



Concussion

Helping clients with dizziness, vertigo and balance issues to move, function and feel better



Concussion (a mild traumatic brain injury, mTBI) is a complex physiological process affecting the brain, induced by traumatic biomechanical forces i.e., impact or rapid acceleration/deceleration forces. This results in neuropathological changes, over a wide area, that result in a functional disturbance rather than discrete or localised structural damage, which is why imaging (brain CT or MRI) is very often reported as normal. Concussion is characterised by short-lived impairment of neurological function that usually resolves spontaneously within days to a couple of weeks. Loss of consciousness is not necessary for a diagnosis of concussion. Sometimes concussion symptoms only start 24 hours after the actual trauma.

Common Signs

Somatic symptoms: visual problems, dizziness or vertigo, nausea, balance difficulties, headache, light sensitivity, nausea, neck pain, light or sound sensitivity

Emotional symptoms: anxiety, lability (mood swings), sadness, irritability

Cognitive: attention problems, memory dysfunction, foginess, fatigue, cognitive slowing, difficulty multitasking, reduced cognitive endurance

Sleep disturbance: difficulty falling asleep, excessive sleepiness, early morning waking

Resolution of symptoms usually follows a sequential course over days to a couple of weeks. However, some concussion injuries involve a prolonged recovery (the range in literature for people experiencing a prolonged recovery is 15-30%).

Contributing Factors

Pre-injury factors contributing to prolonged recovery include:

- Younger age ~ 10-19yrs
- History of anxiety/ depression
- History of learning difficulties/ADHD
- History of migraine
- Gender ~ being female
- History of somatisation of symptoms i.e. unexplained tummy aches and/or headaches

Pre-injury factors contributing to prolonged recovery include:

- Dizziness on field/at injury
- Higher number of reported symptoms
- Retro or anterograde amnesia (memory loss)
- Exertion/higher activity level i.e., staying in play after a hit
- Recent prior concussion or repeated concussions >3

Treatment

✓ Rehabilitation steps include recognising the concussion and removing from play (if sports related), refer to a medical professional, rest (mentally and physically) until symptoms have resolved (relative rest), ensuring the person is symptom free during normal daily activities before beginning exercise and ensuring a graded return to play as per each sports' guidelines.

✓ The best approach for management of prolonged recovery from concussion is usually a team approach with the person and/or their family/carers liaising and working with the medical and allied health providers. The multi-disciplinary team might involve a GP, sports specialist, neurologist, physiotherapist (musculoskeletal/vestibular), orthoptist/optometrist, psychologist, neuropsychologist or occupational therapist.

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vertigo • dizziness • balance



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Assessment

The physiotherapy assessment involves history taking, including asking about the mechanism of injury, current symptoms, medications and past medical history. Some specific questionnaires might also be given, dependent on the symptoms. Getting baseline information is important and serial testing can monitor improvement and guide treatment for return to activity/function or inform further specialist onward referral. Domains for assessment include: vestibular/oculomotor, cervical/musculoskeletal, autonomic/exertional tolerance, motor function/balance and psychological/cognition/sociological factors (for onward referral). The physical assessment for concussion can include (this is individualised based on symptom presentation and can be spread over a few sessions):

Oculomotor and vestibular assessment: with video-oculography (infra-red goggles), dynamic visual acuity tests, pressure tests, Dix-Hallpike and Roll Test for BPPV; Vestibulo-Ocular Motor Screen (VOMS)

Static balance and dynamic balance assessment: using sway monitor and other objective tests such as mCOBALT, 5xSTS; FSST; Mini-Best Test; balance tasks with dual tasking, DGI/FGA /HiMAT

Cervical spine (neck) assessment: tests for instability, range of motion, palpation, joint position error test (JPE), strength/endurance, headache, posture

Exertion assessment (tests autonomic nervous system): graded stationary bike exertion test, recovery HR

Autonomic system assessment: lying/sitting and standing blood pressure and heart rate



Interventions

Physiotherapy interventions for symptoms related to prolonged concussion might include (depending on the assessment findings):

- Education on symptoms, impairments, and management (including self-management) of concussion symptoms
- Aerobic exercise prescription based on exertional testing (in early stages, any exertion is limited but too much rest for too long can be detrimental)
- Careful grading and pacing of activity for return to school/work/play/sport
- Management of vestibular/oculomotor impairments such as the treatment of BPPV with appropriate particle repositioning manoeuvres. Rehabilitation of other vestibular and oculo-motor impairments through individualised oculo-motor and vestibular rehabilitation programmes.
- Management of cervical spine (neck) dysfunction with mobilisation/manual therapy, sensori-motor control training; strength and endurance training; stretching and postural/positioning advice. Exercise programmes for secondary prevention of further concussion.
- Graded progression of home exercise programmes for improving visual clarity (gaze stability); improving balance (static and dynamic); improving sensory integration for balance; reducing symptoms with motion (habituation); improving endurance and fatigue and sport or occupation specific training.





