

INTRODUCTION

Mal de Debarquement Syndrome (MdDS) is a rare condition in which those afflicted perceive a chronic rocking or swaying sensation, often relieved when in motion and symptomatic when still. Etiology is uncertain; thus, treatment options are limited.¹

The purpose of this study was to investigate rehabilitation outcomes following sensorimotor, multi-axis, rotational (SMART) training to address MdDS symptoms.

METHOD

Design: Retrospective chart review

Participants: 49 patients who participated in 10-20 sessions of SMART training with integrated use of a visual targeting system and physical therapy

Inclusion criteria: Chronic symptoms (≥ 4 weeks) consistent with MdDS (internal sense of motion worse when still and alleviated during motion) or diagnosis of MdDS

Exclusion criteria: Absence of MdDS symptoms due to medication, declining to participate in SMART training, contraindications to SMART training (e.g., ankylosing spondylitis, pregnancy, abnormal intracranial pressure, uncontrolled seizures, undiagnosed neck pain, Arnold Chiari Malformation Type II-IV, detached retina)

Outcome Measures:

- Subjective improvement at discharge, 5 weeks, 3 months, 6 months, and 1-year
- Dizziness Handicap Inventory (DHI)
- MdDS severity verbal numeric rating scale (VNRS)
- Motion severity VNRS
- 4-item Dynamic Gait Index (mDGI)
- Sensory Organization Test (SOT)

Intervention:

- 40 minutes/session x 2 sessions/day x 5 days x 2 weeks (max total=20 sessions) and each session made up of multiple trials of 30 – 60s
- Levels (intensity) correlated to revolutions per minute (rpm; i.e., level 1 = 1 rpm) and plane of movement: yaw only, pitch only, yaw & pitch (roll produced by active head movement)
- Controlled parameters: direction(s), speed, acceleration, deceleration, duration
- Concurrent visual motor task: “shooting” 4 electronic sensors (targets) in standardized locations around the perimeter using a hand-held laser pointer and additional cognitive tasks as appropriate
- Physical therapy: Mindfulness breathing, relaxation techniques, grounding activities (weight shifting, mini-squats, trekking pole, resisted mini-squats, resisted mini-lunges, resisted scapular retraction)
- Strongly encouraged to avoid excessive visual stimulation (e.g., shopping)
- Education on strategies to maintain proper hydration, optimize sleep, reduce stressors, and avoid focus on symptoms

Data Analysis:

- Wilcoxon Signed Rank Tests were performed for ratings at 1 week, 5 weeks, 3 months, and 6 months to determine whether improvements at discharge were sustained.
- Paired t-tests were performed to determine change in outcome measures from initial evaluation to discharge ($\alpha = 0.01$)
- Nonparametric bivariate correlations (Spearman’s rho) were performed to determine factors associated with change in outcome measure

RESULTS

Participants

- Mean age (SD) was 52.9 (12.6) years with the majority female (n=47)
- Mean time from onset of symptoms (SD) was 50.8 (87.8) months suggesting chronic symptoms.

Rehabilitation outcomes: Subjective improvement in symptoms

Subjective Improvement	Discharge (n=49)	1 wk post* (n=45)	5 wks post (n=41)	3 mo post (n=36)	6 mo post (n=23)
Marked (76 - 100%)	11 (22.4)	9 (20.0)	8 (22.2)	8 (22.2)	8 (34.8)
Moderate (51 - 75%)	13 (26.5)	9 (20.0)	7 (17.1)	5 (13.9)	3 (13.0)
Mild (26 - 50%)	11 (22.4)	11 (24.4)	9 (22.0)	7 (19.4)	2 (8.7)
None to Minimal (0 - 25%)	14 (28.6)	16 (35.6)	17 (41.5)	16 (44.4)	10 (43.5)

* Significant difference ($p = 0.03$) from discharge

Rehabilitation outcomes: Outcome measures

Outcome Measure (n)	Initial Mean (SD)	Discharge Mean (SD)
Dizziness Handicap Inventory (27)	64.1 (16.9)	35.3 (23.2)*
MdDS severity VNRS (47)	5.4 (2.1)	2.4 (2.2)*
Motion VNRS (49)	5.3 (2.1)	2.4 (2.3)*
4-item Dynamic Gait Index (26)	9.0 (2.8)	11.0 (1.6)*
Sensory Organization Test (41)	71.7 (14.6)	83.5 (11.0)*

Note: Not all patients completed all measures. The number (n) who completed each measure is indicated in parentheses. VNRS: verbal numeric rating scale.

*Significant change ($p < 0.001$) from baseline to discharge

Summary of outcomes

- At discharge, 42 of 49 (86%) patients reported improvements in symptoms, with nearly half of patients (n=24, 48.9%) reporting marked or moderate improvement.
- Patients improved significantly ($p < 0.001$) from initial evaluation to discharge on all outcome measures (DHI, MdDS severity VNRS, Motion VNRS, mDGI, and SOT).
- Several personal factors were associated with rehabilitation outcomes including age ($p=0.321$), time from onset of symptoms ($p=0.353$), history of panic disorder ($p=0.339$), and motion sensitivity ($p=0.461$).
 - Greater improvements in DGI for older patients and patients with longer duration of symptoms.
 - Greater improvements in DHI for patients with a history of panic disorder
 - Fewer improvements in DGI for patients with a history of motion sensitivity
- In general, patients who sustained improvements at 1-week post-discharge, continued to sustain improvements at 5 weeks, 3 months, 6 months and 1 year.

