



Balance problems and dizziness after brain injury: causes and treatment

Headway's publications are all available to freely download from the [information library](#) on the charity's website, while individuals and families can request hard copies of the booklets via the [helpline](#).

Please help us to continue to provide free information to people affected by brain injury by making a donation at www.headway.org.uk/donate. Thank you.

Introduction

The ability to maintain balance and orient ourselves to the outside world is vitally important. However, most people take the skill for granted and don't realise the complex interactions involved between multiple systems in the brain and body. Brain injury often disrupts these systems, resulting in many different problems with balance and dizziness.

This factsheet explains how the balance systems work, including explanations of all the most important regions of the brain and body which are involved. It then goes on to summarise the main balance impairing conditions which brain injury can cause, before outlining a range of medical interventions which can help to overcome the problems.

Dizziness and balance problems can be extremely debilitating; damaging self-esteem and leading to social isolation. There are no easy solutions, but the information in this factsheet can help people to understand the issues and regain some control of their lives.

The information should not replace expert advice from doctors or other healthcare professionals. Please make sure you discuss any dizziness or balance problems with a professional first.

The accompanying Headway factsheet *Balance problems and dizziness after brain injury: tips and coping strategies* provides practical suggestions to help people cope with or overcome the difficulties. Please refer to this if you or someone you know needs help with their balance.

The human balance system

The human balance system is a complex interaction of different parts of the brain, inner ear, muscles, joints and visual system. The main areas are:

- The vestibular system
- The brain
- The proprioceptive system
- The visual system

The vestibular system

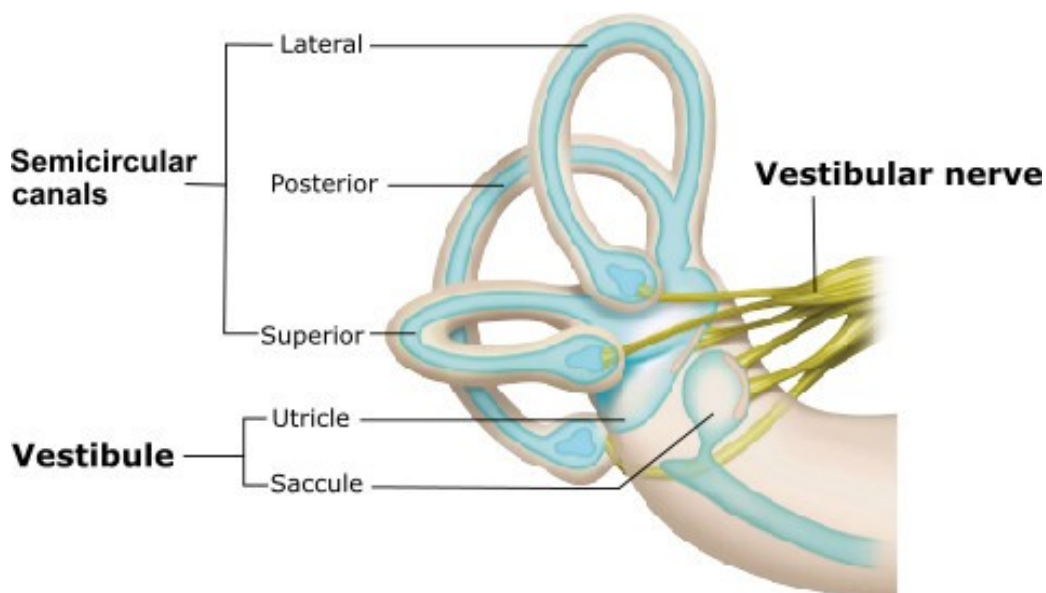
The area most associated with balance is the region of the inner ear known as the vestibular system. Along with the cochlea (the main organ of hearing processing) this system forms the labyrinth of the inner ear. The main function of the vestibular system is to respond to movements of the head in order to build up a picture of the body's position in space. The vestibular system can be thought of as the body's spirit level.

There are two types of sensors in the vestibular system: the otolith organs (sacculle and utricle, which are situated in the vestibule); and the three semicircular canals. The otolith organs specialise in detecting movements in a straight line. They contain crystals which deflect hairs during movement. The movement of these hairs then sends positional signals to the brain.

