An Overview of **Concussion** for Primary Healthcare Professionals

# PART 1: Identifying and diagnosing patients with concussion

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# **Concussion** – a form of mild traumatic brain injury

Force applied or transmitted to the head → Transient disturbance in neurological function

e.g. rapid acceleration/ deceleration or rotational forces

The magnitude of impact does not necessarily predict the severity of symptoms

Traumatic brain injury spectrum

**Functional**
**Mild TBI**
(e.g. concussion*)

**Structural**
**Severe TBI**
(e.g. a brain injury that causes extended loss of consciousness [coma] or amnesia)

* Concussion is a form of mild TBI – it should not be graded further, e.g. into mild- moderate- and severe-concussion. Concussions are associated with functional brain disturbances and there is not structural damage evident on imaging, e.g. CT scan or MRI.

$Ca^{2+}$, calcium ion; CT, computed tomography; $K^+$, potassium ion; MRI, magnetic resonance imaging; $Na^+$, sodium ion; TBI, traumatic brain injury.

## The pathophysiology of concussion

**Concussive events cause an acute cascade of significant neurometabolic and neurotransmitter changes** which the brain must progressively compensate for and correct

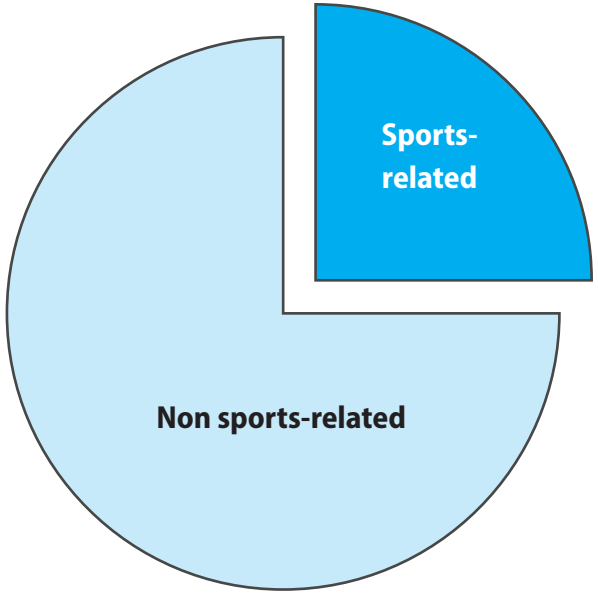
| Change | Effect |
|---|---|
| "Leaky Cells" → Imbalance of ionic flux, e.g. $Na^+$, $K^+$, $Ca^{2+}$ | Depolarisation |
| "Leaky Cells" → Release of excess glutamate | Inflammation |
| Reduced cerebral blood flow | Energy depletion |

**Symptoms are due to functional disturbances – not macrostructural damage,** e.g. bruising, bleeding, swelling (as there would likely be for more severe TBIs)

**There does not need to be a direct blow to the head for concussion to occur.** Injury can occur indirectly due to "impulsive forces" associated with the body rapidly changing or correcting its position

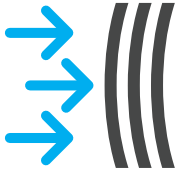

1. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022);
2. Barkhoudarian G, Hovda DA, Giza CC. Phys Med Rehabil Clin N. 2016;27:373–93;
3. Romeu-Mejia R, Giza CC, Goldman JT. Curr Rev Musculoskelet Med. 2019;12:105–16;
4. Broglio SP, Eckner JT, Kutcher JS. Curr Opin Pediatr. 2012;24:702–8.

# Most concussions in New Zealand are not sports-related




## Common causes include:

Falls



Mechanical forces

Driving accidents

Assaults

1. data.govt.nz. Concussion/TBI dataset obtained from the Accident Compensation Corporation (ACC). 2021. Available from: https://catalogue.data.govt.nz/dataset/acc-concussion-tbi-data/resource/49bc050e-bed1-4b8a-95c9-9d15a19b7ac9 (Accessed Feb, 2022).

