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Roadmap to Success with Vestibular Rehabilitation

Colleen Sleik PT, DPT, OCS, NCS



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Learning Outcomes

- Discuss vestibular hypofunction, central, and cervicogenic dizziness clinical presentation.
- Define the four components of a vestibular rehabilitation program and assessment tools for each.
- Apply vestibular rehabilitation treatment techniques and progressions in each of the four areas of vestibular rehabilitation

2

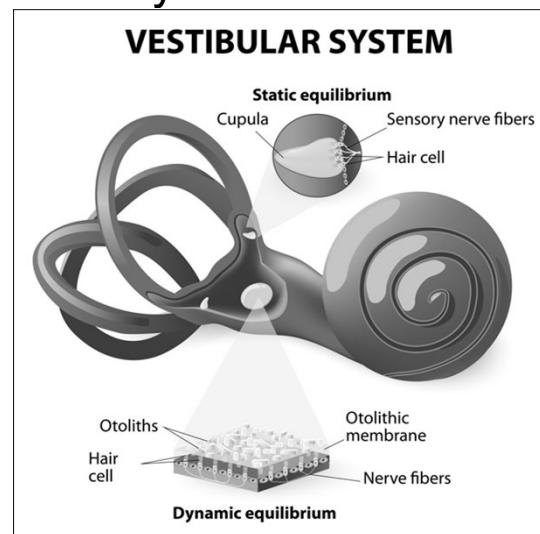
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Peripheral Vestibular System

- Located in inner ear
- Static and dynamic sensory inputs to provide position sense in space
- Linear and angular head velocity

(Herdman & Clendaniel, 2014;
Alyahya et al., 2016)



3

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Reflexes

- Vestibulo-Ocular Reflex: gaze stabilization
 - Sensory: semicircular canals
 - Motor: ocular adjustments for gaze stability
- Vestibulocollic Reflex: head stabilization
 - Sensory: vestibular inputs
 - Motor: cervical muscle contraction for head stability
- Vestibulospinal Reflex: body stabilization
 - Sensory: vestibular inputs
 - Motor: postural adjustments for body and head stability

(Herdman, 2007)

4

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Peripheral Vestibular Disorders

5

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Vestibular Hypofunction

- Mechanism: viral infection, Meniere's disease, acoustic neuroma, ototoxicity
- Unilateral vestibular loss results in static asymmetry
 - Static: nystagmus, asymmetry in muscle activity of lower extremities, postural instability
 - Dynamic: VOR dysfunction, visual blurring, disequilibrium, gait ataxia
 - Musculoskeletal: neck pain, headaches, postural changes
- Prognosis: Excellent with proper diagnosis and vestibular rehabilitation

(Herdman & Clendaniel, 2014; Wilhelmsen & Kvale, 2014; Bayat & Saki, 2017)

6

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Clinical Presentation

- **Acute Vestibular Hypofunction:** sudden onset of dizziness persisting for hours to several days
 - Dizziness
 - Balance deficits
 - Musculoskeletal involvement
- **Bilateral Vestibular Hypofunction:**
 - Imbalance is the primary presentation, less dizziness due to bilateral involvement

7

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Recovery

- Static recovery
 - Regeneration of peripheral sensory hair cells, axonal sprouting, increased synaptic weight of remaining vestibular inputs
- Dynamic recovery
 - Requires both visual input and head and body movement
- Vestibular Adaptation / Habituation
 - Reduce asymmetry at peripheral or central levels of recovery of VOR
- Substitution
 - Utilization of other systems to compensate for vestibular loss

(Herdman & Clendaniel, 2014; Lacour & Vidal, 2016; Lacour & Bernard-Demanze, 2015)

8

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Goal of Vestibular Rehabilitation for Peripheral Hypofunction

- Central compensation for peripheral vestibular dysfunction

9

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Clinical Predictors of Chronic Dizziness

- Visual dependence
 - Poor recovery if sensory integration mechanisms are unable to down-regulate visual contribution to central compensation
- Psychological factors
 - Anxiety
 - Autonomic arousal – heart pounding, excessive sweating, shortness of breath
- 30-50% of patients develop chronic dizziness