The semicircular canals detect rotational movements. There are three semicircular canals (horizontal, anterior and posterior), arranged at right angles to each other in each inner ear. This arrangement allows the semicircular canals to detect movement in three dimensions.

The otoliths and semicircular canals are filled with fluid (called endolymph, or Scarpa's fluid) which freely moves around as the head moves. Receptors respond to the movement of the fluid to detect the direction of movement and send the information back to the brain via the vestibular nerve.

Diagram one: The vestibular system



© Dorling Kindersley Limited



The brain

The information from the vestibular nerve is relayed to vestibular nuclei on either side of the brain stem. Here, the messages are synthesised with information from other parts of the brain and body. For example, some pathways run to and from the brain stem and the cerebellum, a large cauliflower-shaped structure at the back of the brain which is concerned with co-ordinating movement.

The brain stem and cerebellum are important junctions in the control of balance as they co-ordinate information from the vestibular system, the cerebral cortex, muscles and joints in order to make adjustments to body movements and balance control. Much of balance control is unconscious and so occurs at an automatic level co-ordinated by the cerebellum.

The conscious aspects of balance and movement are controlled by the cerebral cortex. The important areas of the cortex for movement are the supplementary motor area, the pre-motor area and the primary motor cortex, which are all situated in the frontal lobe. These regions are responsible for planning and initiating conscious movement and also for stabilising posture.

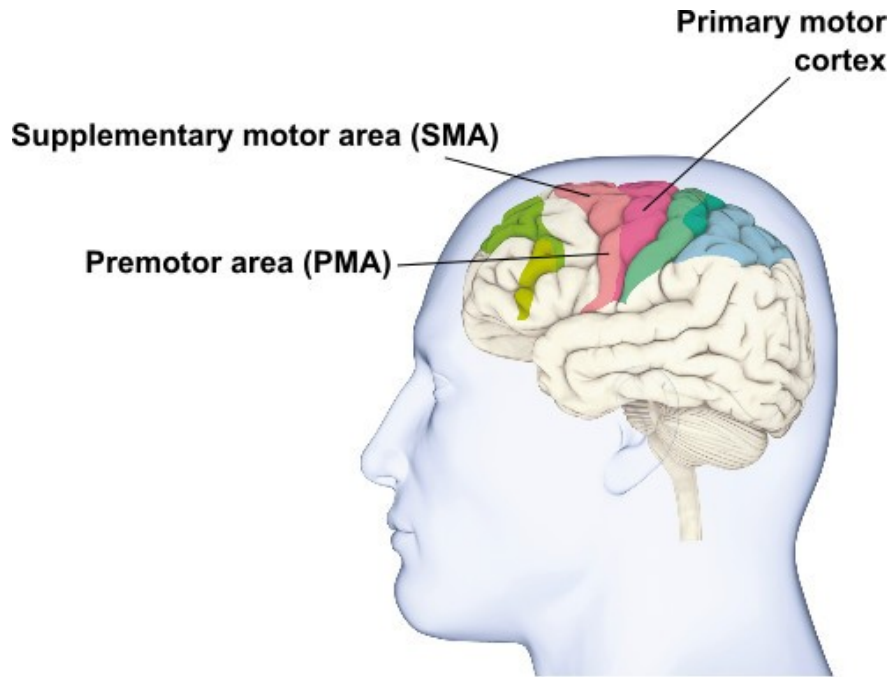
The basal ganglia are also important brain structures for balance. The basal ganglia are a group of small structures deep inside the brain which are involved in a range of functions including movement, planning, goal-seeking, addiction and emotion.

Voluntary movement commands from the motor areas of the cortex are processed in the basal ganglia, which help to fine tune the movements and respond to changes in the environment. The basal ganglia then send signals back to the cortex where movements are initiated. Injuries to the basal ganglia can result in difficulty controlling posture and adjusting balance.

The control of balance by the brain is extremely complicated and injury to any of the regions mentioned here can have an effect.

