Accelerometers for assessment of concussion in sport; a systematic review

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Intended journal for submission

Options include

- British journal of sports medicine
- Medical journal of Australia
- Clinical journal of sports medicine

Background

Concussion is defined as a complex pathological process affecting the brain, induced by biomechanical forces [1]. Sports-related concussion is one of the most common brain injuries in the world, accounting for over 50% of all diagnosed concussions [2]. Recently the use of accelerometers has enabled the measurement and quantification of the head's dynamic responses in sports impacts, including concussive impacts.

Several cohort studies have examined the effectiveness of accelerometers in monitoring concussive and sub-concussive episodes [3-8]. Despite this it remains unclear whether the biomechanical data from such instruments can provide reliable and objective quantification of the head’s dynamic response to impact. To date no systematic reviews have objectively assessed accelerometer data and their correlation with a clinical diagnosis of concussion.

The primary goal of this review is to assess whether studies examining athletes wearing accelerometer systems demonstrate a correlation between biomechanical data and a diagnosis of concussion or whether biomechanical data can assist with a diagnosis of concussion.

Objectives

The objective of this review is to determine whether parameters of the head's measured dynamic responses correlated with the clinical characteristics of concussion among athletes where head impact has been measured by an accelerometer system.

Methods

Eligibility criteria

Participants

We will include studies conducted on athletes (in any sport) who are instrumented with any head instrumentation (e.g. an accelerometer) for the purpose of measuring head impact.

Intervention

We will include studies that have published biomechanical data (linear or rotational acceleration or both) recorded by head instrumentation and associated such data to a measure of concussion.

Outcomes

Our primary outcome of interest is the diagnosis of concussion, as measured and defined by included study. This is most likely to be concussion as diagnosed by clinician and/or as indicated by objective measures of change on tools such as the SCAT (sports concussion assessment tool) [1].

Search strategy

Authors will search for articles in English language in MEDLINE, PubMed, the Cochrane library, Scopus, PsycINFO and SportDiscus for manuscripts published from 1990 until present. Truncation will be used in applicable databases. A combination of keywords and subject headings will be used, listed; “head acceleration”, “accelerometer”, “sensor*”, “acceleration”, “biomechanics”, “injury threshold”, “concuss*” (concussion, concussed, concussive), “brain inj*” (brain injury, injuries), “head inj*” (head injury, injuries), “mild traumatic brain injury”, “head impact”, “sport injury”, “sport*”, “athlete*”, “football”, “soccer”, “ice hockey”, “rugby”, “boxing”, “lacrosse”, “wrestling”, “tae kwon doe”, “karate”, “martial arts”. Keywords will be matched to subject headings to expand the scope of the search. MeSH/EMTREE terms will be included and are as listed; “acceleration”, “accelerometry”, “brain concussion”, “post-concussion syndrome”, “brain injuries”, “sports”. Reference lists of identified relevant studies and recent books will be hand-searched for further studies. All selected studies will be downloaded to endnote and duplicates will be removed.

Study selection

Two review authors will independently screen manuscripts on title and abstract, selecting agreed citations in full text. Two review authors will then independently screen the selected manuscripts on full text in keeping with the PRISMA statement protocol. Results will be compared and any disagreement will be resolved by discussion or consultation with a senior member of the review team. The study selection process will be documented according to the PRISMA flowchart [9].

Data collection/extraction

The following data will be extracted:

- Exposure: Accelerometer system used and biomechanical data recorded
- Outcomes:
    - Incidence of concussive, sub-concussive episodes
    - Definitions of concussion and sub-concussion used to make a diagnosis
    - Clinical markers of concussion, signs, symptoms and timing (e.g. day of injury)
    - Whether video recording of concussive and sub-concussive events correlated with accelerometer data or not
- Measures of study quality
    - Study design and source of funding
    - As per QUADAS-2 tool framework; patient selection, index test, reference standard, and flow and timing
- Potential confounders
    - Setting: sport played, level of sport played, helmeted vs non-helmeted
    - Participant characteristics: Patient demographics and injury characteristics

Assessing risk of bias

Two review authors will independently assess the risk of bias. Results will be compared and any disagreements resolved by discussion or consultation with a senior member of the review team.

To assess risk of bias in experimental studies we will use the QUADAS-2 tool [10]. This tool assesses four bias domains: patient selection, index test, reference standard, and flow and timing. Each domain is assessed in terms of risk of bias, and the first 3 domains are also assessed in terms of concerns regarding applicability.

Statistical analysis

Key study characteristics will be presented in table form and narratively described. Should there be a number of sufficiently homogenous studies (in terms of study design, population, intervention and outcome) a meta-analysis will be performed. If meta-analysis is deemed inappropriate, we will present a narrative summary of results, considering the strength, direction, precision and clinical significance of effects.

References

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