Vestibular Treatment

Introduction

Vestibular disturbance is a significant issue globally, with 80 percent of people aged over 65 years experiencing dizziness. [1] The severity, frequency and prevalence increases with age.[2] Individuals who have vestibular impairment generally have problems with gaze and motion stability, as well as balance and postural control dysfunction.[1] Other symptoms can include visual blurring, lightheadedness and .disorientation.[3] Vestibular rehabilitation is an evidence-based approach to managing these issues.[1] Clinicians providing vestibular rehabilitation include physicians, physiotherapists, occupational therapists, and audiologists and is considered a speciality within these professions.[4]

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Goals of Treatment

The focus of vestibular rehabilitation is to:[5]

- Improve postural control and balance
- Improve the patient's ability to see clearly during head movement (gaze stability)
- Improve the patient's overall general physical condition
- Reduce the patient's social isolation
- Decrease the patient's motion sensitivity

For treatment to be effective, an appropriate home exercise programme and patient compliance are essential. It is also important that patients feel that their programme is manageable and within their level of ability.[5]

Patient Tips

The following advice can be useful for patients engaging in vestibular rehabilitation programmes:[5]

- "What makes you a little bit dizzy is good for you" (for chronic vestibular hypofunction)
- "You don't have to overdo it for the exercises to work - you just need to make yourself mildly to

moderately dizzy, but it should settle fairly quickly"
- "You don't need to do all the exercises at once. It's better to do brief, multiple episodes of exercises during the day"
- "It can be helpful to engage in 'grounding' or 'calming' strategies before and even during the exercises"

Decompensation

It is important for patients and clinicians to understand that recovery following vestibular loss may be tenuous.[5] Patients may experience a recurrence in symptoms or a relapse with fatigue, stress, prolonged periods of inactivity, illness or occasionally a change in certain medications. This is termed 'decompensation'.[5][6]

Predictors of Outcome

The following factors are predictive of a better prognosis in vestibular patients:[5]

- Patients who have less initial disability
- Patients who are seen earlier after onset
- Patients with stable unilateral vestibular deficits
- Partially compensated patients whose symptoms are provoked only by movement

Treatment Approaches

Surface Orientation Exercises

Surface orientation exercises are performed as follows:[5]

- Patients lie on a firm surface (i.e. bed or floor)
    - Alternatively they can sit or stand
- Patients breathe deeply and relax
- They should concentrate on the sensation of lying quietly on the bed and remain quiet / still for 5 to 10 seconds
- They should then close their eyes for five seconds

These exercises draw the patient's attention to somatosensory input, which can have a positive effect on this patient group. It can help to calm the central nervous system, improve sensory integration and enhance postural control and balance. They are particularly useful for post-concussion syndrome patients.[5]

Vision Exercises

Vision exercises can be introduced in the following order:[5]

- Peripheral field expansion
- Smooth pursuits
- Saccades

Peripheral field expansion

These exercises encourage the patient to soften his / her gaze and work on increasing peripheral visual field awareness.

Soft Focus

The patient holds the star chart at a reading distance. The following instructions are given:[5][7]

- Look 'hard' at the dot in the centre of the star
- Notice how the dot reduces in size and your awareness of the periphery decreases
- Next look at the dot 'softly'
- Notice how your periphery opens up
- While making sure you keep looking at the dot, touch each number in order with your finger

100 Number Exercise

The purpose of this exercise is to stimulate a patient's peripheral visual fields in a tabletop activity. When patients learn to actively 'soften' their gaze, visual information can enter without using their focal system.[5] The exercise is performed as follows:[5]

- The patient sits with the 100 number grid in front of them - either lying flat or on an angle using an incline board
- Patients are asked to choose a number to look at
- Without moving the focus of their vision from this number, they aim to see as many numbers as possible away from the number they are focusing on

NB: The harder patients try to 'focus', the worse they tend to perform. It is, therefore, important that patients 'soften' their gaze in order to see the peripheral numbers. Some patients may wish to use 'blinders' to block other numbers when focusing on a specific block.[5]

