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Scientific/Clinical Article

Cumulative incidence of carpal instability 12-24 months after fall onto outstretched hand

Lisa O'Brien PhD [a,b,*], Luke Robinson BOccTherapy(Hons) [a], Eugene Lim MBBS [c], Hayley O'Sullivan BOccTherapy [d], Helen Kavnoudias PhD [e]

[a] Department of Occupational Therapy, Monash University, Frankston, Victoria, Australia
[b] Department of Occupational Therapy, Alfred Health, Melbourne, Victoria, Australia
[c] Department of Plastic and Reconstructive Surgery, Alfred Health, Melbourne, Victoria, Australia
[d] Department of Occupational Therapy, Melbourne Health, Melbourne, Victoria, Australia
[e] Department of Radiology, Alfred Health, Melbourne, Victoria, Australia

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ABSTRACT

Study Design: Descriptive Epidemiological Study.
Introduction: Ligament tears between carpal bones are easily missed on initial presentation, but can have potentially debilitating effects on the patient if they progress to an instability. They are usually the result of a fall onto an outstretched hand with the wrist in hyperextension. Current incidence of carpal instability after these falls is unknown.
Purpose of the Study: Using established clinical and radiological measures, we sought to establish the cumulative incidence of carpal instability in people who have fallen onto an outstretched hand in the second year after injury. We also sought to describe its relationship with functional impairment.
Methods: We used emergency department records of an inner-urban tertiary hospital to contact all patients who presented with wrist pain following fall onto outstretched hand who were between one and two years after injury. Carpal instability was defined by blinded radiological evaluations and provocative clinical tests, including Scaphoid Shift (Watson's) test, Ballottement, and mid-carpal shift test. Wrist-related pain and disability was measured using the Patient-Rated Wrist and Hand Evaluation.
Results: Of the 279 potentially eligible cases, only 146 were contactable, and fifty (28 male, 22 female; mean age of 48 years) attended for assessment. We found a cumulative incidence of 44% of carpal instability within the second year after injury. Of these, 12 (24%) cases had scapho-lunate instability, 12 (24%) had luno-triquetral instability and 7 (14%) had mid-carpal instability. There were no significant correlations between clinically confirmed carpal instability and pain, function, or work participation.
Discussion and Conclusion: This study found a higher than anticipated cumulative incidence of carpal instability in the second year after injury, which may reflect volunteer bias. Patients should be advised to monitor symptoms in the year after injury and seek a review if symptoms of pain, clicking or clunking arise.
Level of Evidence: II

Introduction

Ligament instability between carpal bones is easily missed on initial presentation as X-rays can appear unremarkable.[1] They most often occur after high-speed falls (or falls from a height) onto an outstretched hand with the wrist in hyperextension[2] and can have potentially debilitating effects on the patient if mismanaged.[3] In the worst cases, the altered kinematics can result in a collapse of the wrist structure resulting in pain and osteoarthritis.[4]

A diagnosis of carpal instability is made if the wrist is unable to carry physiologic loads without yielding and/or is incapable of moving smoothly without sudden changes (often experienced as a clunk, snap, or click) in the alignment of the carpal bones.[2] They are an important group of injuries in terms of their clinical and economic impacts as the peak incidence is in the third or fourth decades,[3] an important time in the life span for involvement in employment and sporting activity. Economic impacts include time

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* Corresponding author. Department of Occupational Therapy, Monash University, Frankston, Victoria 3199, Australia. Tel.: +613 9904 4100.
E-mail address: lisa.obrien@monash.edu (L. O'Brien).

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lost from work, health care costs (medical and therapy) and, in some cases, an inability to return to their previous occupation.[5] They can be particularly problematic injuries for athletes, leading to lost playing time, inability to perform at preinjury levels, and premature retirement from sport.[6] They are common in collision sports such as football[7] and gymnastics.[8]

It is estimated that perilunate injuries in general make up around 7%-10% of all wrist injuries[3,9] and 19% of sprains without fracture.[10] Incidence of carpal instability for those with fractures of the distal radius is estimated to be as high as 30%.[11] The true incidence of these injuries after a fall onto an outstretched hand is, however, currently unknown.

The aim of this study was to establish the cumulative incidence of carpal instability at 12-24 months after a fall using established radiologic and clinical measures to more accurately estimate the true incidence and identify whether an association exists between carpal instability and pain, function, and work participation.

