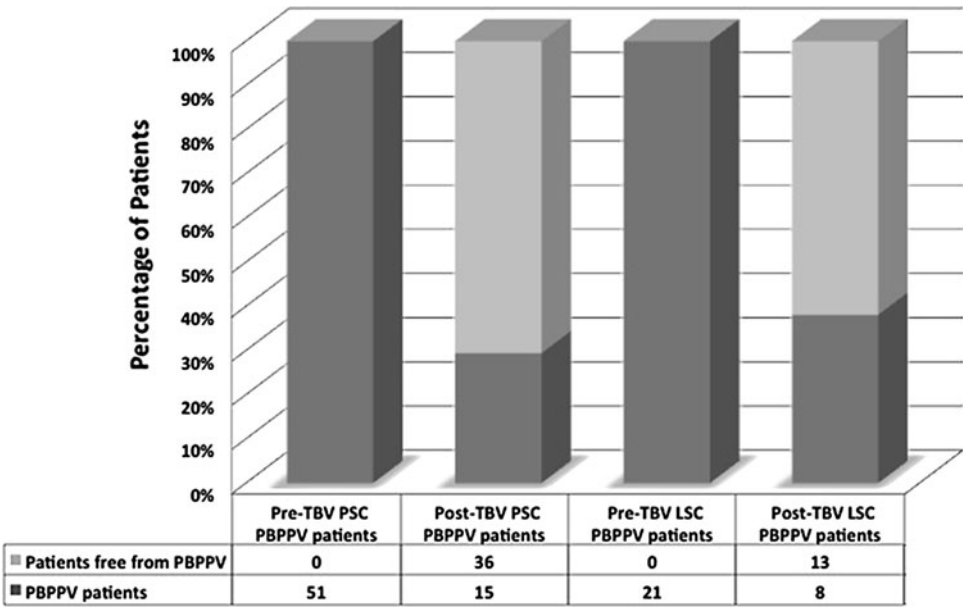

Fig. 2 Success rate of TBV treatment on PBPPV patients. *PBPPV* persistent benign paroxysmal positional vertigo, *CRPs* canalith repositioning procedures, *PSC* posterior semicircular canal, *LSC* lateral semicircular canal, *TBV* temporal bone vibration

observe a RBPPV, respectively, in 8 (28.5 %; 5 female; 3 male) and 13 (46.4 %; 8 female; 5 male) patients treated for PBPPV of CSP; on the other side RBPPV was observed in 3 patients (33.3 %; 2 female; 1 male) and 4 (44.4 %; 3 female; 1 male) patients treated for PBPPV of LSC after 12 and 24 months, respectively (Table 1).

Overall, we were able to follow-up for a 24-month period only 1,387 patients (80.2 %; 869 female; 518 male; 1,019 PSC BPPV; 364 LSC BPPV; 4 ASC BPPV) of the 1,729 treated for BPPV. We observed at 12 and 24 months, respectively, 283 (27.8 %; 167 female; 116 male) and 442 (43.4 %; 263 female; 179 male) cases of RBPPV of PSC, 95 (26.1 %; 58 female; 37 male) and 168 (46.1 %; 97 female; 71 male) cases of RBPPV of LSC and 1 (25 %; 1 female) and 3 (75 %; 2 female; 1 male) cases of RBPPV of ASC (Table 1).

Multiple regression analysis between cohort of BPPV patients with positive treatment outcome after CRPs and "age" and "gender" regressors did not provide any statistically significant result ($r = 0.11$) as well as any statistically significant result was found in multiple regression analysis between "age" and "gender" regressors and RBPPV patients previously treated by CRPs or TBV ($r = 0.19$ and $r = 0.24$, respectively).