(Cousins et al., 2017)

10

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Clinical Presentation

- **Chronic Vestibular Hypofunction (Uncompensated):**

- Increased weighting of visual and/or somatosensory cues, may use an assistive device
- Postural changes – flexion through neck and trunk, looking at the ground while walking, decreased respiration
- Psychosocial –fear, anxiety, activity avoidance, sedentary lifestyle

11

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Clinical Practice Guidelines

- Harm/benefit ratio for vestibular rehab in terms of quality of life and psychological stress: clinicians should offer vestibular rehab for peripheral vestibular hypofunction (Level I-III, strong recommendation)
- Clinicians may use achievement of primary goals, resolution of symptoms or plateau in progress as reasons for stopping vestibular rehab (Level V, expert opinion)

12

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Clinical Practice Guidelines

- Gaze stabilization exercises for HEP should be performed 3x/day (Level V, expert opinion)
 - Acute/subacute: minimum of 12 minutes per day
 - Chronic: minimum of 20 minutes total per day

- Clinicians should not offer saccadic or smooth pursuit exercises in isolation (without head movement) as specific exercises for gaze stability for patients with unilateral or bilateral vestibular hypofunction (Level I, strong recommendation)

13

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Clinical Practice Guidelines

- Factors that modify rehab outcomes (Level I-III, weak to strong recommendation)
 - Age and gender do not affect potential for improvement
 - Acute: earlier intervention improves rehab outcomes
 - Chronic: potential for harm due to decreased quality of life or falls
 - Co-morbidities: anxiety, migraine, peripheral neuropathy may have negative impact
 - Vestibular suppressants: long-term use may negatively impact rehab outcomes

(Hall et al., 2016; Lacour & Bertrand-Demanze, 2015; McDonnell & Hillier, 2015)

14

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Central Vestibular Disorders

15

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Central Vestibular Disorders

- Disruption to central processing
- CVA / TIA, post-concussion syndrome, multiple sclerosis, Parkinson's Disease, multiple system atrophy, Chiari malformation, drug toxicity, B12 or magnesium deficiency
- Symptoms: balance deficits, dysmetria, ataxic gait, dizziness, decreased perception of vertical, oculomotor deficits, coordination deficits

16

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Goal of Vestibular Rehabilitation for Central Vestibular Dysfunction

- Recovery of function through neuroplasticity

17

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Cervicogenic Dizziness

18

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Cervicogenic Dizziness

- Theory: abnormal cervical sensory afferent input (proprioception) causing sensory integration deficit
- Common post-whiplash or closed head injury, post-surgical
- Close temporal relationship between neck pain and dizziness
- Clinical presentation: postural instability and lightheadedness

(Wrisley et al., 2000)

19

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Goal of Vestibular Rehabilitation for Cervicogenic Dizziness

- Restore mechanics and proprioceptive input from cervical spine
- Re-integration of cervical afferent input with vision and vestibular inputs

20

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Vestibular Rehabilitation

21

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Four Components of Vestibular Rehab Program

- Vestibular rehab is exercise-based approach addressing four components:
 1. Gaze stabilization
 2. Habituation
 3. Gait and balance
 4. Walking for endurance

(Hall et al., 2016)

22

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Vestibular Functional Assessments

23

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Functional Assessments: Vestibular EDGE (VEDGE)

- Academy of Neurologic Physical Therapy (Neurology Section of APTA): neuropt.org
- Vestibular EDGE documents: Evidence Database to Guide Effectiveness
 - Recommended outcome measures
 - <http://www.neuropt.org/docs/default-source/vestibular-edge/v-edge-clinical-recommended-by-domain.pdf?sfvrsn=2>

Vestibular EDGE: Shared with permission from The Academy of Neurologic Physical Therapy. VEDGE Taskforce Members: Matthew R. Scherer, PT, PhD, NCS, Chair; Linda B. Horn, PT, DScPT, MHS, NCS, Co-Chair; Elizabeth Dannenbaum, MScPT; Jennifer L. Fay, PT; Karen H. Lambert, PT, MPT, NCS; Teresa A. Rice, PT, MPH, NCS; Jennifer L. Stoskus, PT; Diane M. Wrisley, PhD, PT, NCS

