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# Vestibular Rehab Therapy for Stroke

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# Financial Relationship Disclosure(s)

**Lauren Hall, MD**

- Nothing to disclose

# Vestibular Rehabilitation in Stroke Recovery

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PM&R and Spinal Cord Injury Medicine
Stroke Conference, September 2025

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# Financial Disclosures

- No financial disclosures

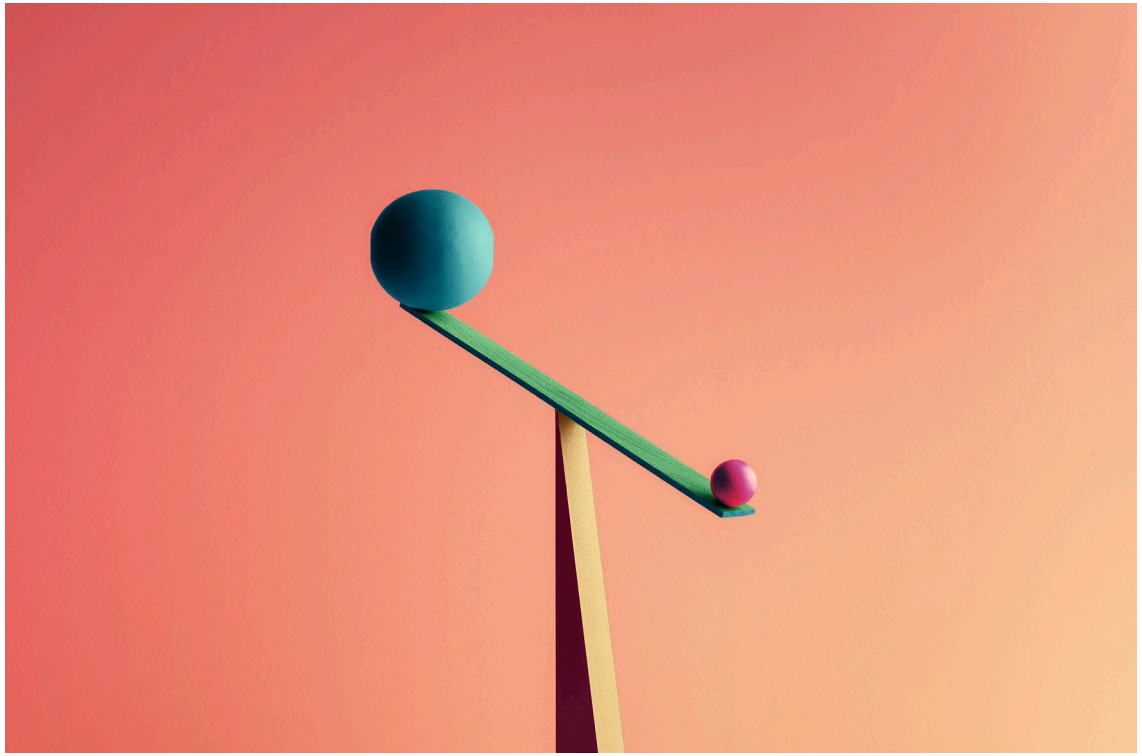
# Objectives

- Review the anatomy and physiology of the vestibular system
- Review the clinical signs and symptoms of vestibular dysfunction
- Review the incidence and clinical signs/symptoms of vestibular dysfunction post-stroke
- Understand the general principles of vestibular rehabilitation therapy (VRT)
- Review the current evidence and guidelines supporting VRT use post-stroke
- Explore the mechanisms, protocols, and outcomes of VRT in subacute and chronic stroke populations

# Anatomy and Physiology of the Vestibular System

# Vestibular System

- Maintains balance, gaze stability, and spatial orientation
- Input from peripheral vestibular organs, visual and somatosensory feedback
- Output to postural control, eye movements, and perception of movement