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Post-Concussion

Vestibular system dysfunction post-concussion:

This can be due to direct trauma to the vestibular (inner ear balance) system resulting in BPPV, perilymphatic fistula, labyrinthine concussion, temporal bone fractures or damage/swelling of the vestibular and cochlea nerve. An insult to the vestibular system will very often result in vertigo (usually a strong spinning or motion sensation) which can be accompanied by nausea, vomiting and being off-balance. Vertigo may be persistent or triggered by certain movements, positions, loud noises, straining or exertion.

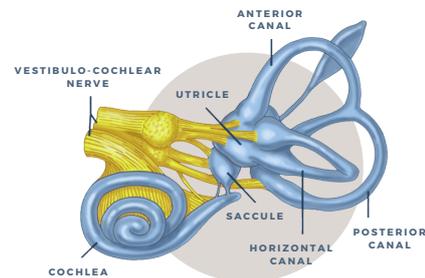
Dizziness/vertigo after concussion is not always a direct result of trauma to the vestibular system but can be related to post-traumatic migraine, vestibular migraine, gaze stability impairment due to oculo-motor abnormalities, autonomic nervous system dysregulation, cervicogenic (neck) dizziness; anxiety related dizziness or PPPD. Anxiety often exacerbates symptoms of dizziness.

Cervical spine (neck) dysfunction post-concussion:

This is very common because a much lower force is required to cause injury to cervical structures (4.5 g) than to the brain (60-160g). Cervical dysfunction can cause symptoms including headache, neck and shoulder pain, jaw pain, visual problems, spatial disorientation, light-headedness or a spacey feeling.

Cervical spine dysfunction can lead to these varied symptoms because the sensory fibres (known as cervical afferents) from the upper neck muscle spindles, ligaments, joints and fascia have direct connections to the brain. These cervical afferents provide very important sensory information about neck position and neck motion. Additionally, they have links to the pain and sensory centres relating to the head, face and jaw. These cervical afferents also help to drive the reflexes which control head stability, balance and eye movements; the cervico-collic and cervico-ocular reflexes.

The small upper neck muscles are particularly important sensory organs for balance, feeling balanced and for eye movements. The muscle spindle is the sensory part of the muscle that tells your brain about muscle position and motion. To highlight what an important sensory organ our neck muscles are, muscle spindle density in the upper neck muscles are between 98-242 spindles per gram of muscle compared to the main thumb muscle, which is only 16 spindles per gram (and thumbs are pretty important!).



When we are moving around in our environment, our brain is using and comparing inputs from our vision, vestibular (inner ear balance) and somatosensory (information from muscles, joints, ligaments, skin) systems. When these sensory inputs all 'agree' with one another, we feel the way we expect to feel in certain environments and balance and spatial orientation seems to 'just happen'. It is mostly a subconscious event.

Upper cervical dysfunction, due to the impact/trauma related to the concussion, is thought to cause a sensory mismatch (either through increased or decreased input from the neck). So, the neck sensory inputs to the brain 'don't match' the vestibular and visual inputs or are not providing the 'expected' sensory inputs for particular movements. This leads to imbalance, perceptual changes with balance, not feeling right and dizziness. The dysfunctional neck inputs also impact on the neck and eye reflexes. Dysfunctional neck afferents can also lead to headache and neck pain.





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Post-Concussion Continued

Autonomic system dysfunction can also occur post-concussion:

When the autonomic nervous system is affected by concussion, at rest the sympathetic nervous system (fight/flight system) dominates rather than the para-sympathetic nervous system (rest/digest system). Conversely, during exercise, when the sympathetic nervous system should start to kick in, there is a blunted sympathetic response.

This autonomic system dysfunction can result in sensations of anxiety, light and sound sensitivity, dizziness and exercise intolerance; difficulty achieving a restful state; difficulty getting to and staying asleep, nausea, irritable bowel, loss of appetite, difficulty with up close vision (accommodation); erratic pupil constriction/dilation; eye muscles not moving as they should or as quickly as they should.

Over 20 Years of Experience

Kim Hawkins has completed the Brain Injury Australia 'mild Traumatic Brain Injury/Concussion' course; the 'Concussion in Sports' course at ACU and multiple other learning modules and updates relating to the vestibular system and headache related to concussion over her working life.



Further Reading

See the latest concussion evaluation guidelines from the American Physical Therapy Association

https://www.neuropt.org/docs/default-source/cpgs/concussion/summary-examination-formatted-final.pdf?sfvrsn=80775f43_2

See the APTA guidelines link:

https://www.neuropt.org/docs/default-source/cpgs/concussion/summary-interventions-final.pdf?sfvrsn=93775f43_2

Further Reading:

- ✓ https://qbi.uq.edu.au/files/32337/Brain-Series-Concussion-Digital-PDF-web_QBI-UQ.pdf?utm_source=concussion&utm_medium=website&utm_campaign=snippet
- ✓ <https://www.jospt.org/doi/full/10.2519/jospt.2020.0301>

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