

New insights in diagnostic and therapeutic maneuvers for BPPV

Citation for published version (APA):

Bhandari, A. (2024). *New insights in diagnostic and therapeutic maneuvers for BPPV*. [Doctoral Thesis, Maastricht University]. Maastricht University. <https://doi.org/10.26481/dis.20240208ab>

Document status and date:

Published: 01/01/2024

DOI:

[10.26481/dis.20240208ab](https://doi.org/10.26481/dis.20240208ab)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

Impact of this thesis

Scientific impact

This thesis provides a model of BPPV based on physics. This allows to visualize and quantify in 3D the movement of the debris and associated eye movements during diagnostic and liberatory maneuvers. The scientific impact is that various parameters that are expected to influence the debris movement and eye movements, like debris size and amount, multiple debris locations, precise angulation, angular velocity, timing of the different steps, the individual orientation (anatomy) of labyrinths in the head, can now relatively easy be studied and visualized in detail. New maneuvers introduced in the literature can be easily verified and examined. Additionally, some findings of this thesis (based on the model), pave the way for future clinical studies: they should be verified in real-life settings.

Clinical impact

The BPPV model and visualization developed in this thesis, allow to optimize existing diagnostic and therapeutic manoeuvres, and allow development of more effective maneuvers. For example, based on this thesis, the order of testing (lateral canal first) should be changed to facilitate a higher detection rate of lateral canal BPPV. Furthermore, the existing Yacovino maneuver should be adjusted to facilitate maximum

effect. It also explains certain types of eye movements obtained during clinical testing, which were previously not described (e.g. unidirectional nystagmus in lateral canal BPPV).

These findings also imply that, based on this thesis, new guidelines for optimal diagnosis and treatment of BPPV should be developed.

Societal and educational impact

The model clearly visualizes BPPV in a way that can easily be understood by the general lay audience, but also for students and all professionals that are involved in the management of BPPV. This can improve understanding of BPPV for a broad audience.

Commercial impact

It was shown in this thesis that a precise detection and analysis of eye movements is crucial for a correct diagnosis. It therefore supports the use of video eye trackers and especially supports the applied research to develop low-cost video eye trackers. Furthermore, it was shown that precise angulation of the head during a liberatory maneuver is only possible with a guidance system that provides visual feedback. This system should be incorporated in commercially available vestibular testing equipment.

References

1. Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *CMAJ*. 2003 Sep 30;169(7):681-93. PMID: 14517129; PMCID: PMC202288
2. Bhattacharyya N, Gubbels SP, Schwartz SR, Edlow JA, El-Kashlan H, Fife T, Holmberg JM, Mahoney K, Hollingsworth DB, Roberts R, Seidman MD, Steiner RW, Do BT, Voelker CC, Waguespack RW, Corrigan MD. Clinical Practice Guideline: Benign Paroxysmal Positional Vertigo (Update). *Otolaryngol Head Neck Surg*. 2017 Mar;156(3_suppl):S1-S47.

doi: 10.1177/0194599816689667. PMID: 28248609.

3. Vennoch P, Pecci R. About nystagmus transformation in a case of apogeotropic lateral semicircular canal benign paroxysmal positional vertigo. *Int J Otolaryngol*. 2011;2011:1-4.

4. Califon L, Vassallo A, Melillo MG, Mazzone S, Salafi F. Direction-fixed paroxysmal nystagmus lateral canal benign paroxysmal positioning vertigo (BPPV): another form of lateral canalolithiasis. *Acta Otorhinolaryngology Ital*. 2013;33(4):254-260.

5. Zuma E, Maia F, Ramos BF, Cal R, Brock CM, Manga Beira Albernaz PL, Strupp M. Management of Lateral Semicircular Canal Benign Paroxysmal Positional Vertigo. *Front Neurol*. 2020;11:1040. Published 2020 Sep 15. doi:10.3389/fneur.2020.01040

6. Mandalà M, Pepponi E, Santoro GP, et al. Double-blind randomized trial on the efficacy of the Gufoni maneuver for treatment of lateral canal BPPV. *The Laryngoscope*. 2013 Jul;123(7):1782-1786. DOI: 10.1002/lary.2391

7. Kim JS, Zee DS. Benign Paroxysmal Positional Vertigo. *New England Journal of Medicine*. 2014;370(12):1138-1147. doi:10.1056/NEJMc1309481

8. Casani AP, Vannucci G, Fattori B, Berrettini S. The Treatment of Horizontal Canal Positional Vertigo: Our Experience in 66 Cases. *Laryngoscope*. 2002;112(1):172-178. doi:https://doi.org/10.1097/00005537-200201000-00030

9. Fife T. Recognition and Management of Horizontal Canal Benign Positional Vertigo (2). *The American Journal of Otology*. 1998;19:345-351.