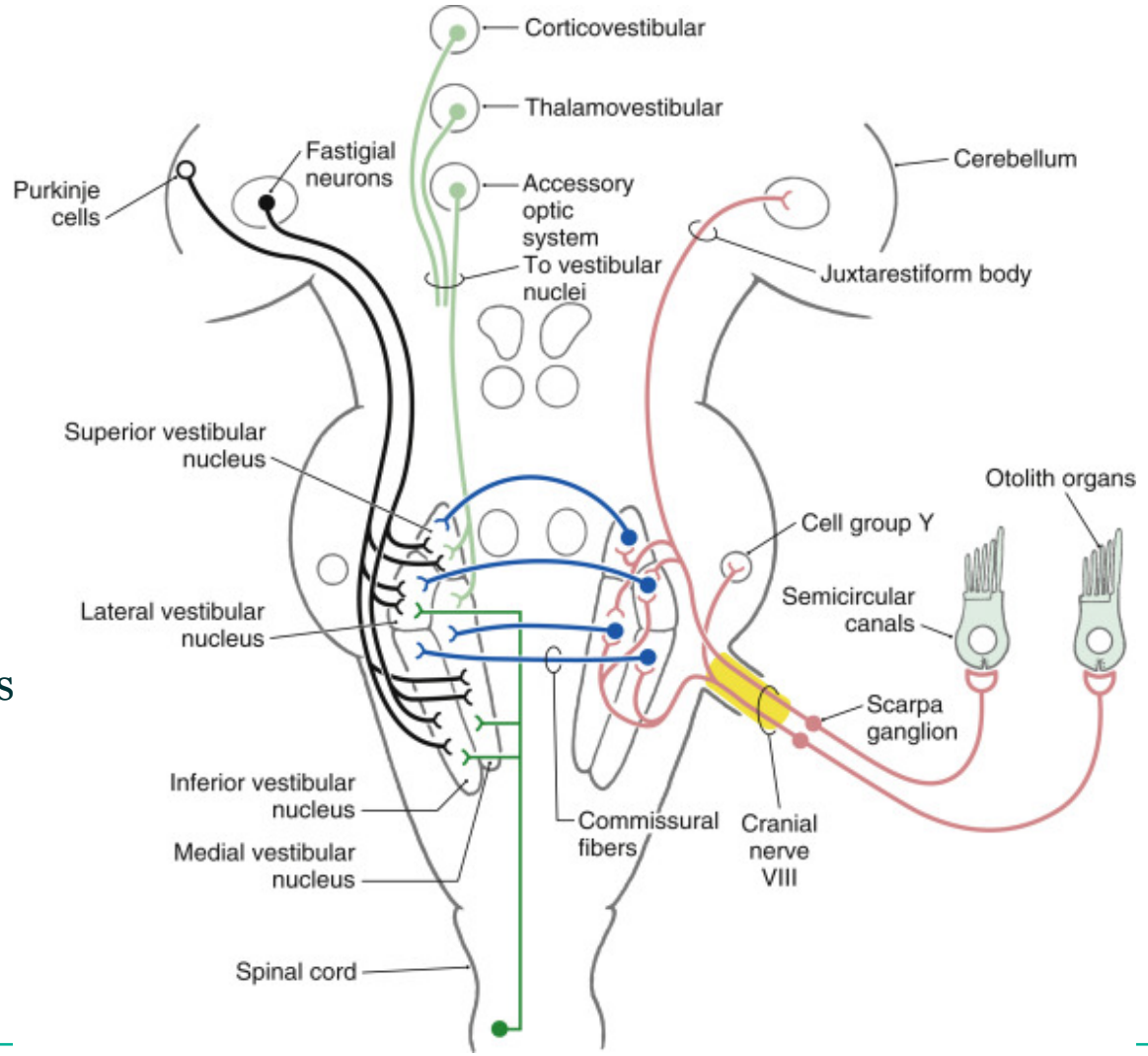


# Sensory Inputs to the Vestibular System

# Anatomy of the Vestibular System

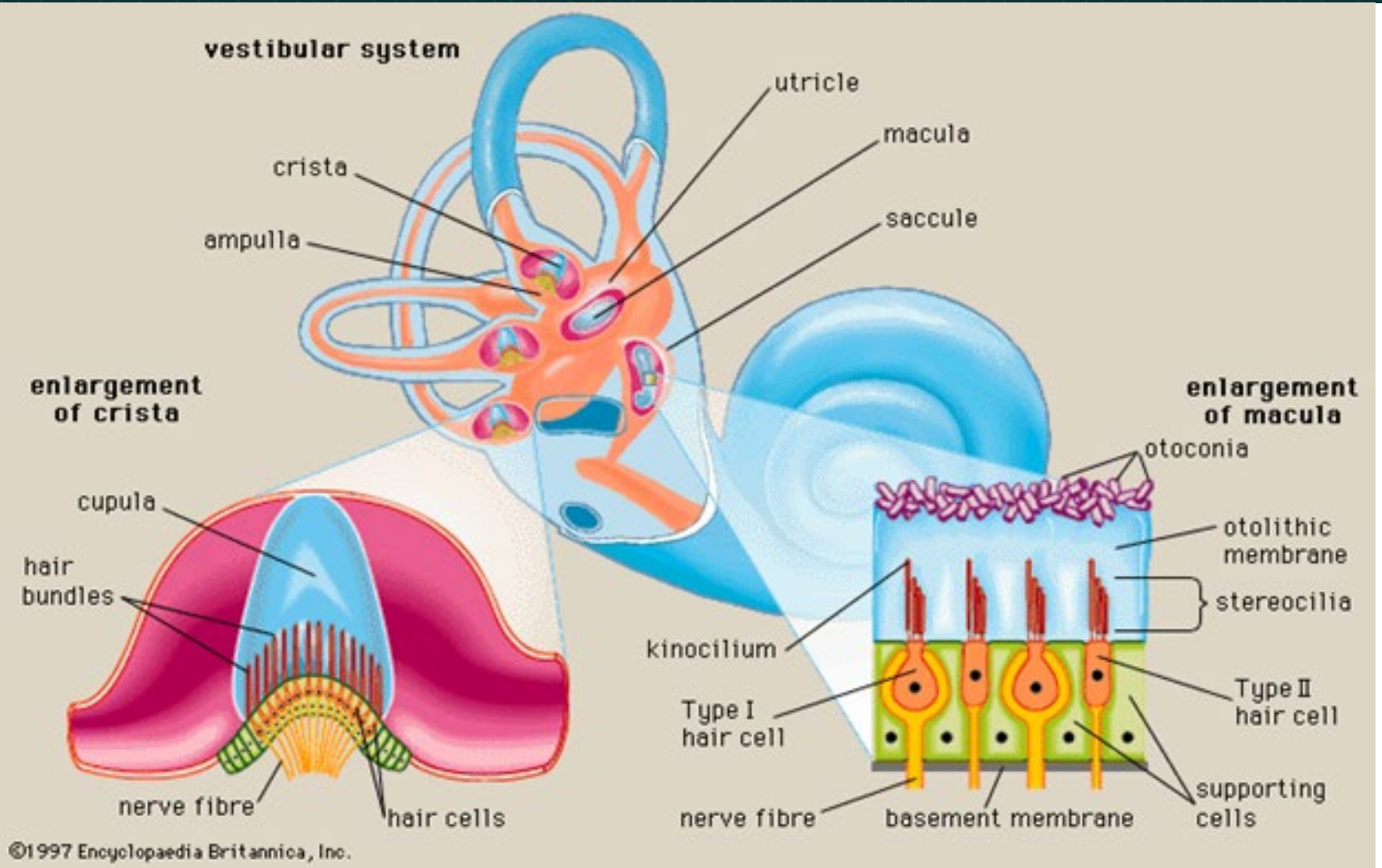
Central Vestibular System

- Brainstem vestibular nuclei
- Cortical and Cerebellar tracts