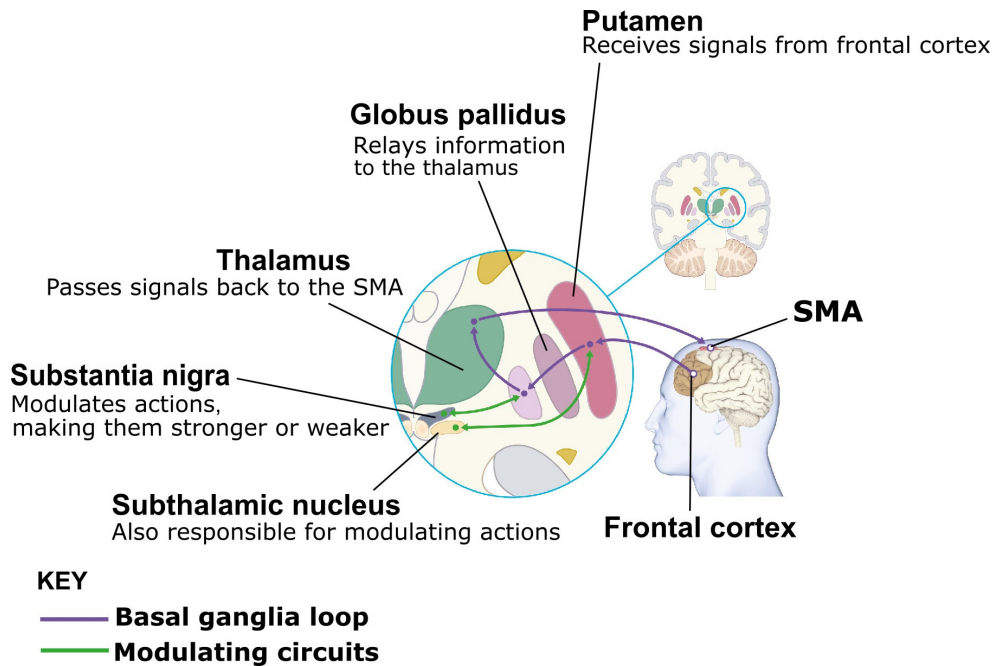
The diagrams on the following pages illustrate the areas of the brain described above.

Diagram two: The cerebral cortex



© Dorling Kindersley Limited

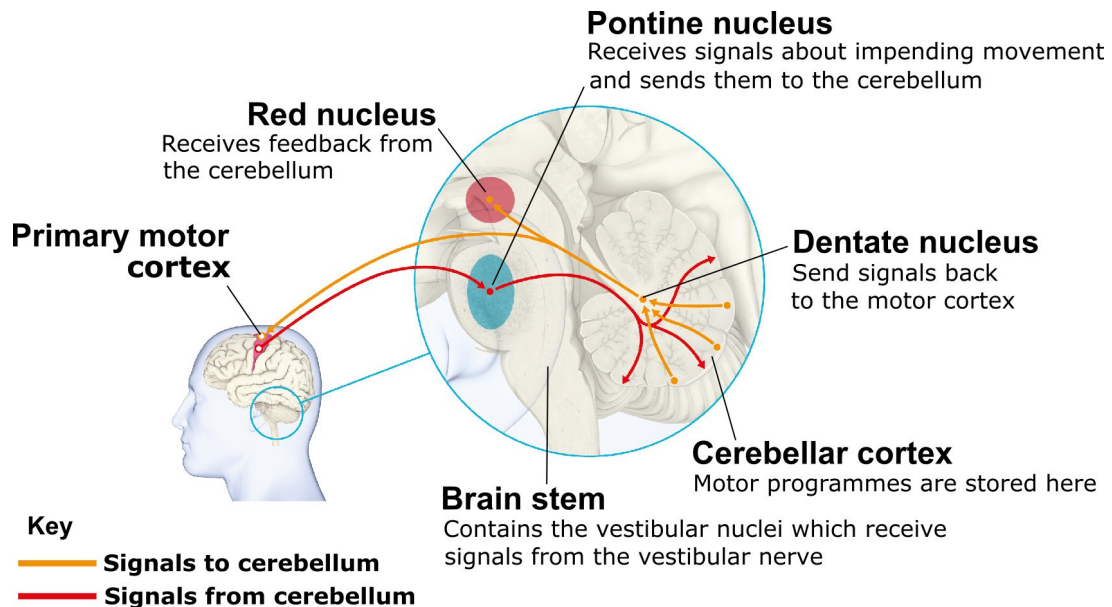
Diagram three: The basal ganglia



© Dorling Kindersley Limited

Helpline: 0808 800 2244
Email: helpline@headway.org.uk
Website: www.headway.org.uk

