

The Symptoms & Mechanisms of Recovery in Scuba Divers with Inner Ear Decompression Sickness (IEDCS)

23. Vestibular Compensation and Rehabilitation

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Background:

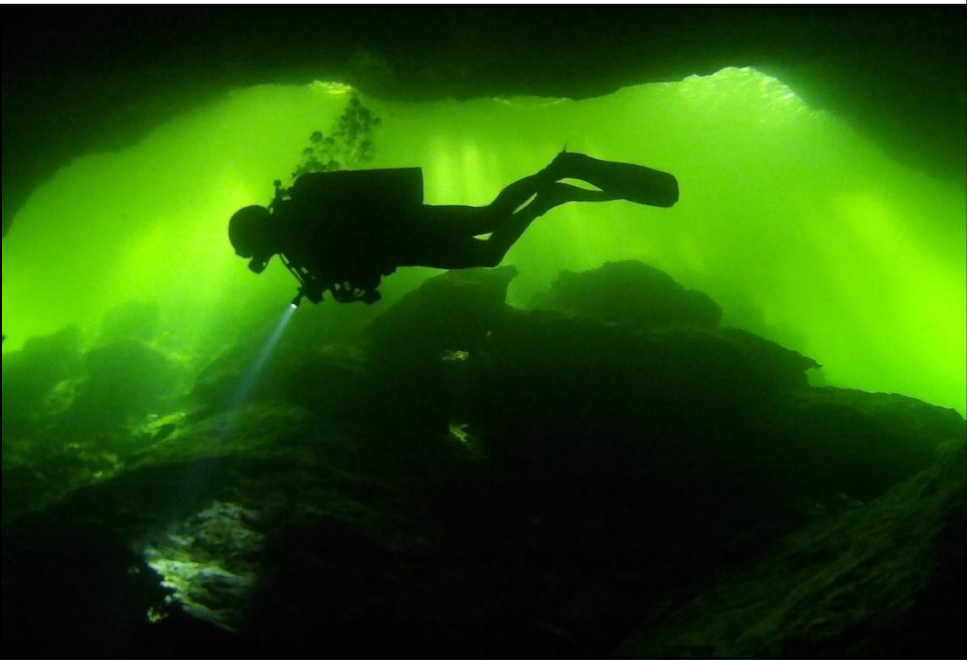
- Scuba divers develop decompression illness (DCI) via either the accumulation of inert gas load under pressure (decompression sickness) or due to rapid ascent and pressure injury to the lungs (arterial gas embolism).
- ~20% of DCI cases affect the inner ear, with divers experiencing mainly vestibular symptoms (+/- cochlear involvement).
- Presentation can vary in severity from a feeling of disequilibrium to profound vertigo with divers unable to move their head or stand without provocation of symptoms.
- The exact mechanism of injury and recovery is poorly understood with symptoms particularly resistant to hyperbaric recompression treatment when compared to other types of DCI, and a high rate of residual symptoms.
- Vestibular rehabilitation has not been used as standard and the assessment of residual symptoms has been based on simple bedside tests (e.g. Sharpened Romberg's) which may not fully capture the extent or complexity of their vestibular dysfunction.

Aims:

- To understand more about the mechanism of injury and recovery of IEDCS.
- To improve support and provide directed vestibular rehabilitation that could be continued once discharged home.

Methods:

- Observational study of 7 IEDCS divers seen between 2021-2024 at DDRC in Plymouth.
- All undertook vestibular testing including videonystagmography (VNG), posturography, dynamic gait index, vertical perception and patient reported outcome measures (PROMS).
- This was included as part of their clinical assessment at presentation (VFT1), discharge (VFT2), and at their 3-month return to dive medical (3MFU).
- Balance retraining and personalised vestibular rehabilitation were also initiated alongside their standard hyperbaric oxygen therapy.