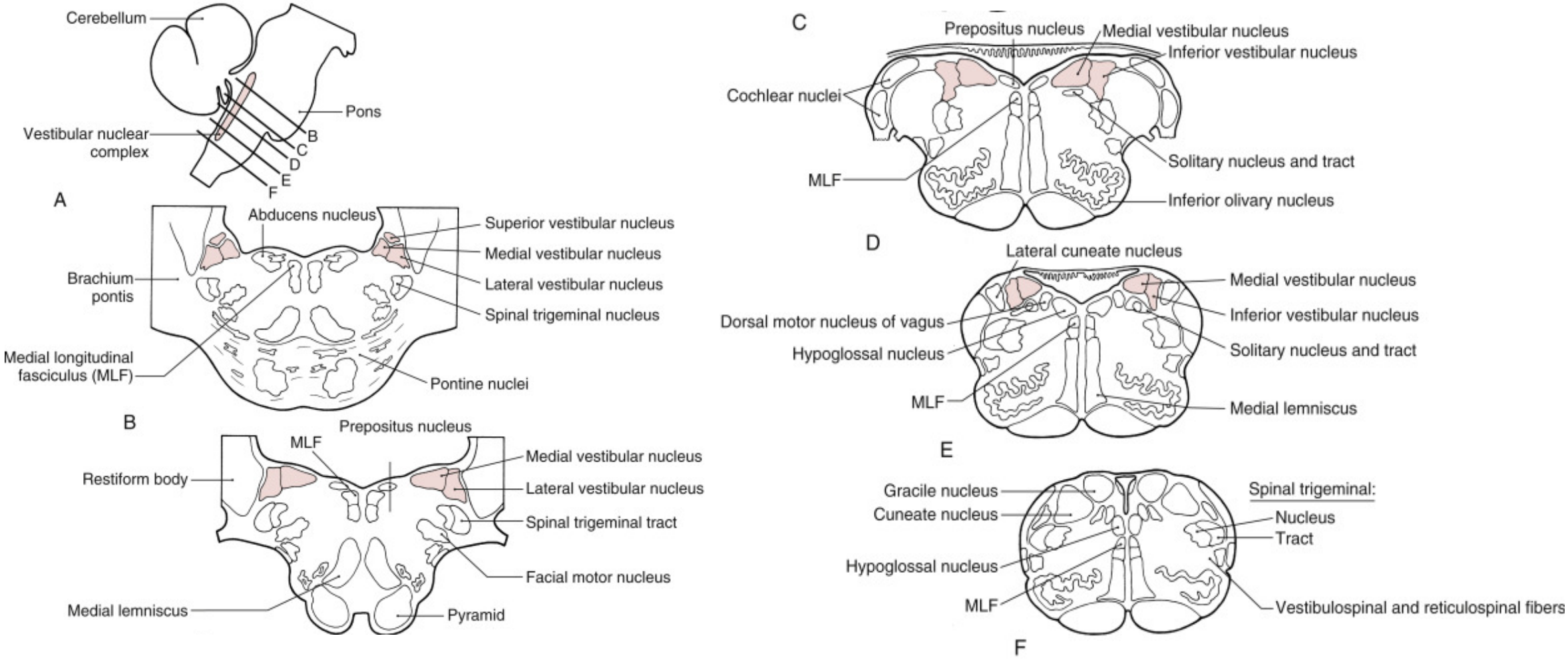

Peripheral Vestibular System

# Peripheral Vestibular System

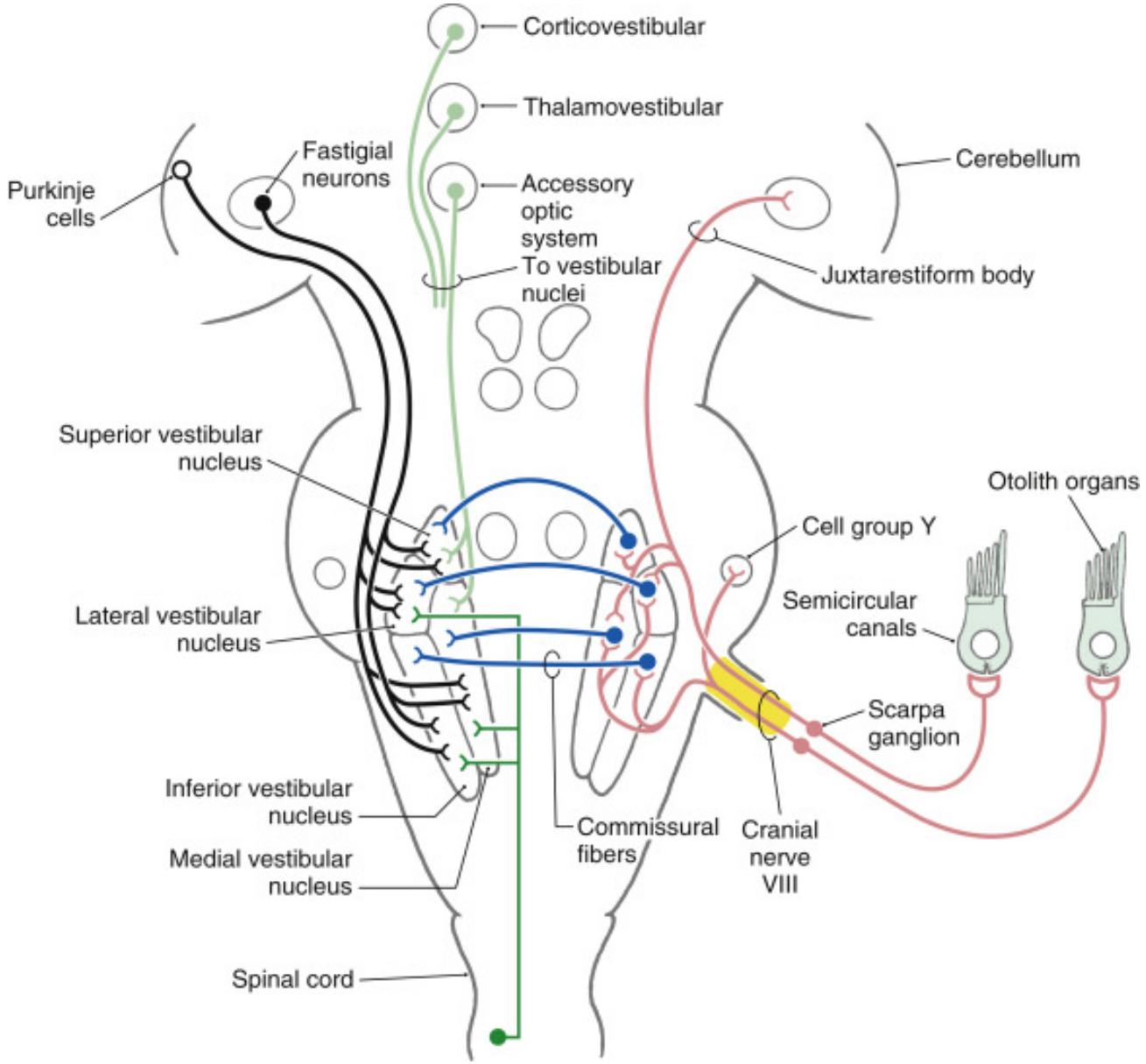



https://soents.com/what-is-the-vestibular-system/

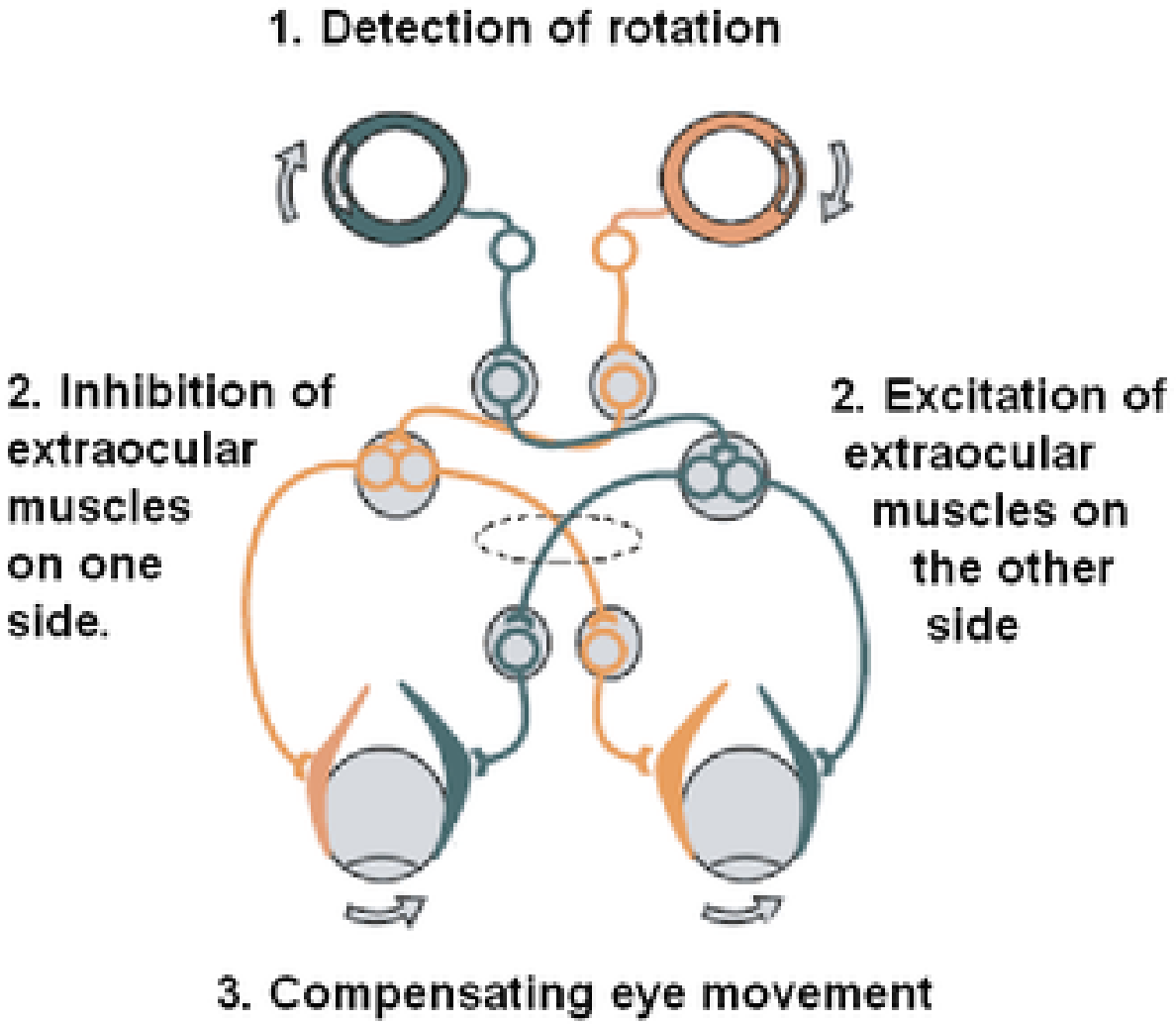
# Central Vestibular System—Brainstem Nuclei