Diagram four: The cerebellum



© Dorling Kindersley Limited

The proprioceptive system

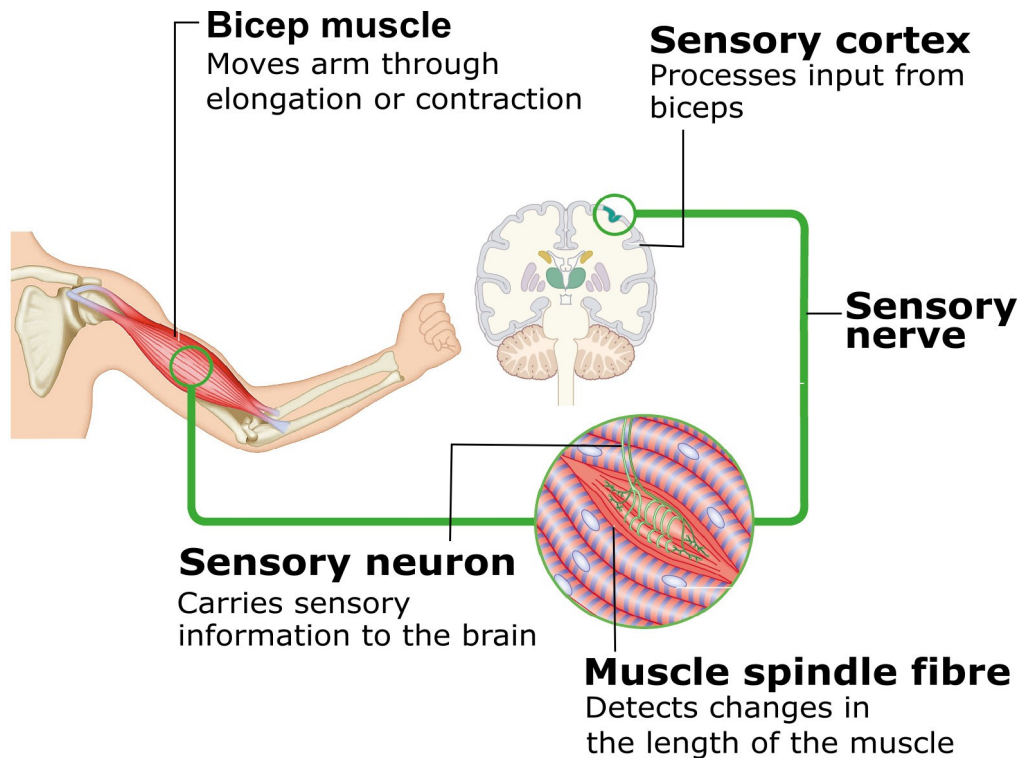
Proprioception is the sense of body position and movement. It translates as “sense of self” and is sometimes referred to as the sixth sense. The awareness is produced by sensors called proprioceptors in the muscles, tendons, joints and ligaments.

Proprioceptors are small bodies of sensory cells which detect the position, angle, length, tension and pressure of the muscles, tendons, joints and ligaments. They send the information to the brain where the brain areas discussed above process and integrate it with information from other sources, such as the vestibular system. The brain then acts on the information and sends instructions back to the body to adjust its position as appropriate.

Our bodies and brains are producing and processing vast amounts of proprioceptive information all the time. Therefore, the majority of it is processed unconsciously by passing from the spinal cord to the cerebellum and then straight back to the body.

Diagram five overleaf illustrates one form of proprioceptive processing.

Diagram five: Proprioception



© Dorling Kindersley Limited

The visual system

Finally, a key part of the balance system is vision. Vision provides vital information to the brain about where we are in space and how we are positioned relative to other objects. For this reason, many people find their balance problems get worse in the dark and must take extra care if going out to dimly lit places, such as the cinema.