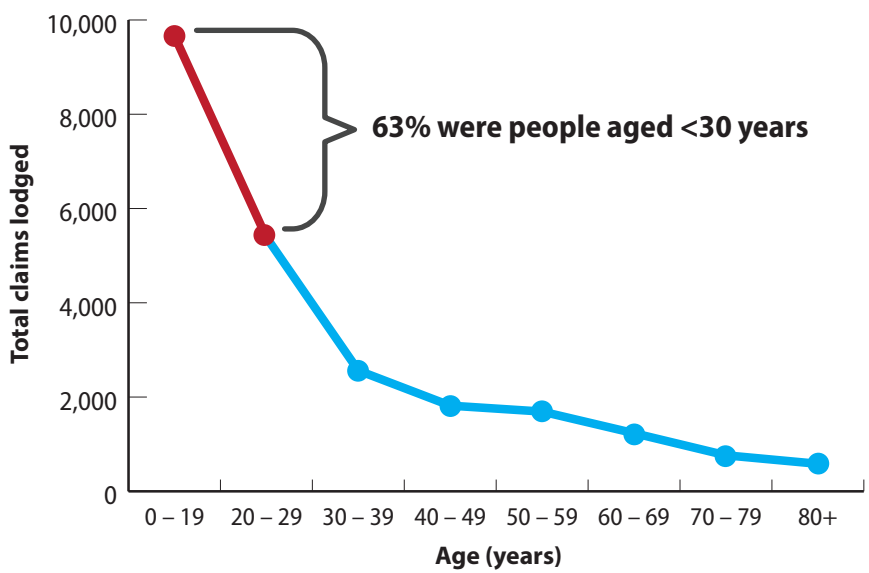
# A closer look at the demographic trends

It is estimated that

**36,000 people** sustain a TBI each year in New Zealand,

**95%** of which are mild in severity

**New concussion injury claims made to ACC** (1 July 2020 – 30 June 2021)*



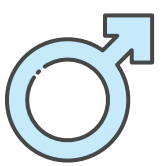

* This time period falls between the first and second nationwide lockdowns associated with the COVID-19 pandemic, and therefore data is not expected to be significantly affected by corresponding restrictions on people's activities and daily living. The data and associated trends for this period are similar to observations for previous years.

**However:**

**Many people do not seek medical attention after sustaining a concussion.** Only 21,000 new concussion-related claims are made each year with ACC.

## Groups at risk of concussion

**Young people**



**Males**

**Māori or Pacific peoples**


1. Accident Compensation Corporation (ACC). Traumatic Brain Injury Strategy and Action Plan (2017–2021). 2017. Available from: https://www.acc.co.nz/assets/provider/1bf15d391c/tbi-strategy-action-plan.pdf (Accessed Feb, 2022);
2. data.govt.nz. Concussion/TBI dataset obtained from the Accident Compensation Corporation (ACC). 2021. Available from: https://catalogue.data.govt.nz/dataset/acc-concussion-tbi-data/resource/49bc050e-bed1-4b8a-95c9-9d15a19b7ac9 (Accessed Feb, 2022).

# Recognising the signs and symptoms of concussion 1

A common misconception is that concussion always has an acute or early onset.
However, **concussion can present as an evolving injury.**

Concussion may not immediately be considered as the **associated symptoms and signs can be subtle, non-specific and vary significantly between people**

The initial recognition of concussion may occur in a number of different settings:

**e.g.**

**At the location where the accident or injury occurred**

**At a hospital emergency department or urgent doctors**

**In a general practice consultation**

**If the person initially presents in general practice:**

**They may not have considered their symptoms to be associated with a concussion** and therefore not immediately report an accident or injury as having occurred

1. Silverberg ND, Gardner AJ, Brubacher JR, et al. J Neurotrauma 2015;32:517–26.

# Recognising the signs and symptoms of concussion 2

## Common symptoms and signs indicating possible concussion

### Physical

- Headache
- Neck pain or tenderness (mild-moderate)
- Nausea/vomiting
- Tinnitus
- Taste/smell impairment
- Dizziness/vertigo
- Photosensitivity or sensitivity to noise
- Transient diplopia (double vision)
- Balance or motor inco-ordination

### Cognitive

- Confusion/disorientation
- Brief loss of consciousness (< 2 minutes)
- Difficulty concentrating
- Difficulty remembering things
- Feelings of being "slowed down" or "in a fog"
- Witness reports person was slow to get up after injury

### Behavioural/emotional

- Irritability and other transient personality changes, e.g. disinhibition
- Emotional lability
- Psychological adjustment problems and depressive/ anxious symptoms
- Difficulty attending work or school
- Fatigue, drowsiness and sleep disturbances (including insomnia) or sleeping more than usual

**Loss of consciousness does not usually occur.**
While people commonly associate concussion with loss of consciousness, this occurs in fewer than 10% of cases

An ACC concussion assessment pocket card* is available at: https://www.accsportsmart.co.nz/assets/assets-final/resources-final/db8a31736a/SportSmart-concussion-cards.pdf

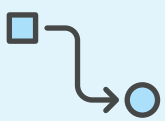
* The ACC pocket card resource is intended for use in a sports-related context, i.e. on the side-line, however, it may still be useful as a quick reminder of concussion symptoms/signs/red flags for clinicians in primary care, or as a prompt to explain concepts to patients.


1. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022);
2. The Australian Institute of Sport, Australian Medical Association, Australasian College of Sport and Exercise Physicians and Sports Medicine Australia. Concussion in Sport Australia. Position Statement. 2019. Available from: https://www.concussioninsport.gov.au/__data/assets/pdf_file/0005/683501/February_2019_-_Concussion_Position_Statement_AC.pdf (Accessed Feb, 2022).

# Digging deeper to support suspicions

**Always**

## Ask questions about any recent accidents or injuries



A **plausible mechanism of injury** needs to be established

**Example questions**

- *Do you remember what you were doing when the accident occurred?*
- *Were you struck on the head, or did your head jolt back and forth? If so, how severe was it?*
- *Did anyone say you were lying still or were unresponsive after the accident?*
- *Were you able to answer questions from people, talk coherently and think clearly afterwards?*
- *Have you previously had a concussion?*

Information may need to be derived from **a witness of the event, video footage** or via a **caregiver**

**If needed**

## Consider additional neurocognitive and physical tests

Features of concussion may become apparent when a patient is asked to complete **tasks that challenge neurocognitive or physical abilities**

**However** in the **absence of a baseline score** there is no *single* validated test

- A variety of individual tests usually form part of a multifaceted screening assessment to identify additional clinical deficits

e.g.

**Vestibular Ocular Motor Screening (VOMS)**

- Includes balance, vision and movement tests

**Standardised Assessment of Concussion (SAC)**

- Includes questions relating to memory and cognitive function

1. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022).

# Clinical examination and consideration of red flags

Perform a **targeted clinical examination**, primarily looking for any **neurological abnormalities**

- Focus on cranial nerves C1 – C8
- Assess cervical spine range of motion

For an example of neurological assessments (including both written descriptions and a video explanation), see:
https://www.msdmanuals.com/en-nz/professional/neurologic-disorders/neurologic-examination/how-to-assess-the-cranial-nerves

Be alert for prominent **vestibular dominant symptoms** (e.g. dizziness, vertigo); this may indicate **BPPV**

## Red flags to consider for emergency referral

### Physical

- Worsening of initial symptoms
- Severe or increasing headache
- Severe neck pain
- Repeated vomiting (as a general guide, more than one vomit in an adult or any vomiting in a child)
- Seizures or convulsion
- Ongoing diplopia or other significant visual disturbances
- Weakness, tingling or a burning sensation in the arms or legs
- Ongoing or severe dizziness/vertigo

### Cognitive

- Prolonged loss of consciousness (≥ 2 minutes), or deteriorating conscious state
- Inability to recognise people or places
- Dysarthria (slurred speech)
- Prolonged post-traumatic amnesia (> 12 hours)