# Central Vestibular System—Brainstem Nuclei



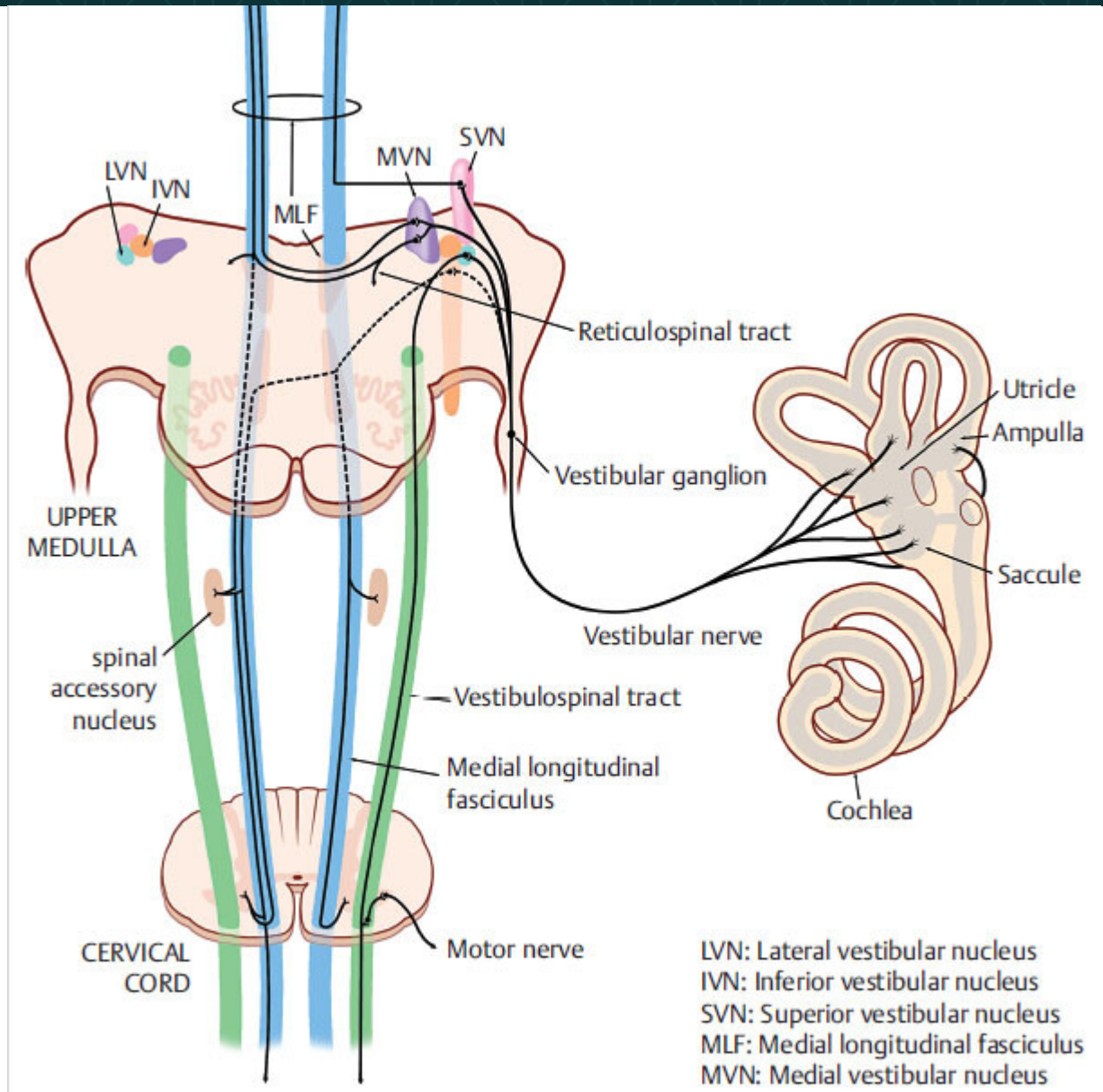
# Central Vestibular System—VOR




https://en.wikipedia.org/wiki/Vestibulo-ocular_reflex

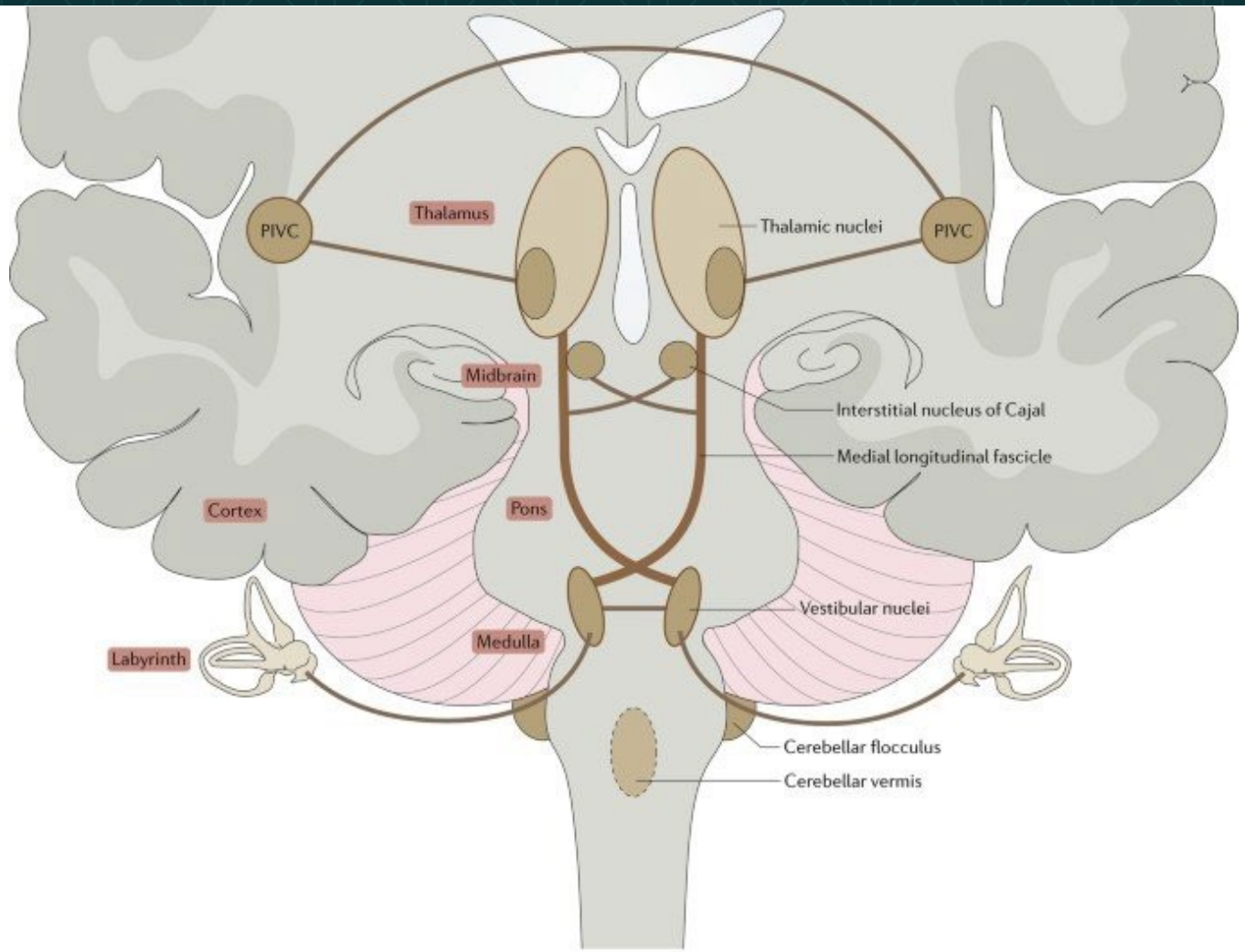
# Central Vestibular System

- Vestibulospinal Tract adjusts posture
- Cerebellum fine-tunes motor responses



# Cortical and High-Level Processing of the Vestibular System

- Parieto-insular vestibular cortex (PIVC)
- Temporo-parietal junction, hippocampus, somatosensory cortex involvement
- Multisensory integration for spatial awareness, navigation, and motion perception




Nature Reviews | Neurology

# Disorders of the Vestibular System

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# Disorders of the Vestibular System

- About 35% of individuals over 40 years old in the US have had a vestibular disorder (69 million Americans)
- 3% of all ED visits have a chief complaint of dizziness or lightheadedness
- Peripheral vestibular disorders account for about 50% of these disorders (BPPV being the most common)

# Differentiating Central and Peripheral Vestibular Disorders

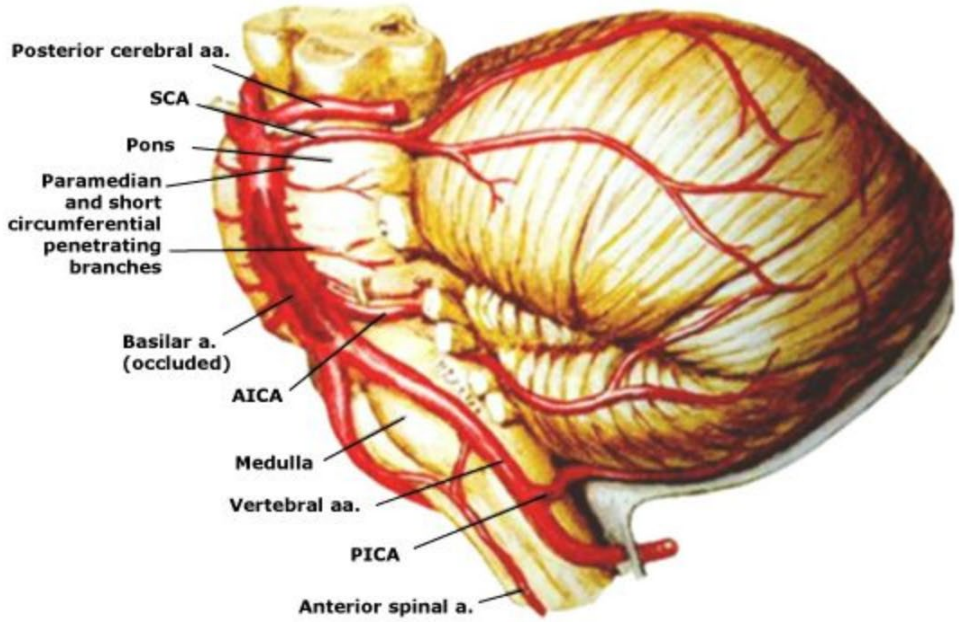
| | Peripheral Vertigo | Central Vertigo |
|---|---|---|
| **Head Impulse Test** | Abnormal; corrective saccade to midline with rotation of head | Normal; no corrective saccade |
| **Nystagmus** | Unidirectional; horizontal | Horizontal & direction-changing; vertical; torsional |
| **Test of Skew** | No skew deviation | Skew deviation present |

https://www.maimonidesem.org/blog/hints-exam

# Vestibular System in Stroke

- Strokes may impact vestibular nuclei, brainstem pathways, cerebellar processing, and cortical integration
  - Most significant being posterior circulation strokes

- Presenting symptoms can include dizziness, lightheadedness, poor balance, falls, spatial disorientation




The intracranial vertebral and basilar arteries are depicted with their major cerebellar arterial branches, including PICA (posterior inferior and cerebellar artery), AICA (anterior inferior cerebellar artery), and SCA (superior cerebellar artery).

*Reproduced with permission from Caplan, LR. Posterior circulation disease. Clinical findings, diagnosis, and management. Blackwell Science, Boston 1996. Copyright ©1996 Blackwell Science.*

# Incidence of Vestibular Impairments in Stroke

- In one study, those that presented with acute vestibular syndromes ,  25% were attributed to stroke
- In all those with chief complaint of dizziness (acute, chronic, and episodic), 10% were stroke

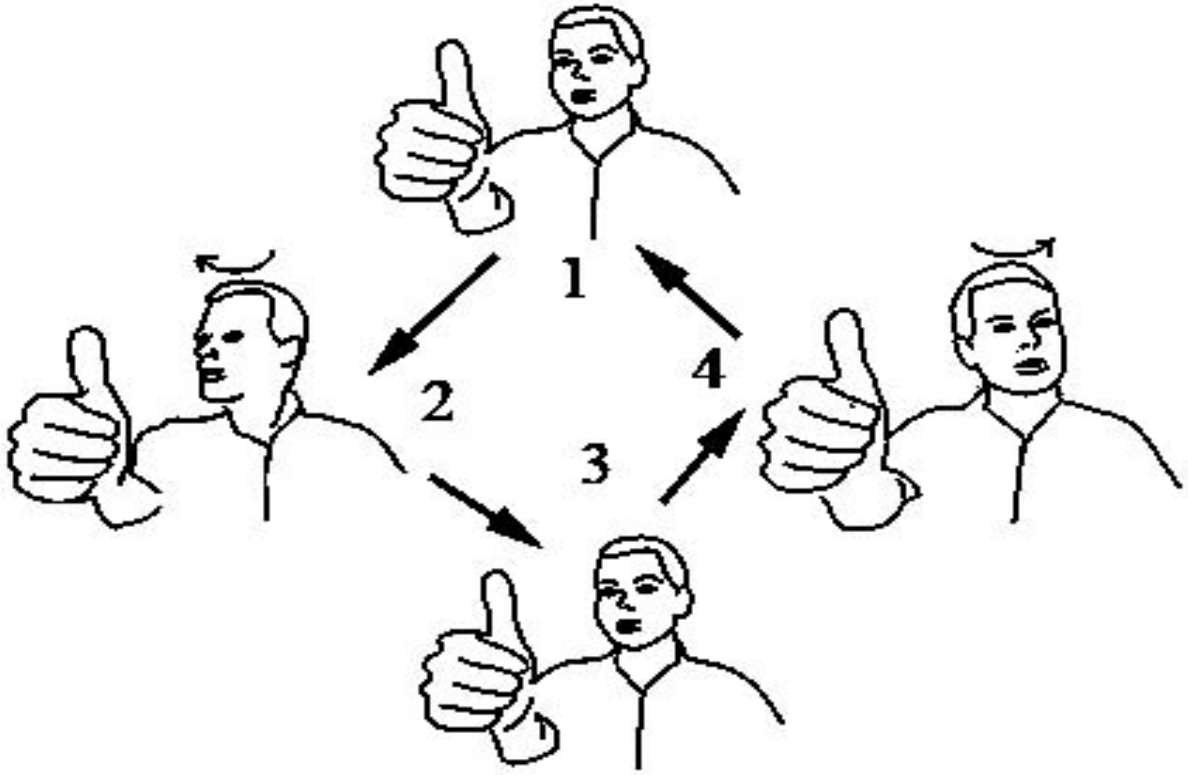
# Principles of Vestibular Rehabilitation

# Vestibular Rehabilitation Therapy


- Individualized rehabilitation program addressing
  - Gait stability
  - Balance
  - Visual gaze
  - Postural stability
- Targets disorders of the peripheral and central vestibular system
  - More traditionally used in mild to severe traumatic brain injury