The visual system is also linked to the vestibular system via the vestibulo-ocular reflex, which stabilises the eyes during head movement in order to keep images still. If this reflex isn't working then the brain doesn't receive the expected images from the eyes and visual vertigo can occur.

You can find out how important vision is for balance if you try practising on a balance board. Once you can successfully stay balanced try closing your eyes. You will find it is very difficult. The more advanced the balancing exercise is, the more the brain relies on as many sources of information as possible.



Putting it all together

As you can see, there are many aspects to the complex way the brain and body process information about balance. All are important and damage to any part of the system can lead to balance problems.

The complex range of information used also means that we can compensate for impairments. For example, many people with inner ear damage rely on visual and proprioceptive information and can still retain a good sense of balance. However, such people can lose all sense of balance in sudden darkness, until their proprioception takes over.

Types and causes of balance problems after brain injury

There are many possible causes of balance problems after brain injuries. Even minor head injuries can cause problems. Injury or disruption to any of the systems discussed above can lead to difficulties.

Specific conditions and their causes include:

Post-traumatic vertigo

Post-traumatic vertigo is sometimes used as an umbrella term for many of the conditions described below when they follow a head injury. Alternatively, it can refer to dizziness after head injury, in the absence of other more complex clinical features.

Labyrinthine concussion

This term refers to symptoms of hearing loss, dizziness and tinnitus which occur after head injury, but without signs of direct injury to the labyrinth. The underlying cause may be related to some of the other conditions described here or may never be accurately identified.

When no underlying cause is found the symptoms often improve with time, although this is by no means always the case. Thorough assessment and examination is required to rule out all possible related conditions.

Vascular vertigo

This occurs when the vessels which supply blood to the inner ear and lower brain (both are supplied by the same blood vessels) are blocked, causing dizziness, hearing loss, visual problems and numbness.

Vascular vertigo is linked to strokes and is likely to mean a higher risk of stroke. Lifestyle factors like smoking and poor diet are risk factors as is a family history of high blood pressure, heart attacks and strokes.



Visual impairment

Vision is extremely important for balance so any visual impairment may cause balance problems, or make existing issues worse. Eyesight problems which may have a particular effect on balance are double vision, blurred vision, impaired depth perception and damage to the vestibulo-ocular reflex. An ophthalmologist can assess and diagnose these issues.

Peripheral sensory impairments

As discussed above, balance relies on complex interactions between different parts of the body. Therefore, injury or loss of feeling in the feet, or other important proprioceptor locations, can lead to balance problems. In these cases, people are more reliant on the other parts of the balance system, such as eyesight and the vestibular system.

Benign paroxysmal positional vertigo (BPPV)

BPPV is caused when the crystals of the inner ear are dislodged from their usual position and build up in the semi-circular canals, thus disturbing the usual movement of endolymph fluid. This makes people sensitive to specific kinds of movement, such as lying down or turning. Balance can also be affected when standing or walking.

The condition is referred to as 'benign' because it is not due to serious disease, although it can be quite distressing and disabling. Attacks tend to occur in short bursts of about 5 – 30 seconds, hence the word 'paroxysmal'. BPPV episodes often make people feel like they are spinning round. Sometimes, when lying down, people experience the sensation of falling through the bed.

Traumatic endolymphatic hydrops

This condition is an abnormal build-up of endolymph fluid in the inner ear. The increased pressure in the otoliths and/or semi-circular canals leads to periods of intense dizziness. Some people have this condition for no obvious reason and it is known as Ménière's disease. However, it is sometimes caused by a head injury, in which case it is referred to as traumatic endolymphatic hydrops or post-traumatic Ménière's disease.

People with the condition experience periods of intense dizziness and spinning sensations (vertigo), along with sounds in the affected ear (tinnitus), fluctuating hearing loss, loss of balance and a feeling of pressure, or fullness, in the ear.

The attacks can last from two or three hours to a day or more, and often cause vomiting. Sufferers are often very anxious about the possibility of episodes in public because the symptoms can be mistaken for drunkenness.

The presentation of endolymphatic hydrops after a head injury is often delayed, from three weeks to as long as three months. It is important for doctors to know this as they may not link the symptoms with the head injury if there has been delayed onset.