### Behavioural/emotional

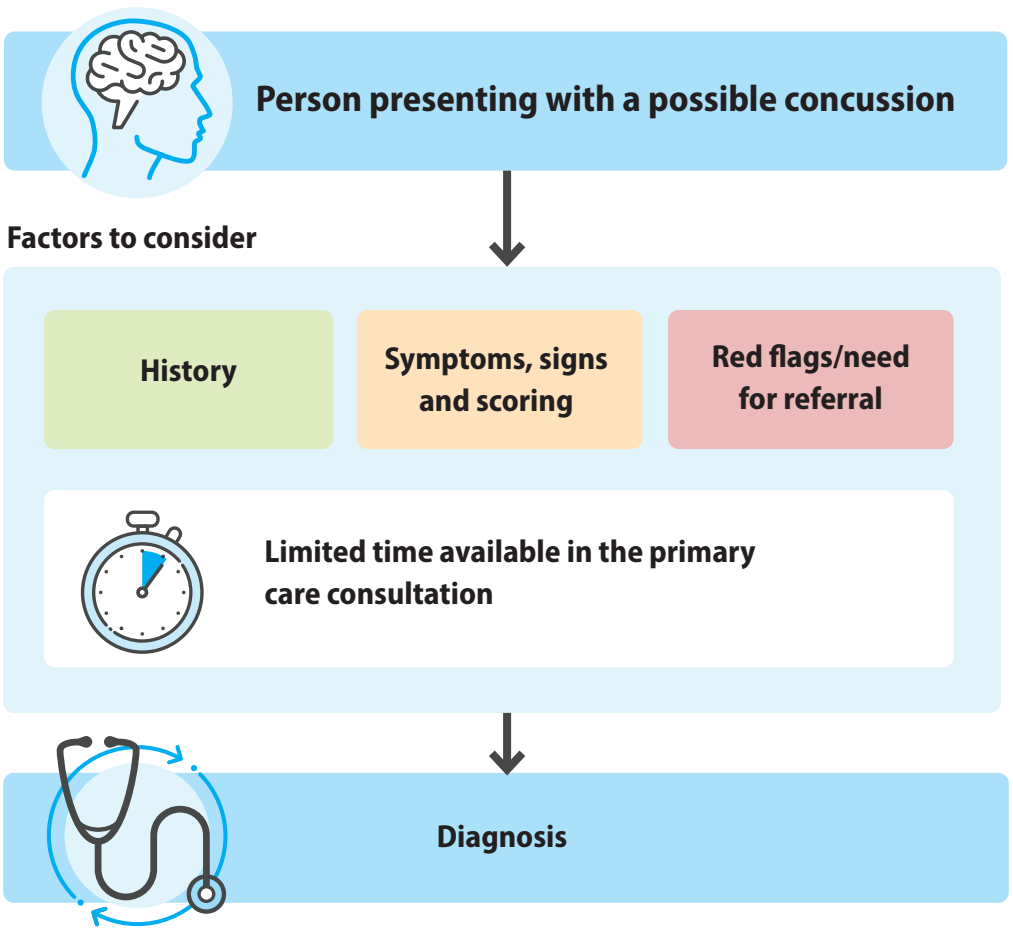
- Increasing restlessness, agitation, confusion or combative behaviours
- Significantly unusual/inappropriate behaviours or personality changes

**A lower threshold for referral is appropriate for certain risk groups**, e.g. younger children, older people or patients who are taking anticoagulants

BPPV, benign paroxysmal positional vertigo.


1. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022);
2. The Australian Institute of Sport, Australian Medical Association, Australasian College of Sport and Exercise Physicians and Sports Medicine Australia. Concussion in Sport Australia. Position Statement. 2019. Available from: https://www.concussioninsport.gov.au/__data/assets/pdf_file/0005/683501/February_2019_-_Concussion_Position_Statement_AC.pdf (Accessed Feb, 2022).

# Tying together the components of clinical review: *which assessment tool to use?*




**Clinical assessment tools** have been developed that aim to tie together the numerous factors which need to be considered

e.g.

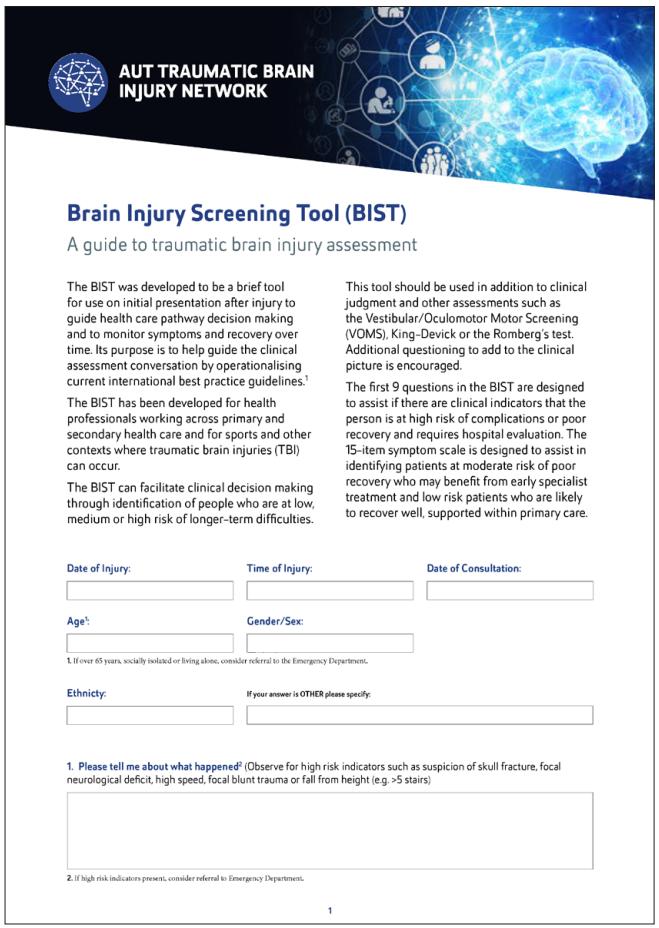
Sports Concussion Assessment Tool-fifth Edition (SCAT-5)

Rivermead Post-Concussion Symptom Questionnaire (RPQ)

**However, these are neither tailored to the context nor time constraints** of primary care consultations

1. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022).