# Gaze Stabilization Therapy Techniques

## Vestibular Ocular Reflex (Single Target)



# Gaze Stabilization Therapy Techniques

## Vestibular Ocular Reflex (Two Target)

# Vestibular Rehabilitation Therapy Techniques

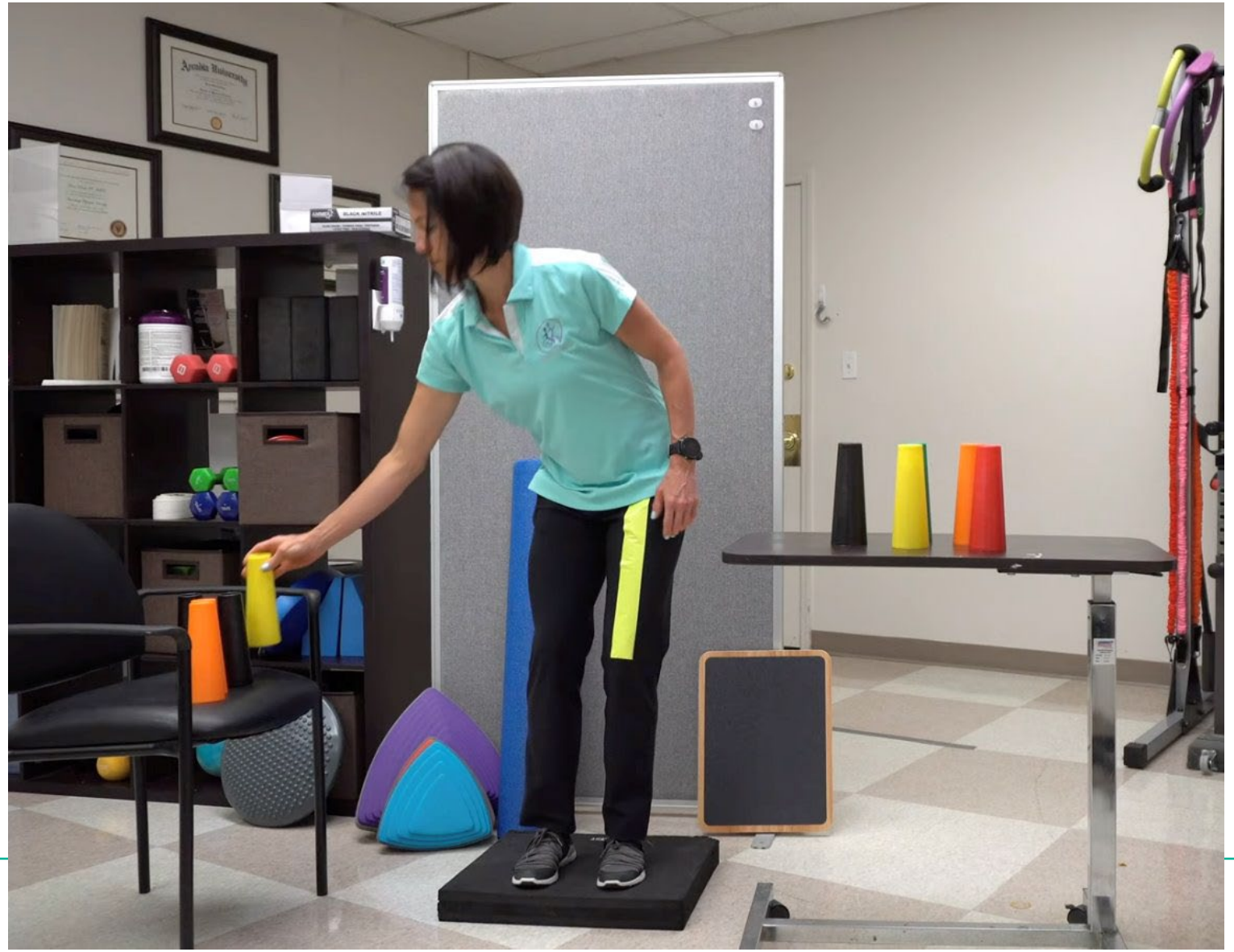
- Balance Retraining

# Vestibular Rehabilitation Therapy Techniques

- Sensory re-weighting
  - Exercises with little to no light/blindfolded
  - Training on uneven surfaces
  - Music therapy/metronome

# Vestibular Rehabilitation Therapy Techniques

- Dual-task training



# Vestibular Rehabilitation Therapy Techniques

- Gait training with obstacle navigation

# Vestibular Rehabilitation in Stroke

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# Functional Deficits targeted by VRT in Stroke

- Vestibular therapy has been shown to have positive effects on multiple different stroke symptoms including
  - Impaired balance
  - Gait dysfunction
  - Fatigue

# Vestibular Therapy in Stroke

- Systematic Review in 2023 reviewed the effects of vestibular rehabilitation therapy (VRT) vs usual rehabilitation (UR) on both gait and balance after stroke
- 15 RCTs were included which individuals with stroke were evaluated and treated with varying VRT programs
- Assessed gait function and balance via pooled data sets of over 700 participants

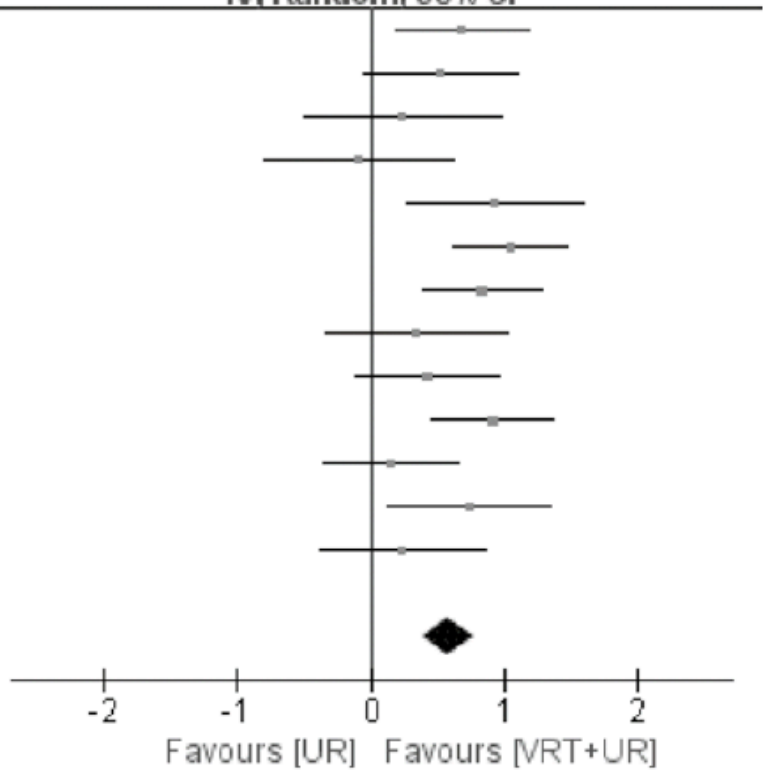
# VRT and Improvement in Balance

(A) Overall effect on balance scales

| Study or Subgroup | VRT+UR Mean | VRT+UR SD | VRT+UR Total | UR Mean | UR SD | UR Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Correia 2021 | 7 | 3.85 | 33 | 4.25 | 4.04 | 35 | 9.1% | 0.69 [0.20, 1.18] |
| Dai 2013 | 8.66 | 9.05 | 24 | 4.04 | 8.35 | 24 | 7.4% | 0.52 [-0.05, 1.10] |
| Guo 2022 | 5.64 | 4.01 | 14 | 4.07 | 7.87 | 14 | 5.1% | 0.24 [-0.50, 0.99] |
| Hansson 2020 | -1.75 | 10.37 | 19 | -0.75 | 11.04 | 13 | 5.5% | -0.09 [-0.80, 0.61] |
| Huang 2019 | 7.5 | 2.38 | 20 | 5.4 | 2.03 | 20 | 6.2% | 0.93 [0.27, 1.59] |
| Jiang 2012 | 5.32 | 3.17 | 48 | 2.02 | 3.05 | 48 | 10.6% | 1.05 [0.62, 1.48] |
| Li 2022 | 8.2 | 4.56 | 42 | 4.6 | 3.86 | 42 | 10.1% | 0.84 [0.40, 1.29] |
| Wang YM 2022 | 7.35 | 10.89 | 17 | 1.92 | 19.15 | 17 | 5.9% | 0.34 [-0.34, 1.02] |
| Wang YQ 2022 | 4.26 | 2.36 | 27 | 3.22 | 2.36 | 27 | 8.1% | 0.43 [-0.11, 0.97] |
| Xie 2017 | 16.39 | 8.55 | 40 | 8.27 | 8.98 | 40 | 9.8% | 0.92 [0.46, 1.38] |
| Yang 2021 | 13.2 | 5.95 | 30 | 12.1 | 7.72 | 30 | 8.7% | 0.16 [-0.35, 0.66] |
| Yao 2021 | 13.9 | 4.17 | 24 | 10.8 | 4.01 | 20 | 6.8% | 0.74 [0.13, 1.36] |
| Zhao 2022 | 5.7 | 5.26 | 20 | 4.1 | 7.45 | 20 | 6.7% | 0.24 [-0.38, 0.87] |
| **Total (95% CI)** | | | **358** | | | **350** | **100.0%** | **0.59 [0.40, 0.78]** |

Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 18.27$, df = 12 (P = 0.11); $I^2 = 34\%$