Perilymph fistula

Sometimes a head injury can cause a tear in the membranes connecting the inner ear and middle ear. This can allow fluid called perilymph to leak into the middle ear and also means that changes in middle ear pressure will affect the inner ear, causing balance and hearing problems.

Some symptoms are similar to endolymphatic hydrops, such as vertigo, nausea and vomiting, periodic hearing loss and fullness in the ear. Because the tear affects the pressure in the middle ear, symptoms can worsen with changes in external air pressure, such as with rising or falling altitude or weather changes, and with physical exertion.

Fortunately, fistulas usually heal by themselves with time and rest. Surgery is not usually necessary, although it is an option in extreme cases.

Visual vertigo

People with visual vertigo experience dizziness and unsteadiness triggered by complex environments with lots of visual stimulation. Symptoms include loss of balance, dizziness, sweating, fatigue, pallor, nausea, vomiting and disorientation.

The situations that cause visual vertigo vary for different people. For some it is fast moving objects, such as passing trains; people walking by, especially in crowded environments; flickering lights; passing scenery from a car or train; or spinning objects. Some people have great difficulty looking at computer screens, especially scrolling ones

Visual vertigo is usually triggered by movement, which is sometimes referred to as motion sensitivity. However, this is not always the case. One common trigger that has been reported is highly-stacked supermarket aisles. Such a seemingly innocuous stimulus can make some people feel as though they are riding on a roller coaster.

There are several theories regarding the causes of visual vertigo. It is believed that it may be due to a mismatch of signals between the visual system, the vestibular system and the brain. This may cause a discrepancy between the stimulus the brain expects and the one it actually receives. Alternatively, if a vestibular disorder causes a person to rely too much on their visual system then this may cause the problem. The visual system may become overloaded. The condition may also be related to vestibulo-ocular reflex damage, which means the eyes are unable to move to compensate adequately for head movement.

The problems may also be brought on if you are adjusting to new glasses, especially bifocals or varifocals, or if you have blurred or reduced vision.



Cervicogenic vertigo

This form of dizziness, otherwise known as cervical vertigo, is associated with neck pain such as whiplash injuries. The attacks of dizziness arise during or after head movements, especially when the head has been still for some time. However, the diagnosis of cervicogenic vertigo is controversial and some doctors don't recognise its existence.

Labyrinthitis and vestibular neuritis

These are quite common conditions which cause dizziness and nausea. They are usually caused by a viral infection of the inner ear and symptoms pass within a few weeks as the infection clears. Some forms of anti-sickness medication, steroids or medications to quieten nerve signals from the inner ear may help, although bed rest is usually the preferred treatment.

These conditions are not usually related to brain injury so we haven't included a lot of detail here. It is important to be aware of them though as if they may need to be ruled out when assessing other causes of balance problems and dizziness. This is especially the case if your usual symptoms suddenly worsen. A simple viral infection may be to blame.

Medication

Some types of medication, such as blood pressure or anti-seizure drugs, can cause dizziness, light-headedness and subsequent balance issues. If you are on any medication then you should talk to your doctor about whether they may be causing the problems. Changing the type or dose may improve things.

Medical interventions

Specialist assessments

It is important to have a specialist assessment and many hospitals have balance clinics which provide assessment and treatment. Such clinics usually have input from ear, nose and throat specialists; neurologists; physiotherapists; neurophysiotherapists; ophthalmologists; audiologists and otologists.

The specialists can check for the exact causes of the balance problems, including looking for damage to the vestibular system or for the build-up of crystals in the inner ear which indicates BPPV.

Assessments involve several standardised tests and questionnaires, such as the Hallpike test, Dizziness Handicap Inventory (DHI) and the Motion Sensitivity Quotient (MSQ). Many other tests are also used in order to identify specific balance problems and a specialist will be able to discuss these with you.



Vestibular rehabilitation

Vestibular rehabilitation (VR) – This is the main treatment for most types of balance problems. Vestibular rehabilitation helps the brain to minimise dizziness symptoms caused by imbalances between the vestibular organs of the inner ears. The brain learns to rely more on the alternative signals from other parts of the balance system, such as joints and limbs. This process is known as ‘vestibular compensation’.