Saccade Training

Wall Clock Saccades

This exercise is performed as follows:[5]

- The patient stands in front of a wall
- 12 visual targets are placed on the wall (e.g. post-its) in a circle like a clock
- An X is placed in the middle of the clock
- Patients are instructed to move their eyes as quickly as possible from each post-it note to the centre X, moving first in a clockwise and then in a counter-clockwise direction
- This exercise can be combined with gaze stability exercises (see below)

Adaptation or Gaze Stability Exercises

Adaptation exercises are aimed at "inducing long-term changes in the neuronal response of the vestibular

system to a specific error signal – retinal slip."[8] They should lead to adaptation (i.e. when there is an error signal, the central nervous system tries to reduce it, and modifies gain of the vestibular system.[5][9]

They aim to:[8]

- Increase the gain of the vestibulo-ocular reflex (VOR)[5]
  - VOR gain is defined as the ratio of eye velocity to head velocity during head movements
  - Ideally, the gain of the VOR approximates 1.0. This indicates that eye velocity matches head velocity, thus providing accurate gaze stability[10]

- Improve visual acuity / reduce the amount of blurring with head movements
- Decrease dizziness with head movements

- Improve postural stability
- Reduce symptoms

They are indicated when patients have:[5]

- Oscillopsia
- Decreased visual acuity with head motion (positive head thrust or dynamic visual acuity tests)
- Blurring or jumping of the visual field with head movement

Adaptation exercises require patients to move their head while focusing on a small stationary target (i.e. X1 adaptation exercises) or on a target that moves in the opposite direction of the head movements (i.e. X2 adaptation exercises).[8] It is possible to use a tennis ball on a string to create a moving target.[5] Additional challenges can be added (e.g. walking forwards or backwards).[5][8] It should be noted that:[5]

- Adaptation takes time
- It is context specific, so it is necessary to vary the exercise
- Adaptation is affected by voluntary control
- It is necessary to keep the target in focus

[11]

Treatment variables:[5]

- Duration: 1-2 minutes - (Tonks has found that clinically patients respond well to sets lasting less than 90 seconds)[5]
- Add in background distraction
- Change body position (e.g. sit, stand, walk)
- Alter speed (slow, fast)
- Vary frequency (2 to 3 times per day, 5 days per week)
- Alter the distance from the target (3ft (0.9m), 8ft (2.4m), 10ft (3m))

NB: The frequency of head movement should be greater than 2 Hz in order to facilitate adaptation.[5]

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Adaptation of the VOR

After an acute unilateral vestibular lesion (UVL), VOR gain returns to normal in 1 to 3 months, but only with low frequencies of head movement.[13] During rapid, unpredictable head movements toward the lesioned side, there is a marked deficit in VOR function. Retinal slip results in an error signal that the brain attempts to minimise by increasing the gain of the vestibular system (adaptation).[5][6] Gaze stabilisation exercises assume that repeated periods of retinal slip will induce adaptation.[5]

However, while adapting VOR gain works for well for lower frequencies of head movement,[5] a substitution strategy involving saccades is more effective for higher frequencies of head movement (see BVL section below for examples).[14] It is important here to understand the difference between covert and overt saccades.[5][15]

- Covert saccades occur during head rotation and cannot be seen
- Overt saccades occur after head rotation and can be seen

Covert saccades are important in the recovery of gaze stability[5] and they are beneficial for the dynamic visual acuity of patients with bilateral vestibular hypofunction.[16]

Riska and colleagues have found that: [17]

- UVL patients who have primarily covert saccades perform better on dynamic visual acuity, gait and balance measures - they, therefore, have a reduced falls risk
- Individuals who rely on overt saccades or a combination of overt and covert saccades are more likely to have an abnormal gait speed and be at risk of falls based on their DGI score

Visual / Vestibular Integration Exercises

These exercises require head movement with visual targeting.[5]