Table 1 12-month and 24-month follow-up results for the BPPV and PBPPV patients

Diagnosis	Mean age	Gender	12-month recurrence rate		24-month recurrence rate	
			General	By gender	General	By gender
BPPV of PSC ($n = 1{,}019$)	51.2	F ($n = 597$)	27.8 % ($n = 283$)	F: 27.9 % ($n = 167$)	43.4 % ($n = 442$)	F: 44 % ($n = 263$)
		M ($n = 422$)		M: 27.4 % ($n = 116$)		M: 42.1 % ($n = 179$)
BPPV of LSC ($n = 364$)	52.2	F ($n = 221$)	26.1 % ($n = 95$)	F: 26.2 % ($n = 58$)	46.1 % ($n = 168$)	F: 43.9 % ($n = 97$)
		M ($n = 143$)		M: 25.8 % ($n = 37$)		M: 49.6 % ($n = 71$)
BPPV of ASC ($n = 4$)	56.5	F ($n = 3$)	25 % ($n = 1$)	F: 33.3 % ($n = 1$)	75 % ($n = 3$)	F: 75 % ($n = 2$)
		M ($n = 1$)		M: no recurrence		M: 100 % ($n = 1$)
PBPPV of PSC ($n = 28$)	50.6	F ($n = 17$)	28.5 % ($n = 8$)	F: 29.4 % ($n = 5$)	46.4 % ($n = 13$)	F: 47 % ($n = 8$)
After treatment		M ($n = 11$)		M: 27.2 % ($n = 3$)		M: 45.4 % ($n = 5$)
PBPPV of LSC ($n = 9$)	53	F ($n = 5$)	33.3 % ($n = 3$)	F: 40 % ($n = 2$)	44.4 % ($n = 4$)	F: 60 % ($n = 3$)
After treatment		M ($n = 4$)		M: 25 % ($n = 1$)		M: 25 % ($n = 1$)
PBPPV of ASC	No case tested					

General and gender-specific recurrence rates are divided by affected canal

BPPV benign paroxysmal positional vertigo, *PBPPV* persistent benign paroxysmal positional vertigo, *PSC* posterior semicircular canal, *LSC* lateral semicircular canal, *ASC* anterior semicircular canal

Discussion

Many hypotheses about the origin of BPPV have been taken into account: the finding of otoconial deposits in the semicircular canals and in the cupulae (canalolithiasis and cupulolithiasis) has suggested that the detachment of these particles from the macular receptors, and their movements in the endolymphatic fluids, could elicit a gravity-related stream that could provoke many of the clinical features [17]. However, the complete pathogenetic route is still largely unexplored: most of the cases are classified as idiopathic, but an accurate anamnesis can discover some risk factors (i.e., organic and/or behavioral) [1]. Many Authors have hypothesized a temporal correlation between head trauma and BPPV, observing a higher incidence of the disease in subjects suffering from whiplash injury following a car crash and in repetitive head trauma for instance related to gun shooting [18]. Further hypotheses about the BPPV pathogenesis suggest the existence of ''secondary'' BPPV in the presence of another inner ear disorder, such as Meniere's disease, vestibular neuritis or viral labyrinthitis. This may be due to ''degeneration'' of the labyrinthine structures, due to underlying disease, causing the otoconial detachment from the maculae [19]. To support this hypothesis, it is also important to consider that some associations between BPPV and systemic inflammatory diseases and hormonal disorders have been studied. According to these hypotheses, inflammatory material would be present in the endolymph and contribute to the onset of vertigo [20].

The efficacy of the CRPs for the BPPV treatment has been well established so that many patients can be treated efficiently and effectively in one visit [21]. Nevertheless, a small part of them does not undergo a resolution even after repeated attempts, so that these patients are classified as PBPPV.

While the CRPs seem to be successful in resolving BPPV by moving otoconial debris far from the ampullar receptors, the role of vibration remains debated [11, 21–24]. In fact some authors suggested in the past the use of mastoid vibration (MV) in order to introduce another attempt to improve the efficacy of CRPs. These authors proposed mainly a technique limited only to the CRPs period [11, 21–23] so that Epley [22] recommended MV only during the CRPs, in order to loosen the otolithic fragments spread within the semicircular canals and to improve success rates. At first, Li and colleagues [11] compared the efficacy of PBPPV treatment performed with and without MV during CRPs and reported that 70 % of the group which underwent MV was free from symptoms and nystagmus, while none of the non-vibration group was cured. Conversely, both retrospective [24] and randomized prospective studies [21] did not show any benefit with the addition of MV limited to CRPs. Therefore, according to the main literature mentioned above, MV performed only during CRPs gave conflicting results over the time and its efficacy remains still debated.