24

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Vestibular Functional Assessments

- Gaze stabilization
 - Best assessed by Dynamic Visual Acuity Test: computerized or clinical testing
 - Assess static visual acuity (head still, read lowest line)
 - Assess horizontal and vertical dynamic visual acuity, head turns 30 deg ROM at 2 Hz (read lowest line during head turns)
 - >2 line change between static and dynamic visual acuity indicates deficit in DVA

25

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Vestibular Functional Assessments

- Habituation
 - Motion Sensitivity Quotient
 - http://www.chartercare.org/uploads/appendix_g_motion_sensitivity_test.pdf
 - High inter-rater reliability, good validity, sensitivity and specificity for detecting motion-provoked dizziness
 - Findings from MSQ will direct habituation treatment

26

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Motion Sensitivity Quotient

Name:	Date:	Initial/Follow-up	
Intensity 0-5 Duration 5-10sec ¹ Score= Intensity+Duration 11-30sec ² x30sec ³			
Baseline Symptoms			
1. Sitting to supine	Intensity	Duration	Score
2. Supine to left side			
3. Supine to right side			
4. Supine to sitting			
5. Left Hallpike-Dix			
6. Up from left HD			
7. Right Hallpike-Dix			
8. Up from right HD			
9. Sitting, head tipped to left knee			
10. Head up from left knee			
11. Sitting, head tipped to right knee			
12. Head up from right knee			
13. Sitting head turns (5x)			
14. Sitting head pitches (5x)			
15. In stance, 180 degree turn to left			
16. In stance, 180 degree turn to right			

MSQ = Total Score * (# positions)/20.48 MSQ = _____

Interpretations: 0-10 is mild;
11-30 is moderate;
31-100 is severe

27

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Vestibular Functional Assessments

- Balance and Gait
 - Balance: Dynamic Gait Index, Functional Gait Assessment, Berg, BEST, MiniBEST, BESS, Neurocom SOT, CTSIB, mCTSIB
 - 10 meter walk test, TUG (manual and dual task)
 - Functional Reach, 4 Square Step Test, Romberg, Unipedal Stance
- Endurance
 - 6 minute walk test
 - 5 time sit to stand
 - 30s sit to stand

28

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Participation and Function

- Patient questionnaires
 - Dizziness Handicap Inventory
 - Activities-Specific Balance Confidence Scale
 - Vestibular Rehabilitation Benefit Questionnaire (VRBQ)
 - Vertigo Handicap Questionnaire (VHQ)
 - Vestibular Disorders Activities of Daily Living Scale (VADL)
 - UCLA Dizziness Questionnaire (UCLADQ)
 - Vestibular Activities and Participation (VAP)
 - Disability Rating Scale (DRS)
 - Vertigo Symptom Scale (VSS)

29

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Vestibular Rehab Treatment

30

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Vestibular Rehabilitation: Treatment Program

Areas of Treatment:

- 1. Gaze stabilization**
- 2. Habituation**
- 3. Gait and balance**
- 4. Walking for endurance**

Progress by challenging:

- Vision
- Vestibular
- Somatosensory

31

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Gaze Stabilization

- Goal: promote vestibular adaptation and improve function of VOR
 - Vestibular adaptation – long-term changes in neuronal response to head movements to reduce symptoms, normalize VOR and postural stability
- Requires visual target and head movement
- Retinal slip: process of losing visual focus on the target during head movement

(Hall et al., 2016)

32

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Gaze Stabilization

- Place target at eye level
- Sit or stand beginning about 5 feet away from target
- Keep eyes on target while turning head 30 deg to each side
- Horizontal and vertical planes

- Perform duration as tolerated, dosing based on CPG
 - Clinical Practice Guideline for gaze: 3x/day
 - Acute or Subacute: total 12 minutes daily
 - Chronic: total 20 minutes daily

33

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Gaze Stabilization Treatment Progression