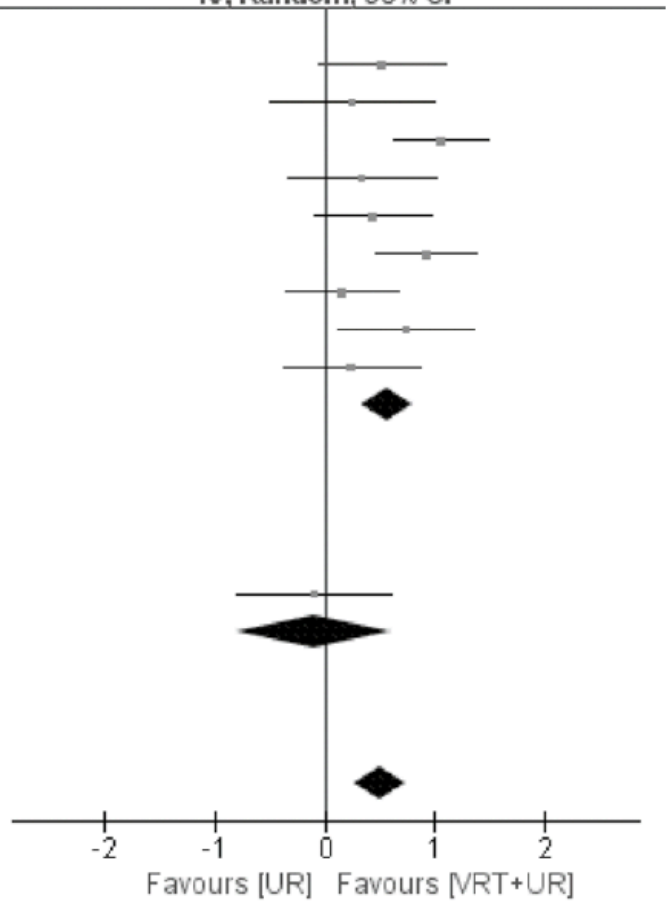
Test for overall effect: Z = 6.05 (P < 0.00001)



# VRT and Improvement in Balance

(C) Patients with various stroke duration

| Study or Subgroup | VRT+UR Mean | SD | Total | UR Mean | SD | Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| **1.3.1 Within 6 months** | | | | | | | | |
| Dai 2013 | 8.66 | 9.05 | 24 | 4.04 | 8.35 | 24 | 10.0% | 0.52 [-0.05, 1.10] |
| Guo 2022 | 5.64 | 4.01 | 14 | 4.07 | 7.87 | 14 | 7.2% | 0.24 [-0.50, 0.99] |
| Jiang 2012 | 5.32 | 3.17 | 48 | 2.02 | 3.05 | 48 | 13.5% | 1.05 [0.62, 1.48] |
| Wang YM 2022 | 7.35 | 10.89 | 17 | 1.92 | 19.15 | 17 | 8.2% | 0.34 [-0.34, 1.02] |
| Wang YQ 2022 | 4.26 | 2.36 | 27 | 3.22 | 2.36 | 27 | 10.8% | 0.43 [-0.11, 0.97] |
| Xie 2017 | 16.39 | 8.55 | 40 | 8.27 | 8.98 | 40 | 12.6% | 0.92 [0.46, 1.38] |
| Yang 2021 | 13.2 | 5.95 | 30 | 12.1 | 7.72 | 30 | 11.5% | 0.16 [-0.35, 0.66] |
| Yao 2021 | 13.9 | 4.17 | 24 | 10.8 | 4.01 | 20 | 9.3% | 0.74 [0.13, 1.36] |
| Zhao 2022 | 5.7 | 5.26 | 20 | 4.1 | 7.45 | 20 | 9.1% | 0.24 [-0.38, 0.87] |
| **Subtotal (95% CI)** | | | **244** | | | **240** | **92.2%** | **0.56 [0.33, 0.79]** |
| Heterogeneity: Tau² = 0.04; Chi² = 12.36, df = 8 (P = 0.14); I² = 35% | | | | | | | | |
| Test for overall effect: Z = 4.74 (P < 0.00001) | | | | | | | | |
| **1.3.2 Beyond 6 months** | | | | | | | | |
| Hansson 2020 | -1.75 | 10.37 | 19 | -0.75 | 11.04 | 13 | 7.8% | -0.09 [-0.80, 0.61] |
| **Subtotal (95% CI)** | | | **19** | | | **13** | **7.8%** | **-0.09 [-0.80, 0.61]** |
| Heterogeneity: Not applicable | | | | | | | | |
| Test for overall effect: Z = 0.25 (P = 0.80) | | | | | | | | |
| **Total (95% CI)** | | | **263** | | | **253** | **100.0%** | **0.50 [0.27, 0.74]** |
| Heterogeneity: Tau² = 0.06; Chi² = 15.71, df = 9 (P = 0.07); I² = 43% | | | | | | | | |
| Test for overall effect: Z = 4.14 (P < 0.0001) | | | | | | | | |
| Test for subgroup differences: Chi² = 2.96, df = 1 (P = 0.09), I² = 66.3% | | | | | | | | |



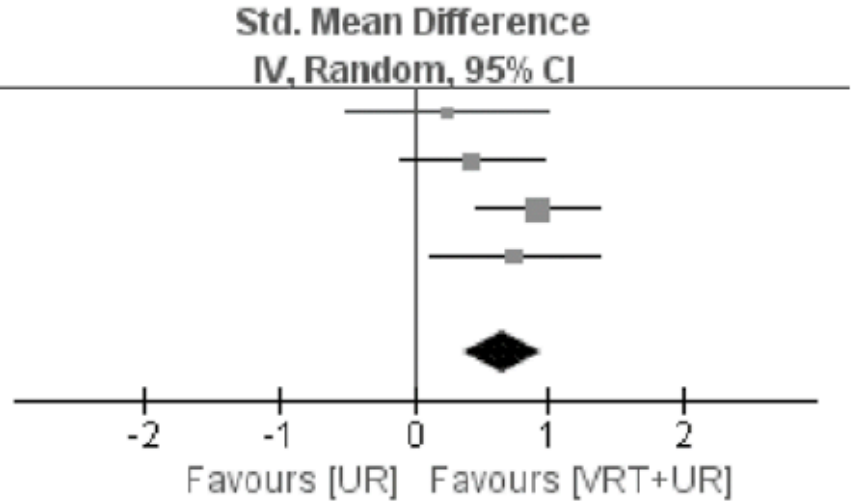
# VRT and Improvement in Balance

(D) Patients with stroke occurred within 3 months

| Study or Subgroup | VRT+UR Mean | VRT+UR SD | VRT+UR Total | UR Mean | UR SD | UR Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Guo 2022 | 5.64 | 4.01 | 14 | 4.07 | 7.87 | 14 | 14.7% | 0.24 [-0.50, 0.99] |
| Wang YQ 2022 | 4.26 | 2.36 | 27 | 3.22 | 2.36 | 27 | 27.3% | 0.43 [-0.11, 0.97] |
| Xie 2017 | 16.39 | 8.55 | 40 | 8.27 | 8.98 | 40 | 36.7% | 0.92 [0.46, 1.38] |
| Yao 2021 | 13.9 | 4.17 | 24 | 10.8 | 4.01 | 20 | 21.3% | 0.74 [0.13, 1.36] |
| **Total (95% CI)** | | | **105** | | | **101** | **100.0%** | **0.65 [0.36, 0.94]** |

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.13$, $df = 3$ ($P = 0.37$); $I^2 = 4\%$

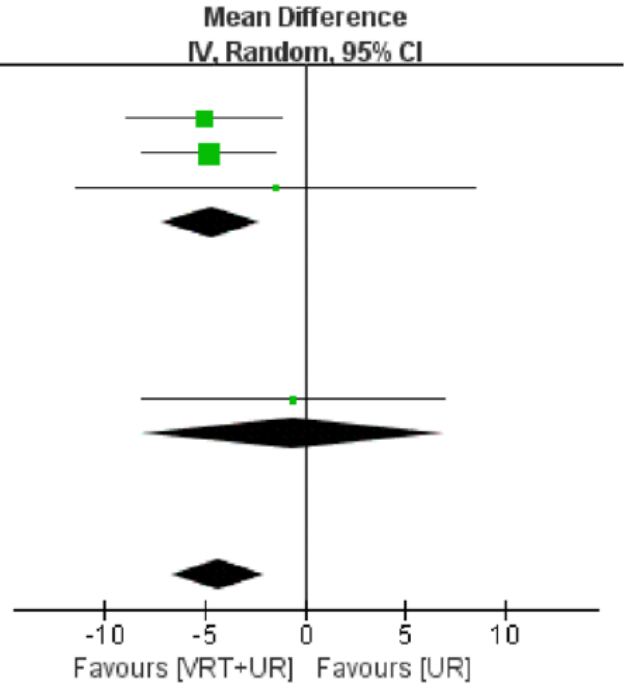
Test for overall effect: $Z = 4.40$ ($P < 0.0001$)



# VRT and Improvement in Gait

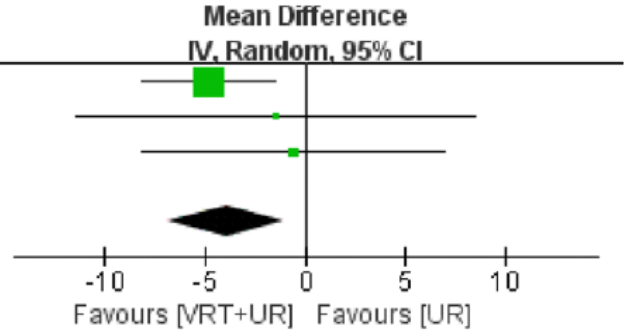
(A) Various intervention duration of VRT on TUG

| Study or Subgroup | VRT+UR Mean | SD | Total | UR Mean | SD | Total | Weight | Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| **2.1.1 Less than 4 weeks** | | | | | | | | |
| Correia 2021 | -7.65 | 8.58 | 33 | -2.62 | 7.7 | 35 | 36.1% | -5.03 [-8.91, -1.15] |
| Guo 2022 | -8.82 | 4.12 | 14 | -3.99 | 4.84 | 14 | 49.0% | -4.83 [-8.16, -1.50] |
| Mitsutake 2017 | -7.53 | 12.51 | 14 | -6.05 | 14.34 | 14 | 5.5% | -1.48 [-11.45, 8.49] |
| **Subtotal (95% CI)** | | | **61** | | | **63** | **90.6%** | **-4.71 [-7.16, -2.26]** |
| Heterogeneity: Tau² = 0.00; Chi² = 0.43, df = 2 (P = 0.80); I² = 0% | | | | | | | | |
| Test for overall effect: Z = 3.77 (P = 0.0002) | | | | | | | | |
| **2.1.2 4 weeks** | | | | | | | | |
| Zhao 2022 | -6.16 | 12.88 | 20 | -5.57 | 11.56 | 20 | 9.4% | -0.59 [-8.17, 6.99] |
| **Subtotal (95% CI)** | | | **20** | | | **20** | **9.4%** | **-0.59 [-8.17, 6.99]** |
| Heterogeneity: Not applicable | | | | | | | | |
| Test for overall effect: Z = 0.15 (P = 0.88) | | | | | | | | |
| **Total (95% CI)** | | | **81** | | | **83** | **100.0%** | **-4.32 [-6.65, -1.99]** |
| Heterogeneity: Tau² = 0.00; Chi² = 1.46, df = 3 (P = 0.69); I² = 0% | | | | | | | | |
| Test for overall effect: Z = 3.63 (P = 0.0003) | | | | | | | | |
| Test for subgroup differences: Chi² = 1.02, df = 1 (P = 0.31), I² = 2.4% | | | | | | | | |




