

Hand Rehabilitation Programs Used for Second to Fifth Metacarpal Fractures: A Systematic Literature Review Protocol

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Protocol

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Abstract

Background

Metacarpal fractures have an incidence rate of 13.6 per 100000, affects males more than females and accounts for 33% of all hand fractures. No evidence-based rehabilitation program exists for second to fifth metacarpal fractures potentially causing poor health related quality of life, decrease hand function and disability.

Methods

Experimental study designs, quasi-experimental, cohort studies and case control studies for the last ten years from January 2008 to September 2018 with English as a language restriction will be included. Sources investigating hand rehabilitation, immobilization, splinting and home programs after surgical and conservative management for second to fifth metacarpal fractures, will be included. MEDLINE, Academic Search Ultimate, CINAHL, CAB Abstracts, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, SPORTDiscus, Africa-Wide Information, MasterFILE Premier, Google Scholar and other grey literature will be searched. Two independent reviewers will independently conduct the study selection, methodology quality assessment and extraction of data. Findings will be pooled, meta-analysis performed, Summary of Findings provided according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis if deemed appropriate.

Discussion

It is imperative to implement effective rehabilitation to prevent poor health related quality of life, decrease hand function and disability. In this systematic literature review, we will determine the existing evidence on hand rehabilitation programs used after post-surgical and conservative management for 20 to 59-year-old humans who sustained a single or multiple second to fifth metacarpal fracture.

Background

Metacarpal fractures account for 10% of bony injuries, one of the most prevalent upper limb injuries among adults [1]. The fifth metacarpal neck fracture called the Boxer's fracture, accounts for 20% of all hand fractures [2]. PROSPERO, the Cochrane Database of Systematic Reviews, the JBI Database of Systematic Review and Implementation Reports and MEDLINE was searched with no current systematic literature review or for the past ten years on a similar topic. The lack of best evidence rehabilitation programs for individuals who sustains second to fifth metacarpal fractures is concerning, especially when limited research exists about the impact of metacarpal fractures on the quality of life. The hand is crucial in performing activities of daily living [3].

The relationship between hand fractures and epidemiology in a social deprived population has been investigated [4]. Boxer's fractures (27% of total hand fractures) were significantly associated ($p=0.017$)

with social deprivation in men. Social deprivation further influenced the pattern and the management of the fractures, where affluent individuals received operative treatment more often [4].

Fifth metacarpal fractures have left individuals with functional deficits including weakened grip strength and decreased metacarpal joint ROM. The concern of these residual deficits is that the young and working adult population sustains metacarpal fractures most frequently [2]. With a decrease in hand function to earn a living and increase days off work, the economic consequences for both employees and employers is concerning [5].

Management of second to fifth metacarpal fractures varies in literature and is dependent on, but not limited to, the follow factors: surgical or conservative medical management, area of fracture, angulation, rotation and shortening of the metacarpal bone. Literature relating to hand rehabilitation after surgical and conventional management will be provided [6-10].

In a retrospective study, 162 individuals who sustained fifth metacarpal fractures irrespective of area (shaft, neck or base) and met the inclusion criteria, were managed with strapping the finger to the next finger (buddy strapping) and early mobilization [7]. Ninety-eight of the participants were assessed with a self-reported, posted questionnaire and a follow-up telephone call, at a mean follow-up time of 21.6 months. The outcomes and outcome measures included: patient satisfaction on a four-point Lickert scale, hand function with the Quick Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH), disability with the EuroQol-five dimensions (EQ-5D). Seventy-nine individuals were satisfied with the outcomes (80.6%) and 83 individuals with the process (84.9%). No statistical difference was found between the individuals who sustained a fifth metacarpal fracture and no fractures, in the QuickDASH scores ($p=0.820$) and EQ-5D ($p=0.307$). The decrease number of follow-up sessions was reported to be the benefit of the process [7].

In a prospective cohort randomized control trial (RCT) the effect of a traditional physiotherapy (PT) program compared to a home exercise program for non-thumb (second to fifth) metacarpal fractures managed with open reduction internal fixation procedures, was measured [8]. The follow up assessments at two weeks postoperatively, demonstrated a severe loss of digital ROM in both groups. The grip strength measurements improved from six weeks to 12 weeks for the PT group from 68% to 91% and for the home exercise group from 71% to 93%. The ROM measured at three months improved to 245° total active motion (TAM) for the PT group and 256° TAM for the home exercise group out of a normal digit range of motion of 270°. The findings suggested that a well-developed and instructed home exercise program as post-operative management for second to fifth (non-thumb) metacarpal fractures can be as effective as traditional PT rehabilitation [8].