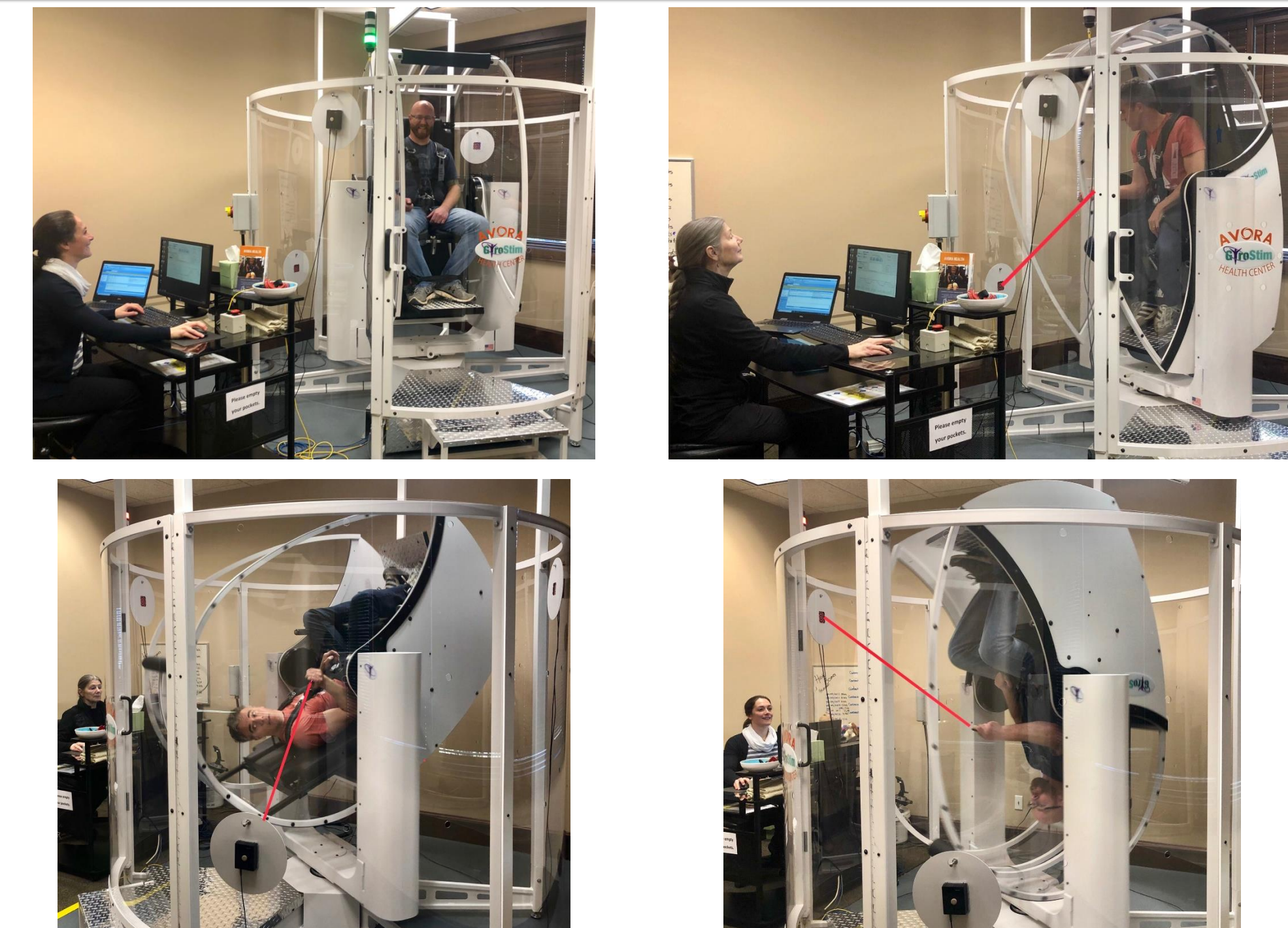


Figure. SMART training set-up and use of concurrent visual motor task (“shooting” a target with laser pointer).

DISCUSSION

- SMART training plus physical therapy resulted in improved outcome measures and significant reduction or resolution of MdDS symptoms.
 - Furthermore, patients who sustained improvements at 1-week post-discharge tended to sustain those improvements for up to 1 year.
- This study provides early evidence that SMART training has promising potential to aid in the management of MdDS.
- Mechanism of SMART training is not understood; potential mechanisms:
 - Neural plasticity with challenging environment
 - Internal predictive modeling
 - Recalibration between vision, somatosensory and vestibular input
- There was a positive correlation between improved outcomes and older age and no correlation between duration of symptoms and improvements.
 - In contrast, studies utilizing optokinetic stimulation (OPK)² and repetitive transcranial magnetic stimulation (rTMS)³ determined that age and duration of symptoms were negatively correlated with improvement.
- On average, patients treated with SMART training plus physical therapy were older and presented with more chronic symptoms compared to patients treated with OPK² or rTMS³.

REFERENCES

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