(B) VRT on TUG in patients with stroke occurred within 6 months

| Study or Subgroup | VRT+UR Mean | SD | Total | UR Mean | SD | Total | Weight | Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Guo 2022 | -8.82 | 4.12 | 14 | -3.99 | 4.84 | 14 | 76.7% | -4.83 [-8.16, -1.50] |
| Mitsutake 2017 | -7.53 | 12.51 | 14 | -6.05 | 14.34 | 14 | 8.6% | -1.48 [-11.45, 8.49] |
| Zhao 2022 | -6.16 | 12.88 | 20 | -5.57 | 11.56 | 20 | 14.8% | -0.59 [-8.17, 6.99] |
| **Total (95% CI)** | | | **48** | | | **48** | **100.0%** | **-3.92 [-6.83, -1.00]** |
| Heterogeneity: Tau² = 0.00; Chi² = 1.26, df = 2 (P = 0.53); I² = 0% | | | | | | | | |
| Test for overall effect: Z = 2.63 (P = 0.008) | | | | | | | | |

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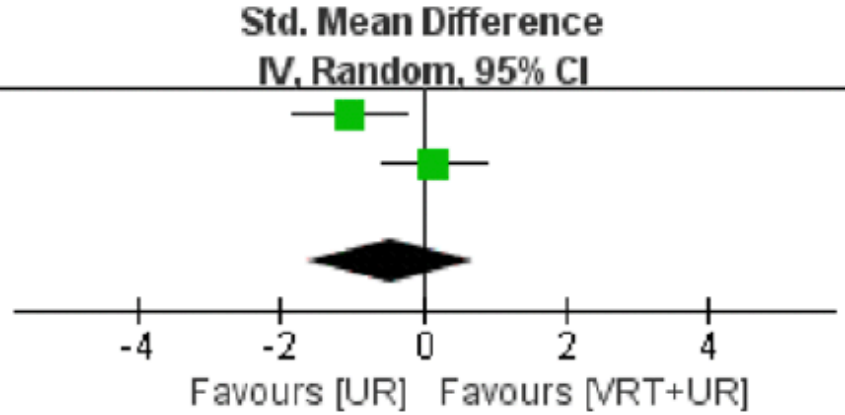
# VRT and Improvement in Gait

(F) 10MWT

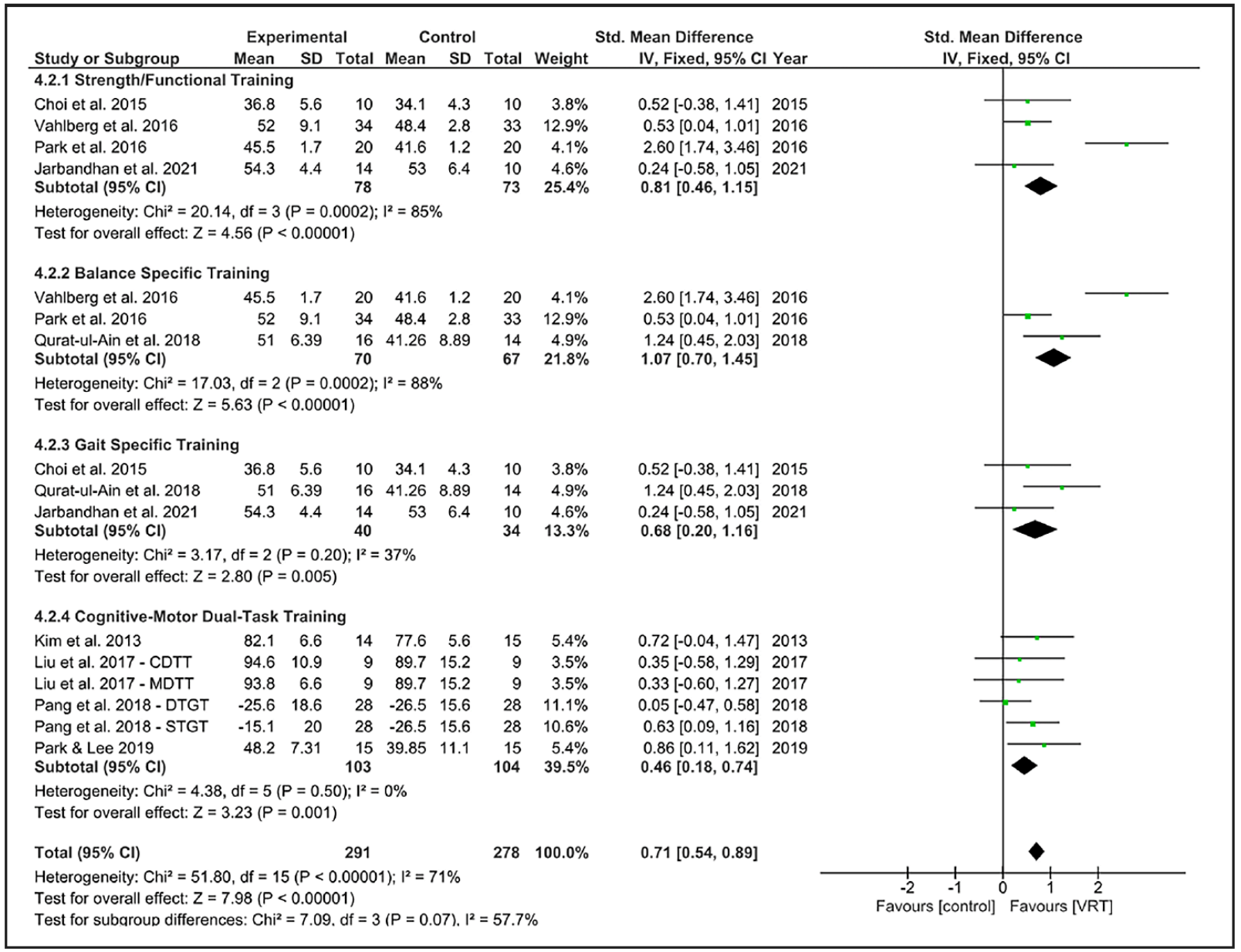
| Study or Subgroup | VRT+UR Mean | VRT+UR SD | VRT+UR Total | UR Mean | UR SD | UR Total | Weight | Std. Mean Difference IV, Random, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Guo 2022 | -9.68 | 6.33 | 14 | -3 | 6.04 | 14 | 49.2% | -1.05 [-1.85, -0.25] |
| Mitsutake 2017 | 0.34 | 0.57 | 14 | 0.26 | 0.45 | 14 | 50.8% | 0.15 [-0.59, 0.89] |
| **Total (95% CI)** | | | **28** | | | **28** | **100.0%** | **-0.44 [-1.61, 0.74]** |

Heterogeneity: Tau² = 0.56; Chi² = 4.66, df = 1 (P = 0.03); I² = 79%

Test for overall effect: Z = 0.73 (P = 0.46)