VR involves a programme of head, eye, neck and body exercises under different visual situations (for example, with the eyes open or closed, or with background objects moving or stationary), on different surfaces and in different environments. There are different types of VR exercises, for example Cawthorne-Cooksey exercises and gaze stabilisation exercises (details of these and other VR exercises can be found in the Brain and Spine Foundation factsheet *Dizziness and balance problems* – see ‘Further reading’).

The key feature of these programmes is that the brain has to sense dizziness and imbalance in order to learn to compensate and adjust. The brain must realise something is wrong in order to begin the process of vestibular compensation. Therefore, in order to make it work people may need to stop or reduce anti-vertigo medication. A doctor must be consulted before doing this.

People vary greatly in the nature of their balance and dizziness, so the more customised the programme is to each individual the more effective it will be.

Treatment for vascular vertigo

Treatment is aimed at lowering blood pressure and cholesterol. Increased exercise, eating a healthy diet and cutting down on smoking and alcohol can all help.

Doctors may also prescribe aspirin or other blood thinning medication, although there may be reasons why this is dangerous so always consult your doctor before taking any medication.

Treatment for BPPV

BPPV can only be diagnosed by the Hallpike test and treatment is by Canalith repositioning procedures (CRP). CRP can potentially bring about a rapid recovery from BPPV. The two main versions of the treatment are the Epley manoeuvre and the Semont manoeuvre, which both involve a series of head and upper body movements aimed at clearing crystals trapped in the inner ear.

A specialist should conduct an assessment and provide the treatment (further details of the exercises are available in the Brain and Spine Foundation factsheet *Dizziness and balance problems* – see ‘Further reading’).



Treatment for traumatic endolymphatic hydrops

Regulating the diet can be an important factor in controlling traumatic endolymphatic hydrops. There is increasing evidence suggesting that cutting out caffeine can significantly reduce symptoms. Reducing sugar and alcohol intake can also help, as can a strict low-salt diet and diuretics, such as water retention tablets, which both help to get rid of excess salt and fluids from the body.

The condition can also be treated using vestibular rehabilitation, anti-vertigo medication, relaxation techniques or counselling.

The Ménières Society can also provide support (see 'Useful organisations' for contact details).

Treatment for visual vertigo

Visual vertigo is usually treated by vestibular rehabilitation, tailored specifically to desensitise the individual to the triggers of their episodes. People are usually assessed using tools such as the Dizziness Handicap Inventory (DHI) and the Motion Sensitivity Quotient (MSQ). The specialist can use the results of these scales to assess the exact nature of the vestibular rehabilitation exercises required.

Cognitive behavioural therapy (CBT) and counselling

Balance and dizziness problems can lead people to experience a lot of anxiety and stress. It can cause people to avoid public situations and reduce contact with friends due to fear of embarrassment. Avoiding going out and doing things means that vestibular compensation can't take place and so leads to a vicious circle where symptoms don't improve.

Talking therapies such as counselling and cognitive behavioural therapy (CBT) can help people suffering from stress, anxiety or depression. CBT can be particularly effective for learning relaxation techniques to reduce anxiety and for helping people recognise and manage the 'triggers' for vestibular problems. Once you understand these triggers you can develop strategies to cope with them.

Talk to your GP about referral to talking therapy services and visit the online directories in the 'Useful organisations' section of this factsheet to find accredited therapists in your area.

Medication

Anti-vertigo or anti-sickness medication can help in some cases. These should usually only be taken for a short time as they may interfere with vestibular compensation if taken for too long.



Optokinetic stimulation

Optokinetic stimulation involves exposing patients to a controlled, simulated, moving background. The virtual environment can be presented on a computer or television screen. The treatment is a type of vestibular rehabilitation and allows a controlled adjustment of the stimuli as the patient improves. It can be particularly useful for people with visual vertigo.

The exercises don't have to involve expensive technology. Many of the tips and strategies in the accompanying Headway factsheet *Balance problems and dizziness after brain injury: tips and coping strategies* can be classed as low-tech optokinetic stimulation or vestibular rehabilitation exercises.