Methods

Setting

The study took place at an urban tertiary hospital in Melbourne Australia. Emergency and trauma department records were accessed to identify all adults who had presented to the hospital after a fall onto outstretched hand (FOOSH) at least 12 months but no longer than 24 months previously. All were sent a letter inviting them to participate and, where current contact details existed, followed up via telephone. The study was approved by the Hospital and University Human Research Committees (Reference: 8/13 and CF13/2973-2013001596, respectively).

Inclusion/exclusion criteria

Adults who presented to emergency/trauma departments or outpatient hand clinics (as determined by hospital administrative database) with wrist pain after a FOOSH, including those sustained in falls during sporting, bicycle or motorcycle accidents, were invited to participate. Participants needed to be capable of providing informed consent and able to speak and comprehend the English language. We excluded pregnant or breastfeeding women (due to the exposure to radiation involved in X-rays as part of this study), people with coexisting rheumatologic disease, significant other injuries to the same limb, significant medical illness, and those who had undergone surgery for wrist instability within a year of their injury.

Procedures

All who agreed to participate attended the hospital for a single appointment at which written informed consent was obtained, demographic data (including sex, age, hand dominance, circumstances of injury, time off work, type of work, and current work participation) were collected, and outcome measures were taken.

Outcome measures

Wrist-related disability was measured using the patient-rated wrist and hand evaluation (PRWHE).[12] The PRWHE contains 15 items: 5 of which evaluate pain (intensity and frequency) and 10 evaluate function (specific activities and usual activities). Information gained from the PRWHE can be used to determine the magnitude of wrist-related disability at one point in time.[13]

Clinical examination of the wrist was conducted by 2 skilled senior public hospital hand therapists from occupational therapy backgrounds, whose assessment technique was credentialed by a senior hand surgeon before commencement of the study. Assessment included a brief interview with the participant regarding areas of pain/tenderness and the following provocative tests of carpal ligaments on both hands. If a test result on the uninvolved wrist was also positive, the positive finding from the involved wrist was nullified.

Provocative tests

- Scaphoid shift (Watson's) test[14] to confirm scapholunate (SL) instability. A positive result was recorded if a clunk was produced when the examiner's thumb pressure was removed or if the patient's symptoms were reproduced. This test has a mean positive likelihood ratio (calculated by dividing sensitivity by 1 − specificity) of 4.7, making it *highly recommended* in a review of provocative wrist tests.[15]
- Ballottement test[16] to confirm lunotriquetral (LT) instability. A positive result was recorded if the participant's painful symptoms were reproduced and/or if excessive laxity at the LT joint (compared with the opposite hand) was evident. This test has a mean positive likelihood ratio of 1.12; however is considered in the *neutral* category due to insufficient published studies.[15]
- Midcarpal shift test to confirm midcarpal instability. A positive test was only recorded if there was a catch-up clunk in the midcarpal joint as well as eliciting the participant's painful symptoms. This test has a mean positive likelihood ratio of 2.67 making it *recommended*.[15]

Participants then underwent the following wrist X-rays:

- Neutral posterior to anterior (PA) view with the wrist in neutral alignment and elbow at shoulder height (so that the radius and ulna are parallel). This enabled identification of static SL instabilities (defined as a gap $\geq$3 mm) and was used as a baseline for comparison with functional PA views;
- Functional PA views also with the elbow at shoulder height and the forearm supinated and with a clenched fist (to detect any widening of the SL gap).[17] Then in radial deviation and ulnar deviation. This allowed us to compare functional PA and neutral PA views to discriminate between static instabilities (ie, those that are constantly present and that can be recognized on a routine radiographic examination) and dynamic instabilities (ie, those that are present transiently and require stress or motion to produce them); and
- Lateral view with the elbow adducted to the side, with shoulder, elbow, and wrist in 1 plane. This positioning enabled the lateral view to be exactly perpendicular to the PA view and enabled identification of static SL instabilities (a gap $>$3 mm) and volar intercalated segment instability (VISI) deformities (capitolunate angle $>30^\circ$) indicating LT dissociation.

As there are considerable variations in normal anatomy, we included X-rays of both wrists, so that any suspected abnormality could be compared with the opposite wrist. A hand surgeon blinded to the symptomatic side assessed standardized X-rays of both wrists. In particular, carpal alignment observing Gilula's lines, SL angle, and lunocapitate alignment were assessed to determine any carpal malalignment, dorsal intercalated segment instability, or VISI. Widening of the SL interval, particularly if asymmetrical or increased with functional views, was assessed to determine if there was radiologic evidence of an SL injury. A dynamic SL instability was defined as an SL midinterval gap of $<$3 mm on the PA neutral view that widened on any of the functional views and static SL instability by a gap of $\geq$3 mm in the PA neutral views that