- Vestibular: Increase speed of movement
 - Daily vestibular function: 2 Hz (120bpm on metronome)

- Vision: Add busy visual background to minimize visual dependence

- Somatosensory:
 - Wide → narrow base of support
 - Firm → compliant surfaces

34

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35

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Habituation

- Goal: reduce behavioral response to repeated exposure to a provocative stimulus
- Habituation requires provocation of symptoms
 - Significant and ongoing patient education for compliance
- Repetition of movements or activities that cause mild-moderate symptoms promotes synaptic level neuroplasticity
- Recent approaches involve optokinetic stimuli or virtual reality

36

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Treatment Progression: Habituation

- Vision: add busy visual background
 - Patterned table cloth, wrapping paper, mirrors
 - Optokinetics – YouTube
 - Virtual Reality
- Vestibular: Increase speed of movement
- Somatosensory: change surface or base of support
 - Foam, pillow, towel roll, Bosu, dynadisc

37

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38

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Balance and Gait Training

- Goal: improve static and dynamic balance to decrease risk of falls and injury, promote return to activity
 - **Static balance**
 - **Dynamic balance**
 - Vary surface, base of support
 - Add dynamic movements of head, arms, perturbations
 - Walking with head turns
 - Vary visual input – busy background, holding mirror, special glasses with stripes, sunglasses

39

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Endurance

- Goal: improve endurance to address sedentary lifestyle that occurs secondary to dizziness and imbalance
- Address through walking or aerobic exercise
- General conditioning exercise such as stationary bicycle alone has not been found to be beneficial for patients with vestibular hypofunction

(Hall et al., 2016)

40

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Central Treatment

- Address deficits in gaze, habituation, balance/gait, endurance
- Oculomotor
 - Smooth pursuit – ball on string, eyecanlearn.com
 - Saccades – sticky note targets, apps
 - Convergence – Brock string, pencil push ups, letters on ball throw/catch
- Coordination

41

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Central Treatment

- Perception of Vertical: Posture, wall reference
- Weight shifting –forward, back, lateral, crossing midline
 - 4 square, imaginary clock
- Additional sensory stimuli & dual tasking
 - Auditory, cardiovascular
 - Dual Tasking: Additional cognitive or physical challenges

42

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Cervicogenic Dizziness Treatment

- Address deficits in gaze, habituation, balance/gait, endurance
- Manual therapy: joint mobility, soft tissue, cervical traction
- Therapeutic exercise
 - Deep cervical strengthening, cervical isometrics, stretching
 - Postural awareness and strengthening

43

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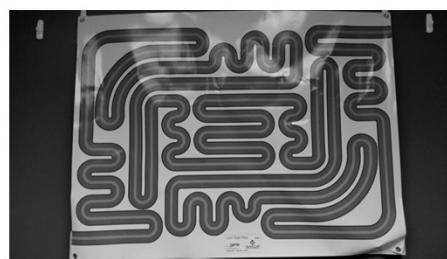
Cervicogenic Dizziness Treatment

- Cervical kinesthesia training: improve cervical proprioception
 - Laser or head lamp with targets
 - Move from one target to the neck with eyes open (for learning)
 - Close eyes move to target, open eyes for visual feedback, correct position, return to first position, repeat with eyes closed
 - Challenge by adding compliant surface, additional targets in multiple locations

44

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Head laser and posters: optp.com

45

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Vestibular Rehabilitation

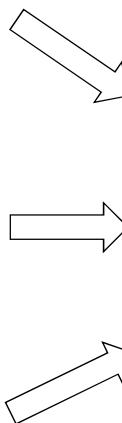
- Gaze
- Habituation
- Balance and Gait
- Endurance

Central Additions

- Oculomotor
- Coordination
- Perception of Vertical
- Additional Sensory Stimuli
- Dual Tasking (cognitive)

Cervicogenic Additions

- Manual Therapy
- Exercise
- Posture
- Cervical Kinesthesia



Progression

- Vision challenges
(busy/moving visual background)
- Vestibular challenges
(head movement)
- Somatosensory Challenges
(BOS, surface)