# Vestibular Therapy and Gait



| Study or Subgroup | Experimental Mean | SD | Total | Control Mean | SD | Total | Weight | Std. Mean Difference IV, Fixed, 95% CI | Year |
|---|---|---|---|---|---|---|---|---|---|
| **4.2.1 Strength/Functional Training** | | | | | | | | | |
| Choi et al. 2015 | 36.8 | 5.6 | 10 | 34.1 | 4.3 | 10 | 3.8% | 0.52 [-0.38, 1.41] | 2015 |
| Vahlberg et al. 2016 | 52 | 9.1 | 34 | 48.4 | 2.8 | 33 | 12.9% | 0.53 [0.04, 1.01] | 2016 |
| Park et al. 2016 | 45.5 | 1.7 | 20 | 41.6 | 1.2 | 20 | 4.1% | 2.60 [1.74, 3.46] | 2016 |
| Jarbandhan et al. 2021 | 54.3 | 4.4 | 14 | 53 | 6.4 | 10 | 4.6% | 0.24 [-0.58, 1.05] | 2021 |
| **Subtotal (95% CI)** | | | **78** | | | **73** | **25.4%** | **0.81 [0.46, 1.15]** | |
| Heterogeneity: Chi² = 20.14, df = 3 (P = 0.0002); I² = 85% | | | | | | | | | |
| Test for overall effect: Z = 4.56 (P < 0.00001) | | | | | | | | | |
| **4.2.2 Balance Specific Training** | | | | | | | | | |
| Vahlberg et al. 2016 | 45.5 | 1.7 | 20 | 41.6 | 1.2 | 20 | 4.1% | 2.60 [1.74, 3.46] | 2016 |
| Park et al. 2016 | 52 | 9.1 | 34 | 48.4 | 2.8 | 33 | 12.9% | 0.53 [0.04, 1.01] | 2016 |
| Qurat-ul-Ain et al. 2018 | 51 | 6.39 | 16 | 41.26 | 8.89 | 14 | 4.9% | 1.24 [0.45, 2.03] | 2018 |
| **Subtotal (95% CI)** | | | **70** | | | **67** | **21.8%** | **1.07 [0.70, 1.45]** | |
| Heterogeneity: Chi² = 17.03, df = 2 (P = 0.0002); I² = 88% | | | | | | | | | |
| Test for overall effect: Z = 5.63 (P < 0.00001) | | | | | | | | | |
| **4.2.3 Gait Specific Training** | | | | | | | | | |
| Choi et al. 2015 | 36.8 | 5.6 | 10 | 34.1 | 4.3 | 10 | 3.8% | 0.52 [-0.38, 1.41] | 2015 |
| Qurat-ul-Ain et al. 2018 | 51 | 6.39 | 16 | 41.26 | 8.89 | 14 | 4.9% | 1.24 [0.45, 2.03] | 2018 |
| Jarbandhan et al. 2021 | 54.3 | 4.4 | 14 | 53 | 6.4 | 10 | 4.6% | 0.24 [-0.58, 1.05] | 2021 |
| **Subtotal (95% CI)** | | | **40** | | | **34** | **13.3%** | **0.68 [0.20, 1.16]** | |
| Heterogeneity: Chi² = 3.17, df = 2 (P = 0.20); I² = 37% | | | | | | | | | |
| Test for overall effect: Z = 2.80 (P = 0.005) | | | | | | | | | |
| **4.2.4 Cognitive-Motor Dual-Task Training** | | | | | | | | | |
| Kim et al. 2013 | 82.1 | 6.6 | 14 | 77.6 | 5.6 | 15 | 5.4% | 0.72 [-0.04, 1.47] | 2013 |
| Liu et al. 2017 - CDTT | 94.6 | 10.9 | 9 | 89.7 | 15.2 | 9 | 3.5% | 0.35 [-0.58, 1.29] | 2017 |
| Liu et al. 2017 - MDTT | 93.8 | 6.6 | 9 | 89.7 | 15.2 | 9 | 3.5% | 0.33 [-0.60, 1.27] | 2017 |
| Pang et al. 2018 - DTGT | -25.6 | 18.6 | 28 | -26.5 | 15.6 | 28 | 11.1% | 0.05 [-0.47, 0.58] | 2018 |
| Pang et al. 2018 - STGT | -15.1 | 20 | 28 | -26.5 | 15.6 | 28 | 10.6% | 0.63 [0.09, 1.16] | 2018 |
| Park & Lee 2019 | 48.2 | 7.31 | 15 | 39.85 | 11.1 | 15 | 5.4% | 0.86 [0.11, 1.62] | 2019 |
| **Subtotal (95% CI)** | | | **103** | | | **104** | **39.5%** | **0.46 [0.18, 0.74]** | |
| Heterogeneity: Chi² = 4.38, df = 5 (P = 0.50); I² = 0% | | | | | | | | | |
| Test for overall effect: Z = 3.23 (P = 0.001) | | | | | | | | | |
| **Total (95% CI)** | | | **291** | | | **278** | **100.0%** | **0.71 [0.54, 0.89]** | |
| Heterogeneity: Chi² = 51.80, df = 15 (P < 0.00001); I² = 71% | | | | | | | | | |
| Test for overall effect: Z = 7.98 (P < 0.00001) | | | | | | | | | |
| Test for subgroup differences: Chi² = 7.09, df = 3 (P = 0.07), I² = 57.7% | | | | | | | | | |

# VRT and Fatigue after Stroke

Table 2: The within-group and between-group analyses of the Fatigue Impact Scale, Fatigue Assessment Scale, Beck Depression Inventory-II, Barthel Index, and Lawton ADL Scale in two groups, the experimental group (16 patients received vestibular rehabilitation interventions) and the control group (16 patients received conventional rehabilitation interventions).

| Variables | | Experimental group | | | Control group | | | Between groups after treatment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline mean (SD) | Outcome mean (SD) | Within group $p$ | Baseline mean (SD) | Outcome mean (SD) | Within group $p$ | Mean difference (SE) | $p$ value | Effect size |
| FIS | Physical | 25.0 (5.11) | 21.16 (6.11) | 0.000* | 28.11 (8.43) | 27.88 (8.50) | 0.042* | 6.72 (2.46) | 0.01*** | 0.38 |
| | Cognitive | 7.77 (2.23) | 6.88 (2.44) | 0.000* | 7.05 (2.97) | 7.05 (2.97) | 1* | 0.16 (0.90) | 0.85*** | — |
| | Social | 37.61 (8.81) | 33.72 (9.92) | 0.000* | 37.38 (9.03) | 37.38 (8.99) | 1.00* | 3.66 (3.15) | 0.25*** | — |
| | Total | 70.38 (13.87) | 61.77 (16.73) | 0.000* | 72.55 (19.84) | 72.27 (19.83) | 0.056* | 10.50 (6.11) | 0.95*** | — |
| FAS | | 28.38 (2.78) | 23.16 (3.32) | 0.000* | 29.88 (3.72) | 29.61 (3.77) | 0.096* | 6.44 (1.18) | 0.000*** | 1.34 |
| BDI-II | | 12.33 (6.56) | 9.05 (5.59) | 0.001* | 12.44 (4.78) | 12.33 (4.88) | 0.163* | 3.27 (1.75) | 0.070*** | — |
| BI | | 85.83 (8.61) | 87.77 (7.90) | 0.038** | 85.00 (8.57) | 85.27 (8.65) | 0.317** | -2.50 (2.76) | 0.37*** | — |
| Lawton ADL | | 6.50 (1.46) | 7.66 (1.53) | 0.005** | 6.94 (1.43) | 7.05 (1.39) | 0.157** | -0.61 (0.48) | 0.21*** | — |

Notes: data were presented as mean (standard deviation) and mean difference (Std. error difference). *Paired $t$-test. **Wilcoxon signed rank test. *** Independent $t$. Abbreviations: FIS = Fatigue Impact Scale; FAS = Fatigue Assessment Scale; BDI-II = Beck Depression Inventory-II; BI = Barthel Index; Lawton ADL = Instrumental Activities of Daily Living.

# Study Limitations on Vestibular Therapy in Stroke

- Poorly defined stroke characteristics included in inclusion criteria
- Lack of standardization amongst VRT protocols in studies
  - Dosing, duration, and delivery mode
- Too few high-quality studies

# Virtual Reality and Vestibular Therapy

RESEARCH ARTICLE: CLINICAL TRIAL/EXPERIMENTAL STUDY

## Effects of vestibular rehabilitation therapy versus virtual reality on balance, dizziness, and gait in patients with subacute stroke: A randomized controlled trial

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RESEARCH Open Access

## Contextual sensory integration training vs. traditional vestibular rehabilitation: a pilot randomized controlled trial

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# Virtual Reality and Vestibular Therapy

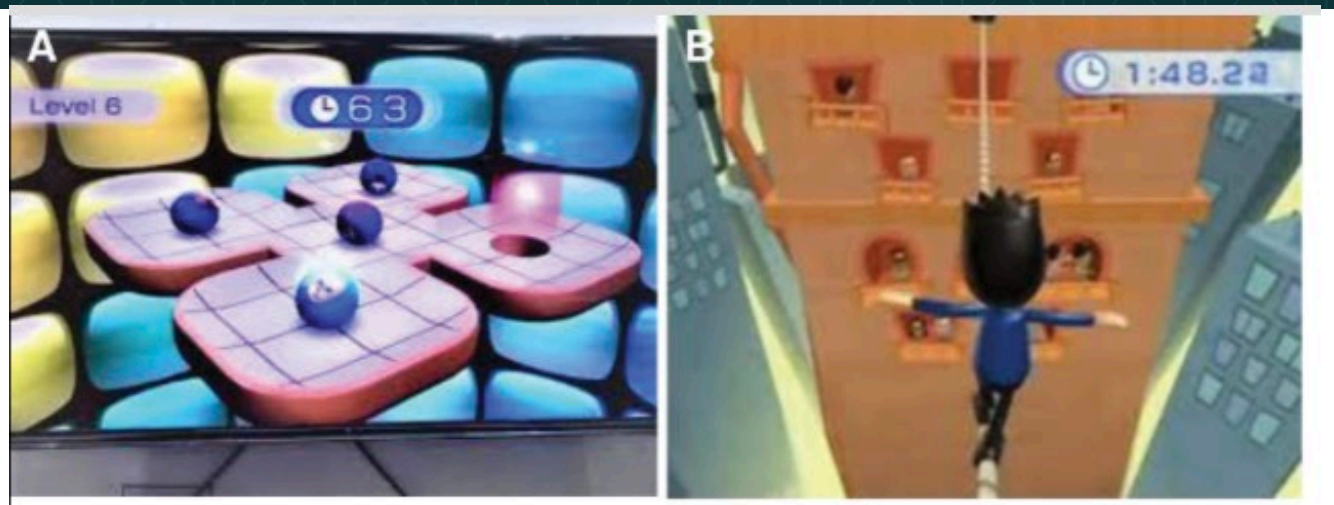


Table Tilt




Tight Rope Tension


Penguin Slide


Ski Slalom

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# Thank you!