A systematic literature review from January 2008 up to September 2018 is the starting point to achieve the objective below.

Objectives

To identify and evaluate evidence on hand rehabilitation programs used after post-surgical and conservative management, for humans between 20 and 59 years of age, who sustained a single or multiple second to fifth metacarpal fractures on outcomes not limited to, hand function, HRQoL, disability, grip strength and digital ROM.

Methods

The proposed systematic literature review will be conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting methods to ensure accuracy, completeness and transparency in planning [11]. A PRISMA-P checklist is presented in an Additional file 1 [11]. The systematic literature review was registered with PROSPERO with the number CRD42019132620. The PRISMA flow diagram for the protocol is presented in Figure 1 below.

Search strategy

A search strategy aimed towards locating both published and unpublished sources will be developed. An information scientist will assist the researcher with development of the search strategy on the appropriate databases.

Primary search strategies will search the databases accessible to the University and the electronic platforms. EBSCOHost databases that include: MEDLINE with Full Text, Academic Search Ultimate, CINAHL with Full Text, CAB Abstracts, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, SPORTDiscus with Full Text, Africa-Wide Information, and MasterFILE Premier will be searched.

Searches will further be performed on Web-of-Science and Scopus to ensure coverage of all available evidence. An example of a database with the search strategy keywords is presented in Table 1. Secondary search strategy will include: grey literature and unpublished sources. Two independent reviewers will screen the reference lists of included full text articles for potential inclusion of further eligible studies.

Table 1 Search strategy

Search	Query	Records retrieved
#1	Database: CINAHL ((boxer* or metacarpal*) n2 fractur*) and (exercis* or program* or protocol* or "functional rehab*" or rehab* or advis* or advic* or educat* or splint* or immobili* or physiotherap* or "physical therap*" or "occupational therap*" or outcome*)	
Limited to January 2008 to September 2018, limited to English		

Eligibility criteria for studies

This review will include experimental study designs, including RCT and quasi-experimental studies, observational studies including retrospective, prospective cohort studies and case control studies for the last ten years from January 2008 to September 2018. A language restriction will apply. Only English resources will be included. Studies including adult human participants older than 20 years and younger than 59 years of age will be included. Participants younger than 20 years will not be included due to skeletal immaturity [12]. Participants older than 59 years of age will not be included because of possible osteoarthritis [13]. Studies reporting on post-surgical and conservative hand rehabilitation interventions for single or multiple second to fifth metacarpal fractures will be included. The three main intervention categories related to hand rehabilitation that will be included are; hand rehabilitation programs, home education and immobilization. Hand rehabilitation programs include functional and/or non-functional exercises and other hand therapy modalities/treatments. Home education includes; advice, home education and home exercises. Immobilization interventions will include, but not be limited to, plaster of paris and/or splinting utilized. Studies comparing hand rehabilitation programs or exercises to home education, self-care programs and different immobilization/splinting programs, will be included.

Studies excluded will now be stated. Studies investigating thumb metacarpal fractures due to the difference in hand performance in rehabilitation. Second to fifth metacarpal fractures with an associated tendon injury, nerve injury or pre-existing osteoarthritis or rheumatoid arthritis due to different physiological healing timeframes acting as complicating factors. Studies investigating second to fifth metacarpal fractures with a concurrent fracture of the phalangeal bones, carpal bones, distal radius and ulna due to different management and joint kinematic involvement, which could be confounding variables and can possibly affect the generalization of results. Infections will be seen as a complicating factor to fracture healing and management in the instance where it is documented.

Outcomes measures

This review will consider studies that include primary outcomes of hand function, HRQoL and disability. Secondary outcomes included will be, digital ROM, grip strength and fine motor dexterity. Outcome measures per outcome may include but will not be limited to: HRQoL measured with the EQ-5D questionnaire, disability measured with the quickDASH or Disabilities of the Arm, Shoulder and Hand (DASH) questionnaires, hand function measured with the Jebson Taylor Hand Function Test or Michigan Hand Outcome questionnaire, grip strength measured with a Jamar hydraulic dynamometer, fine motor dexterity measured with a Nine-Hole-Peg-Test, Purdue Pegboard test or Bruininks-Oseretsky Test of Motor Proficiency and digital ROM measured with a Rolyan finger goniometer. When other outcome measures are identified in the studies, they will also be included.