For the first time, in the present study, we treated 72 PBPPV patients using a remote, prolonged and self-assessed TBV using a domiciliary simple massaging cushion. Forty-nine of them (68 %), affected by PSC as well as by LSC PBPPV, presented a statistically significant ($P < 0.01$) resolution at the first evaluation after 1 week (Fig. 2).

We proposed this TBV technique due to the hypothesis that in many cases of PBPPV, there is a filling defect (obturation) [16] of a semicircular canal due to an excessively large aggregate of otolith material. Therefore, a possible explanation for its significant success rate could be that a prolonged vibration (15 min twice-a-day, for 7 days) may be capable to dissolve the plug by its slow disintegration due to a frequency vibration of 60 Hz. Moreover, TBV positive outcome was not biased by age and gender variables ($r = 0.15$ and $r = 0.28$ for PSC and LSC PBPPV group, respectively). In this field it is important to highlight that age and gender ratio appeared substantially constant in the whole group of BPPV patients treated using CRPs, in PBPPV patients after TBV treatment (both in the cohort of positive and negative outcomes) as well as in all RBPPV patients (Table 1).

Furthermore it was possible to assess that the RBPPV after TBV treatment was approximately the same found in the general trend of the literature [25–27] as well as in the cohort of BPPV patients treated using CRPs (Table 1). This topic highlights that the TBV treatment may modify the persistence rate but not recurrence of one of the BPPV, suggesting the hypothesis that the processes underpinning the persistence and the recurrence of the BPPV are diverse and in the second case potentially not influenced by the same factors involved in the first one.

Finally we may assert that a remote, self-assessed and repetitive TBV treatment is able to significantly reduce the persistence rate of BPPV. This outcome is eligible to be highlighted in order to give a further chance to PBPPV patients, otherwise addressed to undergo more invasive procedures and pharmacological treatment, not completely side effects free [23].

Conclusions

In our experience, among a large cohort of BPPV patients with a 24-month follow-up, natural history of the disease is well modified by performing CRPs. On the other hand a small sample of patients may develop PBPPV resistant to this kind of treatment, so pharmacological and surgical

procedures were proposed as resolving ones. In the present study, PBPPV patients had a significant improvement by self-assessing a TBV treatment. Interestingly, the protocol outcome did not result biased by age and gender ratio and RBPPV rates appeared akin in BPPV and PBPPV after TBV patients. These positive findings bring us to assert that TBV proposed protocol could be a low cost, side effect free and a valid alternative to be considered before ordinarily performed procedures.