Computer games

Other exercises which involve conflict between the vestibular system and the visual system can be used to train the systems to work together more efficiently. Computer game systems like Nintendo Wii and Xbox Kinect can be very effective training, as can the most up-to date virtual reality machine Samsung's Oculus Rift.

The Oculus Rift is currently very expensive and in the early stages of development, but the technology will progress quickly and come down in price as it develops.

Eyewear

Certain types of glasses, such as bifocal and varifocal lenses, may make you feel disorientated and exacerbate balance problems. If you wear these types of glasses then speak to your GP and optician about whether a change might bring about an improvement.

Some types of visual disorders can cause balance problems which may be corrected by special glasses, such as ones which use prism lenses.

Surgical procedures

This may be considered as a last resort in some cases. Only a small number of people will need surgery, usually those with dizziness associated with ear infections or perforated ear drums.



Conclusion

Balance and dizziness problems are common after brain injury and manifest themselves in a wide variety of ways. There is no easy way of dealing with the problems but there are treatments and strategies that can help. The most important thing initially is to seek assessment and treatment from a specialist with experience in vestibular problems, such as a neurophysiotherapist.

It is also very important to try to get out and participate in activities, even if only in a limited way. Staying active can help with the process of recovery and also boost self-esteem.

There are also lots of techniques and strategies which can help to improve balance and reduce dizziness. Headway's factsheet *Balance problems and dizziness after brain injury: tips and coping strategies* provides lots of suggestions, which you might find useful. You may also find new ways for yourself. Be imaginative and think about what works for you.

Headway's groups and branches provide excellent help and support and can be a great way of meeting new people and staying active. For information about your local services, visit www.headway.org.uk/in-your-area.aspx.

If you'd like to discuss any of the issues raised in this factsheet, or anything else related to brain injury, please contact Headway's nurse-led helpline service. The helpline is staffed from 9am-5pm on weekdays and you can call free on 0808 800 2244, or email helpline@headway.org.uk.



Further reading

Balance problems and dizziness after brain injury: tips and coping strategies. Headway factsheet – www.headway.org.uk/factsheets.aspx.

Dizziness and balance problems. Brain and Spine Foundation - www.brainandspine.org.uk/dizziness-and-balance-problems

Vestibular rehabilitation exercises. Brain and Spine Foundation - www.brainandspine.org.uk/vestibular-rehabilitation-exercises

Carter, R (2014) *The Brain Book*. London: Dorling Kindersley Limited.

Useful organisations

The Brain and Spine Foundation
Tel: 0808 808 1000
Web: www.brainandspine.org.uk

British Association for Behavioural and Cognitive Psychotherapies (BABCP)
(Featuring a directory of cognitive behavioural therapists)
Web: www.babcp.com

British Association for Counselling and Psychotherapy (BACP)
(Featuring a directory of counsellors and psychotherapists)
Web: www.bacp.co.uk

British Psychological Society (BPS)
(Featuring a directory of chartered psychologists)
Web: www.bps.org.uk

Chartered Society of Physiotherapy
(Featuring a directory of physiotherapists)
Web: www.csp.org.uk

Counselling Directory
Web: www.counselling-directory.org.uk

The Ménière's Society
Tel: 01306 879 883
Web: www.menieres.org.uk

Physio First
Web: www.physiofirst.org.uk



Acknowledgements

Many thanks to Jan Waddington, Physiotherapist at Cumbria Community Acquired Brain Injury Rehabilitation Team, and Helen Grady, Neurophysiotherapist at Queen's Medical Centre, Nottingham, for their helpful feedback on this factsheet.

Thanks also to the Headway communications team and volunteer Maria Dryden for their help in proofreading various drafts.

Special thanks to Dorling Kindersley publishers, particularly Senior Editor Peter Frances, for permission to reproduce the images for the diagrams in this factsheet. The images of the brain and proprioceptive system originally appeared in *The Brain Book* by Rita Carter and the images of the vestibular system are taken from ...

You can purchase *The Brain Book* from the Headway Amazon shop at www.headway.org.uk/headway-amazon-shop.aspx. To find out more about Dorling Kindersley publications visit www.dk.com/uk.

First published June 2015. Review date Summer 2017.