10. Balatsouras D, Koukoutsis G, Ganelis P, Korres G, Kaberos A. Diagnosis of Single- or Multiple-Canal Benign Paroxysmal Positional Vertigo according to the Type of Nystagmus. *International Journal of Otolaryngology*. 2011;2011:483965. doi: 10.1155/2011/483965. Epub 2011 Jul 14.

PMID: 21792356; PMCID: PMC3139887.

11. Korres S, Riga M, Balatsouras D, Sandris V. Benign paroxysmal positional vertigo of the anterior semicircular canal: Atypical clinical findings and possible underlying mechanisms. *International Journal of Audiology*. 2008;47(5):276-282.

12. Yacovino DA, Hain TC, Gualtieri F. New therapeutic maneuver for anterior canal benign paroxysmal positional vertigo. *J Neurol*. 2009;256(11):1851-1855. doi:10.1007/s00415-009-5208-1

13. Bhattacharyya N, Gubbels SP, Schwartz SR, Edlow JA, El-Kashlan H, Fife T, Holmberg JM, Mahoney K, Hollingsworth DB, Roberts R, Seidman MD, Steiner RW, Do BT, Voelker CC, Waguespack RW, Corrigan MD. Clinical Practice Guideline: Benign Paroxysmal Positional Vertigo (Update). *Otolaryngol Head Neck Surg*. 2017 Mar;156(3_suppl):S1-S47. doi: 10.1177/0194599816689667. PMID: 28248609.

14. Brintjes TD, Companjen J, van der Zaag-Loonen HJ, van Benthem PP. A randomised sham-controlled trial to assess the long-term effect of the Epley maneuver for treatment of posterior canal benign paroxysmal positional vertigo. *Clin Otolaryngol*. 2014 Feb;39(1):39-44. doi: 10.1111/coa.12217. PMID: 24438128

15. Froehling DA, Bowen JM, Mohr DN, Brey RH, Beatty CW, Wollan PC, Silverstein MD. The canalith repositioning procedure for the treatment of benign paroxysmal positional vertigo: a randomized controlled trial. *Mayo Clin Proc*. 2000 Jul;75(7):695-700. doi: 10.4065/75.7.695. PMID: 10907384

16. Yimtae K, Srirompotong S, Srirompotong S, Sae-Seaw P. A randomized trial of the canalith repositioning procedure. *Laryngoscope*. 2003 May;113(5):828-32. doi: 10.1097/00005537-200305000-00011. PMID: 12792318

17. Power L, Murray K, Szmulewicz D. Early experience with a multi-axial, whole body positioning system in the treatment of Benign Paroxysmal Positional Vertigo (BPPV). *J Clin Neurosci*. 2019 Mar;61:186-188. doi:

10.1016/j.jocn.2018.10.039. Epub 2018 Oct 28. PMID: 30377044.

18. Pedersen MF, Eriksen HH, Kjaersgaard JB, Abrahamsen ER, Hougaard DD. Treatment of Benign Paroxysmal Positional Vertigo with the TRV Reposition Chair. *J Int Adv Otol.* 2020 Aug;16(2):176-182. doi: 10.5152/iao.2020.6320. PMID: 32784154; PMCID: PMC7419101.

19. West N, Hansen S, Moller MN, Bloch SL, Klokke M. Repositioning chairs in benign paroxysmal positional vertigo: Implications and clinical outcome. *Eur Arch Otorhinolaryngol.* 2016;273:573–80. doi: 10.1007/s00405-015-3583-z.

20. Li JC, Epley J. The 360-degree maneuver for treatment of benign positional vertigo. *Otol Neurotol.* 2006 Jan;27(1):71-7. doi: 10.1097/01.mao.0000188350.52053.d6. PMID: 16371850.