References

1. Bhattacharyya N, Baugh RF, Orvidas L, Barrs D, Bronston LJ, Cass S, Chalian AA, Desmond AL, Earll JM, Fife TD, Fuller DC, Judge JO, Mann NR, Rosenfeld RM, Schuring LT, Steiner RW, Whitney SL, Haidari J (2008) Clinical practice guideline: benign paroxysmal positional vertigo. Otolaryngol Head Neck Surg 139:S47–S81
2. Von Brevern M, Radtke A, Lezius F, Feldmann M, Ziese T, Lempert T (2007) Epidemiology of benign paroxysmal positional vertigo. A population-based study. J Neurol Neurosurg Psychiatry 78:710–715
3. Strupp M, Brandt T (2008) Diagnosis and treatment of vertigo and dizziness. Dtsch Arztebl Int 105:173–180
4. Parnes LS, Agrawal SK, Atlas J (2003) Diagnosis and management of benign paroxysmal positional vertigo (BPPV). CMAJ 169:681–693
5. Giacomini PG, Alessandrini M, Magrini A (2002) Long-term postural abnormalities in benign paroxysmal positional vertigo. ORL J Otorhinolaryngol Relat Spec 64:237–241
6. Heidenreich KD, Kerber KA, Carender WJ, Basura GJ, Telian SA (2011) Persistent positional nystagmus: a case of superior semicircular canal benign paroxysmal positional vertigo? Laryngoscope 121:1818–1820
7. Lopez-Escamez JA (2008) Practical approach to recurrent benign paroxysmal positional vertigo. Acta Otorrinolaringol Esp 59:413–419
8. Gacek RR (1978) Further observations on posterior ampullary nerve transaction for positional vertigo. Ann Otol Rhinol Laryngol 87:300–306
9. Seok JI, Lee HM, Yoo JH, Lee DK (2008) Residual dizziness after successful repositioning treatment in patients with benign paroxysmal positional vertigo. J Clin Neurol 4:107–110
10. Ramakrishna J, Goebel JA, Parnes LS (2012) Efficacy and safety of bilateral posterior canal occlusion in patient with refractory benign paroxysmal positional vertigo: case report series. Otol Neurotol 33:640–642
11. Li JC (1995) Mastoid oscillation: a critical factor for success in canalith repositioning procedure. Otolaryngol Head and Neck Surg 112:670–675
12. Katsarcas A (1995) Paroxysmal positional vertigo: an overview and the deposits repositioning maneuver. Am J Otol 16:725–730
13. Dix MR, Hallpike CS (1952) The pathology, symptomatology and diagnosis of certain common disorders of the vestibular system. Proc R Soc Med 45:341–354
14. Mc Clure JA (1985) Horizontal Canal BPV. J Otolaryngol 14:30–35
15. Balatsouras DG, Koukoutsis G, Ganelis P, Korres GS, Kaberos A (2011) Diagnosis of single or multiple canal benign paroxysmal positional vertigo according to the type of nystagmus. Int J Otolaryngol. doi:10.1155/2011/483965
16. Horii A, Kitahara T, Osaki Y, Imai T, Fukuda K, Sakagami M, Inohara H (2010) Intractable benign paroxysmal positional vertigo: long term follow-up and inner ear abnormality detected by three-dimensional magnetic resonance imaging. Otol Neurotol 31:250–255
17. Schuknecht HF (1969) Cupulolithiasis. Arch Otolaryngol 90:113–126
18. Bruno E, Napolitano B, Di Girolamo S, De Padova A, Alessandrini M (2007) Paroxysmal positional vertigo in skeet shooters and hunters. Eur Arch Otorhinolaryngol 264:381–383
19. Karlberg M, Hall K, Quickert N, Hinson J, Halmagyi GM (2000) What inner ear diseases cause benign paroxysmal positional vertigo? Acta Otolaryngol 120:380–385
20. Cohen HS, Kimball KT, Stewart MG (2004) Benign paroxysmal positional vertigo and comorbid conditions. ORL J Otorhinolaryngol Relat Spec 66:11–15
21. Macias JD, Ellensohn A, Messingale S, Gerkin R (2004) Vibration with the canalith repositioning maneuver: a prospective randomized study to determine efficacy. Laryngoscope 114:1011–1014
22. Epley JM (1992) The canalith repositioning procedure for treatment of benign paroxysmal positional vertigo. Ann Otol Rhinol Laryngol 107:399–404
23. Laveque M, Labrousse M, Seidermann L, Chays A (2007) Surgical therapy in intractable benign paroxysmal positional vertigo. Otolaryngol Head Neck Surg 136:693–698
24. Hain TC, Helminski JO, Reis IL, Uddin MK (2000) Vibration does not improve results of the canalith repositioning procedure. Arch Otolaryngol Head Neck Surg 126:617–622
25. Do YK, Kim J, Park CY, Chung MH, Moon IS, Yang HS (2011) The effect of early canalith repositioning on benign paroxysmal positional vertigo on recurrence. Clin Exp Otorhinolaryngol 3:113–117
26. Brandt T, Huppert D, Hecht J, Karch C, Strupp M (2006) Benign paroxysmal positioning vertigo: a long-term follow-up (6–17 years) of 125 patients. Acta Otolaryngol 126:160–163
27. Perez P, Franco V, Cuesta P, Aldama P, Alvarez MJ, Mendez JC (2012) Recurrence of benign paroxysmal positional vertigo. Otol Neurotol 33:437–443