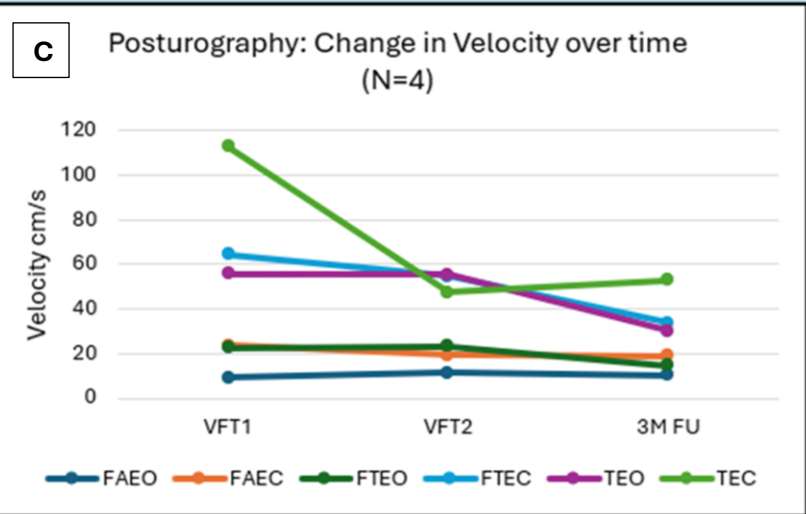
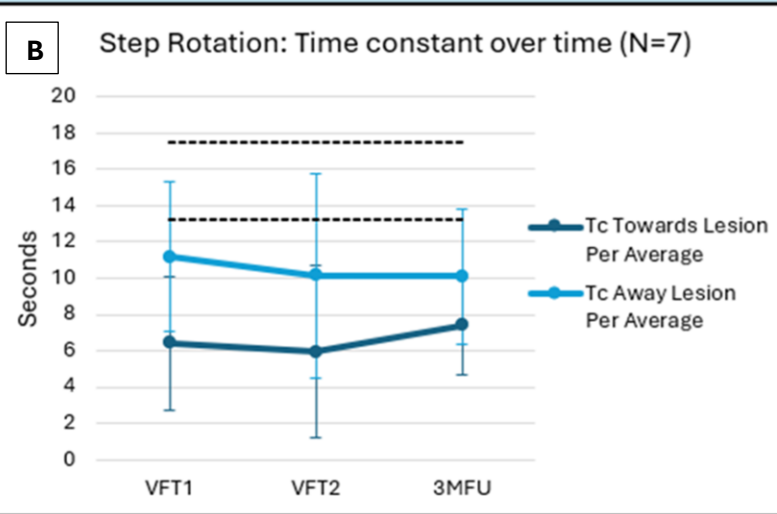
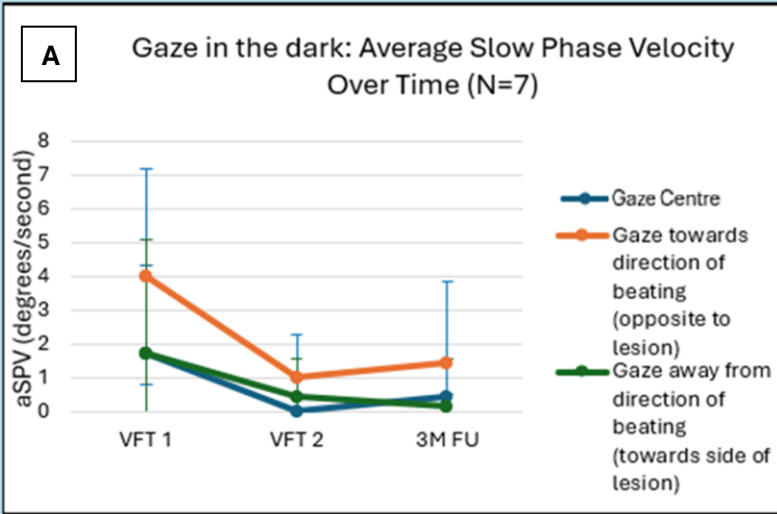


Results:

- At initial presentation all had visible nystagmus in the light and a positive head thrust.
- VNG: VOR assessed using 0.2Hz sinusoidal motion in the dark (A) and step rotation (B) improved with time
- Posturography (C): Tandem eyes closed/open (TEC/TEO) and Feet together eyes open (FTEO) improved over time.

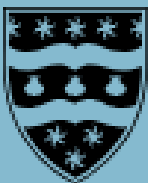
N=7		VFT1 (2.30 days SD 1.11)	VFT2 (10.03 days SD 4.79)	3MFU (7.03 months SD 5.40)	Outcome
Dynamic Gait Index (<=19 risk of falls)		20/24	23/24	24/24	Improved
Vertical Perception (Dynamic)					
° Tilt Toward healthy side		-0.33	1.03	0.96	Worsened
° Tilt Toward side of lesion		2.00	2.28	1.15	Improved
PROMS	Dizziness Handicap Inventory ¹	43/100 (moderate handicap)	12/100 (no handicap)	4/100 (no handicap)	Improved
	Vertigo Symptom Scale ²	19/60	12/60	2/60	Improved
	Situational Characteristics Questionnaire ³	1.27/4	0.68/4	0.09/4	Improved
	ABC-UK Scale ⁴	63%	94%	99%	Improved

- Follow up: 5 divers had either a positive head thrust and/or nystagmus in the dark at follow up despite symptomatic recovery.
- All divers reported that they had found the vestibular rehabilitation exercises useful as a tool to help aid recovery. Some reported return of vestibular symptoms in low light environments, after drinking alcohol, when fatigued or with other illnesses.



Conclusions:

- 5 out of 7 (71%) showed an ongoing vestibular deficit despite reporting a full recovery.
- Changes in the VOR time constant with step rotation indicate that central compensation is occurring.
- Anecdotal findings indicate that when this compensation is compromised there is a substantial burden of residual symptoms. This has the potential to impact safety on future diving, especially in poor conditions e.g. with swell or poor visibility.
- Further investigation with a larger cohort and more extensive testing is planned (including video head impulse (vHIT), MRI imaging, vestibular evoked myogenic potentials (VEMPS), and structured qualitative interviews).



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