Blind spot check

- Patients are asked to keep their head still and turn their eyes to the left
- They then turn their head to look over their shoulder, still looking left with their eyes
- They are then asked to return their head and eyes forward in one smooth motion
- The therapist should watch the patient's eyes to ensure they return forward without stopping along the way
- Repeat the same sequence looking to the right[5]

Chair Spins

- Patients are asked to spin their chair 180 degrees to the right and stop and fixate on a target
- They should let any dizziness or disturbance settle before spinning the chair 180 degrees back to the left
- Once again, they should focus on the visual target and let any dizziness or disturbance settle
- Repeat this sequence as tolerated[5]

Habituation Exercises

Habituation refers to "the reduction in a behavioral response to repeated exposure to a provocative stimulus, with the goal of reducing symptoms related to the vestibular system."[18]

The patient is asked to perform a number of repetitions of a specific movement that causes mild or moderate symptoms.[18] The specific exercises are chosen based on which movements / situations provoke a patient's symptoms (e.g. busy environments).[5] Habituation exercises are used to decrease motion sensitivity - i.e. repeated, controlled exposure to a provocative stimulus can cause a decrease in symptoms of dizziness.[5][18]

They are indicated in patients who:[5]

- Have dizziness with quick head position changes
- Avoid specific movements

Patients who are experiencing anxiety with motion may also benefit.[5]

Treatment variables to consider include:[5]

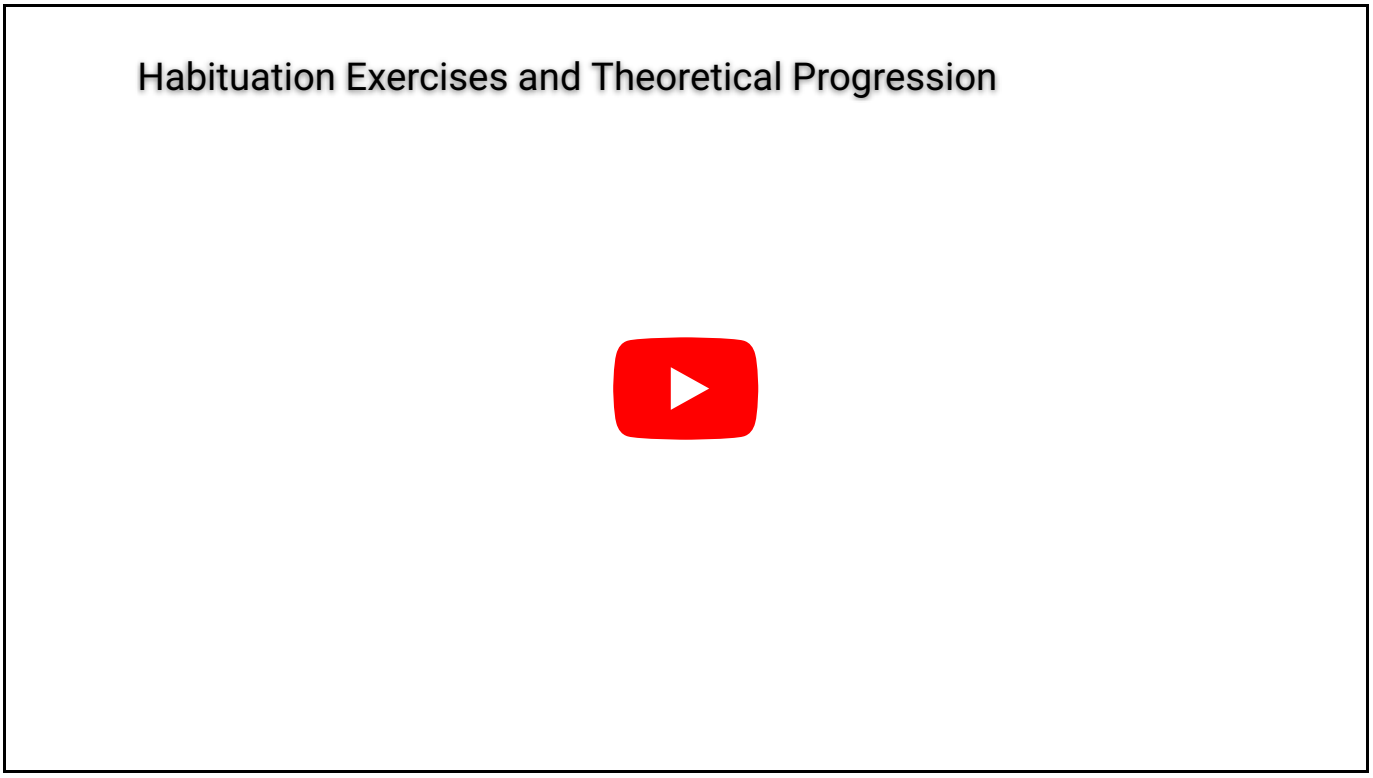
- Intensity
  - There needs to be enough speed and range of motion to cause mild to moderate dizziness
  - The patient should return to his / her baseline symptoms within 1 minute
- Number of positions
  - Up to 3 (easy to hard)
- Symptom duration
  - Should not exceed 1 minute

