

Demystifying Horizontal Canal BPPV Using Virtual Modelling: A Service Improvement Project

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Visualising horizontal-canal BPPV mechanics helped us turn variable practice into a shared, pragmatic treatment pathway

1 Why did we need to change?

Horizontal-canal BPPV was encountered regularly, but clinician confidence and management was variable

- There was mixed use of BBQ roll, Gufoni, Casani and Appiani manoeuvres
- The Gufoni manoeuvre was being used as if it were one technique, without consistently distinguishing variants
- BBQ rolls were used extensively, but rolling within a limited space was often difficult unless patients had good mobility.
- We lacked a cohesive, standardised, evidence-based approach that considered efficacy alongside tolerability for patients of varying mobility

Aim: To improve shared understanding and produce usable local guidance for assessment and treatment.

2 Summary of what we did

- 01 Understand**
Revisited anatomy, physiology, nystagmus patterns and possible debris locations based on our current understanding of horizontal canal BPPV
- 02 Review**
Identified available canalith repositioning manoeuvres and appraised the literature for efficacy and limitations.
- 03 Model**
Simulated evidence-based manoeuvres with anatomically accurate grounded 3D modelling to evaluate and learn about manoeuvres
- 04 Stress-test**
By using computer modelling and practicing manoeuvres on volunteers, considered mobility, tolerability, treatment time and the specific variants each manoeuvre was effective in treating.
- 05 Standardise**
Agreed a pragmatic treatment pathway and created written, pictorial and both treatment and modelling video resources.
- 06 Embed**
Delivered team training and shared early clinical experience to refine practice.

3 The use of anatomically accurate 3D modelling

BPPV Viewer¹ provides a manipulable 3D model of both labyrinths, allowing expected debris movement to be explored as head position changes.

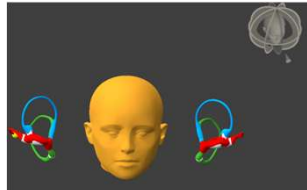


Figure 1 - Example BPPV viewer screenshot

- ✓ BPPV Viewer is reconstructed from 780 histological sections of a human membranous labyrinth, which cannot be practically delineated using CT or MRI scans¹
- ✓ The labyrinth was orientated within an adult head using anatomical norms averaged from imaging of 21 subjects
- ✓ Otoconia can be modelled throughout the semicircular ducts, common crus and utricle, with crista planes represented to visualise orientation relative to gravity
- ✓ This enables meaningful predictions about BPPV mechanics, an approach that is already being used to propose novel manoeuvres²

Seeing the predicted mechanics made abstract manoeuvres easier to explain, compare and teach.

4 From insight to clinical resource

The pathway was translated into resources clinicians could easily access on our local SharePoint site:

- Decision aid** A summary table to help clinicians to choose the appropriate manoeuvre
- Mobility alternatives** An alternative strategy for those with poor mobility
- 3D model videos** BPPV viewer videos to promote deep clinical understanding
- Step-by-step guides** Written pictorial instructions designed for quick-reference in clinic
- Video Demos**

Figure 2 – Example image taken from Gufoni (Geo) step-by step guide



7 Take-home message

Virtual modelling was the bridge between evidence and implementation.

For a clinically complex problem, combining literature review with visual simulation helped the team ask better questions and understand why manoeuvres differ mechanically.



Figure 3 – A demonstration of how the 'Zuma' manoeuvre dislodges otoconia from both the utricular and canal side of the cupula

5 Summary of treatments adopted

Treatment selection was only one output of the project. This summary shows how the review + modelling + practical discussion translated into local practice.

Hc BPPV type	Preferred local manoeuvre	Why it fitted our service
Posterior arm canalithiasis	Gufoni (geotropic variant)	✓ Quick ✓ Simple ✓ Good evidence-base ✓ Mobility friendly
Cupulolithiasis	Zuma or Cupulolith Repositioning Manoeuvre	✓ Designed to address utricular & canal-side cupulolithiasis ✓ May avoid sequential treatments ✓ Well tolerated and simple ✓ Encouraging evidence-base ✓ Vibration not needed ✗ Longer duration
Cupulolithiasis treatments where Zuma not possible		
Cupulolithiasis if Zuma not possible or successful	Gufoni-Appiani (head-up) followed by Gufoni (geo)	✓ Good for those with back issues as all positions are side-lying ✓ Well-tolerated ✓ Good evidence-base
If utricular cupulolithiasis suspected	Gufoni-Appiani (head-down)	✓ Side-lying only ✓ Well-tolerated ✓ Designed to dislodge otoconia on the utricular side ✗ Less convincing evidence base than Zuma or Appiani

6 Early impact & next steps

What changed?

- Shared language and treatment rationale
- New manoeuvres introduced with practical teaching resources
- Consistency across sites and clinicians

What we cannot yet claim

- No formal pre/post audit was possible before conference submission
- Early clinician and patient feedback has been favourable
- The evidence-base doesn't support a single manoeuvre as the standard for cupulolithiasis – further studies are needed

Ideas for future further improvement

- Pre/post service audit
- Evaluate treatments required, recurrence & patient tolerability
- Explore outcomes using data from North Wales primary-care audiology

Key references

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- AI Use statement:** Microsoft 365 Copilot (GPT-5 chat model) was used to assist with poster structure, language refinement and visual layout. All clinical content and references were revised by the authors
- BPPV Viewer was used as an independent educational/modelling tool. The authors have no affiliation with BPPV Viewer and declare no related conflict of interest
- Acknowledgement: BPPV Viewer © Michael Teixido MD / collaborators. Modelling should complement, not replace, critical appraisal of the evidence.



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