# The Brain Injury Screening Tool (BIST)



AUT TRAUMATIC BRAIN INJURY NETWORK

## Brain Injury Screening Tool (BIST)

A guide to traumatic brain injury assessment

The BIST was developed to be a brief tool for use on initial presentation after injury to guide health care pathway decision making and to monitor symptoms and recovery over time. Its purpose is to help guide the clinical assessment conversation by operationalising current international best practice guidelines.[1]

The BIST has been developed for health professionals working across primary and secondary health care and for sports and other contexts where traumatic brain injuries (TBI) can occur.

The BIST can facilitate clinical decision making through identification of people who are at low, medium or high risk of longer-term difficulties.

This tool should be used in addition to clinical judgment and other assessments such as the Vestibular/Oculomotor Motor Screening (VOMS), King-Devick or the Romberg's test. Additional questioning to add to the clinical picture is encouraged.

The first 9 questions in the BIST are designed to assist if there are clinical indicators that the person is at high risk of complications or poor recovery and requires hospital evaluation. The 15-item symptom scale is designed to assist in identifying patients at moderate risk of poor recovery who may benefit from early specialist treatment and low risk patients who are likely to recover well, supported within primary care.

Date of Injury: | Time of Injury: | Date of Consultation:

Age[1]: | Gender/Sex:

1. If over 65 years, socially isolated or living alone, consider referral to the Emergency Department.

Ethnicity: | If your answer is OTHER please specify:

1. Please tell me about what happened[2] (Observe for high risk indicators such as suspicion of skull fracture, focal neurological deficit, high speed, focal blunt trauma or fall from height (e.g. >5 stairs)

2. If high risk indicators present, consider referral to Emergency Department.

1

Designed to be completed in **six minutes**

Suitable for both **adults and children** (aged ≥ 8 years)

- **Patient details** and the **injury context**
- **Key prognostic questions** that may suggest the person is at high risk of complications and requires hospital evaluation
- A **16-item symptom severity checklist**, with associated **recommendations for referral**, or primary care follow-up based on the cumulative score in accordance with threshold cut-offs
  - **Baseline scoring data obtained** from an initial BIST assessment can be used to **facilitate patient monitoring** for improvement over time (see Part 2)
- The overall **impact of the injury on the patient's quality of life**

BIST was developed in New Zealand and has been validated

- **Questions are straightforward** for patients to understand
- Shown to be a psychometrically **reliable measure of symptom burden**

1. Auckland University of Technology (AUT) Brain Injury Network. Brain Injury Screening Tool: a guide to TBI assessment. 2021. Available from: https://tbin.aut.ac.nz/support-and-resources/brain-injury-screening-tool-bist (Accessed Feb, 2022).

# Diagnose concussion based on clinical judgement

- Plausible brain injury mechanism documented
- Symptoms and signs consistent with altered brain functioning
- Symptom severity assessed using a scoring criteria
- Exclude more serious injury that requires emergency department referral

This process can be supported by using **BIST**

**Imaging and blood tests are not useful** unless there is suspicion of a differential diagnosis

Deliver appropriate **management advice, reassurance** and general **education** relating to concussion
**– For further information, see Part 2**

**Referral to ACC concussion services is generally not appropriate** at the first consultation as it is too early to predict recovery – *only half of patients recover within two weeks*

N.B. This will depend on the time to presentation (some patients may not present in primary care within the first two weeks) and other complicating factors, e.g. pre-existing mental health conditions – for further information, see the "Part 2: the management and education of patients with concussion" slidecast

BIST, Brain Injury Screening Tool


1. Kara S, Crosswell H, Forch K, et al. Clin J of Sport Med. 2020;30:96–101;
2. Ontario Neurotrauma Foundation. Guideline for concussion/mild traumatic brain injury & prolonged symptoms. 3rd edition, for adults over 18 years of age. 2018. Available from: https://braininjuryguidelines.org/concussion/ (Accessed Feb, 2022).