- Frequency
  - 2 to 3 times per day
  - 2 to 3 movement patterns per set
  - 2 to 3 repetitions per movement pattern

Treatment considerations:[5]

- Symptoms must return to baseline before continuing

- It is necessary to wait an additional 30 seconds after each repetition
- It is not possible to habituate headaches, oscillopsia or nausea
- Symptom duration and intensity should decrease after 2 to 3 weeks
- Patients may have to increase the intensity of the movement to bring on the same amount of dizziness
- It is important to be creative with these exercises - consider the activities that cause dizziness / symptoms and focus on these



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Cawthorne-Cooksey Exercises

These exercises were developed in the 1940s to address patient's complaints of vertigo and impaired balance. They are similar to habituation exercises and could be indicated in patients who have dizziness, motion-provoked symptoms and imbalance. However, the Cawthorne-Cooksey is a generic exercise programme that is not customised to a patient's specific needs.[5][18]

Static and Dynamic Postural Control Balance Exercises

When introducing postural control balance exercises, it is important to try to incorporate all aspects of

balance:[5]

- Visual
- Somatosensory
- Vestibular

Other considerations during balance retraining include:[5]

- Head position - static / moving
- Eyes open / closed

Physical Conditioning

Physical conditioning is an extremely important component of a vestibular rehabilitation programme. For patients who are able to participate, a regular walking programme can have a number of benefits:[5]

- Prevent deconditioning
- Provide balance challenges
- Improve compensation
- Decrease social isolation
- Other exercises can also be completed during the walk

Tai Chi

There are a number of articles that highlight the benefits of Tai Chi, including balance, flexibility and lower extremity strength. However, patients do typically need to attend a specialised class.[5][18][20]

Efficacy of Treatment for Unilateral Vestibular Dysfunction

A recent Cochrane review found that:[21]

- There is moderate to strong evidence to suggest that vestibular rehabilitation is safe and effective for patients who have unilateral peripheral vestibular dysfunction
- It is not associated with adverse effects

Hall and colleagues found that:

- “Strong evidence indicates that vestibular rehabilitation provides clear and substantial benefit to patients with acute or subacute unilateral vestibular hypofunction, so, with the exception of extenuating circumstances, vestibular rehabilitation should be offered to all patients who are still experiencing symptoms (dizziness, dysequilibrium, motion sensitivity, and oscillopsia) or imbalance due to unilateral vestibular hypofunction”[18]

Shepard and Telian examined the effectiveness of vestibular rehabilitation for patients with chronic vestibular dysfunction. They compared a customised 3 month vestibular exercise programme with a generic 3 month exercise programme. [22] They found that:[22]

- Dizziness decreased by 85 percent in the vestibular exercise group and 64 percent in the generic group

- Only the vestibular exercise group had a decrease in dizziness with activities of daily living
- The vestibular exercise group had significant improvement in dynamic and static postural control and a reduction in motion sensitivity
- The generic exercise group only had improvements in static balance