46

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Case Study 1

- 65 y/o male presents with acute onset of labyrinthitis (1.5 weeks ago) with symptoms of dizziness, imbalance and vision "problems". He is retired, but active. He walks 5 miles per day, golfs 4 days/week and keeps up his yard and house. For the past week and a half he has been doing what he can around the house, but feels unsafe driving, off balance in the yard and unable to do yard work and cannot golf. He reports the room was spinning initially, now he feels more off balance and has difficulty focusing while reading.
- Activities-Specific Balance Confidence Scale: 67% (moderate)
- Dizziness Handicap Inventory: 82 (severe)
- Motion Sensitivity Quotient: 73.4 (severe motion sensitivity)
- Dynamic Gait Index: 17/24 (increased risk of falls <21/24)
- Dynamic Visual Acuity: 4 line change (<2 line change is WNL)

47

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- 65 y/o male presents with acute onset of labyrinthitis (1.5 weeks ago) with symptoms of dizziness, imbalance and vision "problems". He is retired, but active. He walks 5 miles per day, golfs 4 days/week and keeps up his yard and house. For the past week and a half he has been doing what he can around the house, but feels unsafe driving, off balance in the yard and unable to do yard work and cannot golf. He reports the room was spinning initially, now he feels more off balance and has difficulty focusing while reading.
- Diagnosis:
- Treatment Approach:
- Treatment Progression:
- Prognosis:

48

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Case Study 2

- Patient is a 54 y/o female who fell while hiking, hit her head and sustained a concussion 6 months ago. She was treated in physical therapy initially, but reached a plateau and was discharged. She returns today with increased symptoms as she has returned to work. Symptoms include headache, dizziness, imbalance, vision challenges while working on the computer, and sensitivity to light, sound and moving visual environment.
- She has c/o neck pain rated 2-6/10 and constant headaches rated 4-7/10.
- Deficits noted in smooth pursuit and saccades, convergence 24 cm (<6cm WNL)

- Activities-Specific Balance Confidence Scale: 55% (moderate)
- Dizziness Handicap Inventory: 36 (moderate)
- Dynamic Visual Acuity: 5 line change (<2 WNL)
- Motion Sensitivity Quotient: 29 (moderate)
- Dynamic Gait Index: 18/24 assessed (increased fall risk)
- mCTSIB: abnormal for conditions 2-4 (firm EC, foam EO, foam EC)

49

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- Patient is a 54 y/o female who fell while hiking, hit her head and sustained a concussion 6 months ago. She was treated in physical therapy initially, but reached a plateau and was discharged. She returns today with increased symptoms as she has returned to work. Symptoms include headache, dizziness, imbalance, vision challenges while working on the computer, and sensitivity to light, sound and moving visual environment.
- She has c/o neck pain rated 2-6/10 and constant headaches rated 4-7/10.
- Deficits noted in smooth pursuit and saccades, convergence 24 cm (<6cm WNL)

- Diagnosis:
- Treatment Approach:
- Treatment Progression:
- Prognosis:

50

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Case Study 3

24 y/o female PT student presenting with neck pain and dizziness. Dizziness is described primarily as lightheadedness and imbalance, though she has not fallen. She states the dizziness is worse with studying and activity. PMH: unremarkable

- Activities-Specific Balance Confidence Scale: 67% confidence in balance (moderate)
- Dizziness Handicap Inventory: 18 (mild)
- Motion Sensitivity Quotient: 22 (moderate)
- Dynamic Gait Index: 17/24
- Dynamic Visual Acuity: 1 line change (WNL)
- Cervical ROM: decreased rotation bilaterally, pain at end range left rotation
- Pain 2/10 at rest, 8/10 with activity and prolonged positioning, with headaches toward the end of the day

51

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- 24 y/o female PT student presenting with neck pain and dizziness. Dizziness is described primarily as lightheadedness and imbalance, though she has not fallen. She states the dizziness is worse with studying and activity. PMH: unremarkable
- Diagnosis:
- Treatment Approach:
- Treatment Progression:
- Prognosis:

52

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Questions?

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53

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54

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