Strupp and colleagues found that patients with acute unilateral vestibular hypofunction who participated in one month of vestibular rehabilitation had significantly improved postural stability compared with an untreated control group.[23]

Yardley and colleagues investigated the benefits of an unsupervised, customised vestibular exercise programme compared to an untreated control group.[24] Outcome measures were:[24]

- Symptom severity
- Anxiety
- Motion sensitivity
- Sharpened Romberg test

The authors found that there were significant improvements in all measures in the vestibular habituation exercise group versus the control group who did not exercise.[24]

Two studies by Cohen and Timball found that vestibular rehabilitation resulted in increased independence in activities of daily living, decreased subjective reports of dizziness, reduced ataxia and better postural control in patients who had chronic dizziness caused by UVLs. They also noted that improvements were not affected by age, gender or a history of vertigo.[25][26]

Topuz and colleagues explored the effect of vestibular rehabilitation exercises on 122 patients with chronic unilateral vestibular dysfunction. They compared home exercises with supervised exercises and found that subjects in the supervised sessions "demonstrated rapid recovery while the home exercise group did not".[27]

Finally, Herdman and colleagues demonstrated that UVL patients who participated in adaptation exercises had improved dynamic visual acuity.[28]

Treatment Approaches for Bilateral Vestibular Lesion (BVL) Patients

- Exercises that foster the substitution of visual and somatosensory information to improve gaze and postural stability should be included in the rehabilitation programme of BVL patients
- Patients should be encouraged to develop compensatory balance strategies
- Adaptation exercises may enable some patients to augment their remaining vestibular function[5]

Prognosis for BVL Patients

- Recovery following BVL is slower
- Recovery may be compromised by other medical conditions
- Patients may need to continue exercises on a regular basis to maintain function
- Postural stability will never be normal
- There is an increased risk for falls in low-vision environments, on uneven surfaces, or when patients are fatigued[5]

Treatment Approaches for BVL Patients (which can also be used for UVL patients)

Gaze Stability Exercises

Exercises such as the X1 adaptation exercise[29] (see above) can help to improve BVL patients' remaining vestibular function.[5]

Substitution Exercises

- Active eye-head movements between two targets foster saccadic or pursuit strategies
- Imaginary targets help to foster central pre-programming[5]

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Postural Stability

The same treatment approach used for patients with UVL can be used for BVL, but the following considerations are important for BVL patients.[5]

- Avoid simultaneous alteration of somatosensory and visual cues
- Note that patients are easily overstimulated
- Safety education is essential to ensure that a patient does not fall
- Progress exercises slowly

Efficacy of Treatment in Bilateral Vestibular Dysfunction

There is strong evidence to suggest that vestibular rehabilitation has significant benefits for patients with bilateral vestibular hypofunction".[18][28][32] [33][34]

Exercise Prescription Suggestions

As little as 12 minutes of gaze stabilisation exercises per day over 3 exercise sessions may be enough to cause recovery in acute and subacute post-operative vestibular patients.[18] In patients with chronic unilateral vestibular hypofunction, it appears that performing gaze stability exercises 3 times per day for a total of 20 minutes may be enough to encourage recovery.[18]

The following table summarises treatment choices for UVL and BVL patients:

Table 1. Treatment Approaches for UVL and BVL Patients.

Treatment	UVL	Asymetrical BVL	BVL
VOR X 1 (adaptation exercise)	Yes	Yes (usually)	Can try, but difficult
VOR X 2 (adaptation exercise)	Yes as a progression	Maybe as a progression	No – too difficult
Habituation exercises	Yes	Yes (usually)	Can try, but difficult
Cawthorne – Cooksey exercises	No - not customised	No - not customised	No - not customised
Postural control exercises	Yes	Yes	Yes
Physical conditioning	Yes	Yes	Yes
Active eye head exercises	No	Generally no, but occasionally	Yes
Imaginary targets	No	No	Yes

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