Data management

Title and abstract screening, review of full-texts and data extraction using a piloted modified Cochrane document will be undertaken.

Study selection

Following the search phase, the citations of all identified sources will be imported into Endnote® X8 (Clarivate Analytics, PA, USA.) where duplicates will be removed. The two independent reviewers will screen all identified articles. The screening of all identified articles, against the inclusion criteria, will be based on both the title and abstracts of articles eligible for inclusion. Excluded studies will be documented in a table with detailed reasons for exclusion [14]. Full-text articles for potentially relevant article/document, which adhere to the inclusion criteria, will be obtained followed by a thorough screening of the article/document by two independent reviewers. Disagreements during any phase of the study selection process, will be resolved through discussion by the two reviewers, and a third reviewer with experience in systematic literature reviews will act as the deciding vote in the instance where reviewers' discussion could not resolve the issue. Reporting of the results will be presented in the final systematic review with the PRISMA flow diagram to foster transparency in reporting of the results [15].

Data extraction

Data extraction from the included studies will be independently performed by two reviewers with a modified and piloted Cochrane extraction document [14]. Data extracted will include: population, participant demographics, participant numbers, participant's characteristics, interventions, comparisons, controls, outcome measures, study methods, study design, sampling details, socioeconomic status, fracture level and fracture types. Disagreement will be resolved through discussions among the reviewers, or a third reviewer when no consensus can be reached.

Quality assessment

Quality assessment of all included studies will be undertaken by two independent reviewers at the outcome level, with a third reviewer acting as a deciding vote in disagreement. The JBI critical appraisal checklists for Experimental studies (RCT), Quasi-experimental studies, Controlled observational studies

(including cohort studies) and Case control studies will be used [16]. The critical appraisal results will be reported in a narrative form and in a table format. The appraisal tools assess: selection bias, allocation bias, reporting bias, detection risk, performance bias and attrition bias. Response options on the appraisal checklists are: 'yes' (criteria appropriately applied), 'no' (criteria not applied), 'unclear' (criteria not described clearly) and 'not applicable'. After reviewing each included study according to the criteria, the studies will be classified as follows: low risk of bias: criteria are all met, moderate risk of bias: one or more criteria not clearly reported and high risk of bias: one or more criteria not met.

Data synthesis and assessment of heterogeneity

A narrative summary report of the finding of included studies and a quantitative summary using meta-analysis, will be provided if the included studies are sufficiently homogeneous. An expression of either odd ratios for dichotomous data or weighted mean differences for continues data will be utilized and the confidence interval of 95% will apply for analysis. Heterogeneity is expected due to the diversity of included studies and thus will be evaluated by visual examination of forest plots and poor overlap between confidence intervals. The Chi² (0.1 significance level) and I² statistical test (0%-40% low importance, 30%-60% moderate, 75%-100% high heterogeneity) will be used (11). The X² test of heterogeneity will determine whether the differences between results are due to chance alone. A random-effects model will be used when it has been decided to pool the results as some degree of heterogeneity is expected between studies. Where sufficient data is synthesized on variability in hand rehabilitation or immobilization/splinting effects across different participants or study types, a subgroup analysis will be performed. A sensitivity analyses on different ranges of variables will be conducted to test the outcomes of decisions made, when deemed appropriate.

Limitations

Where high heterogeneity is measured, combining data will be difficult and a meta-analysis unlikely. In the instance of small sample sizes, limited conclusions can be drawn from this review, due to limited quality.

List Of Abbreviations

DASH Disabilities of the Arm, Shoulder and Hand

EQ-5D EuroQol-five dimensions

JBI Joanna Briggs Institute

PT Physiotherapists

PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analysis

RCT Randomized control trial

ROM Range of motion

TAM Total active motion

QuickDASH Quick Disabilities of the Arm, Shoulder and Hand questionnaire

Declarations

Ethical approval

This research has been approved by a Health Sciences Research Ethics Committee (UFS-HSD2019/0046/2602).

Consent for publication

Not applicable

Competing interests

The authors, MK, RB and CB declares no competing interests.

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Authors' contributions

MK proposed the topic of research, wrote the protocol for ethical approval and the first version of the article. The protocol and article were read, elaborated and refined with the help of RB and CB.

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Accessibility of data and material

Any underlying research material related to the systematic literature review and future results will be made accessible on the primary author's ORCID account.

Statement of Human and Animal Rights

The article does not contain original research with human or animal subjects.

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Figures



PRISMA 2009 Flow Diagram

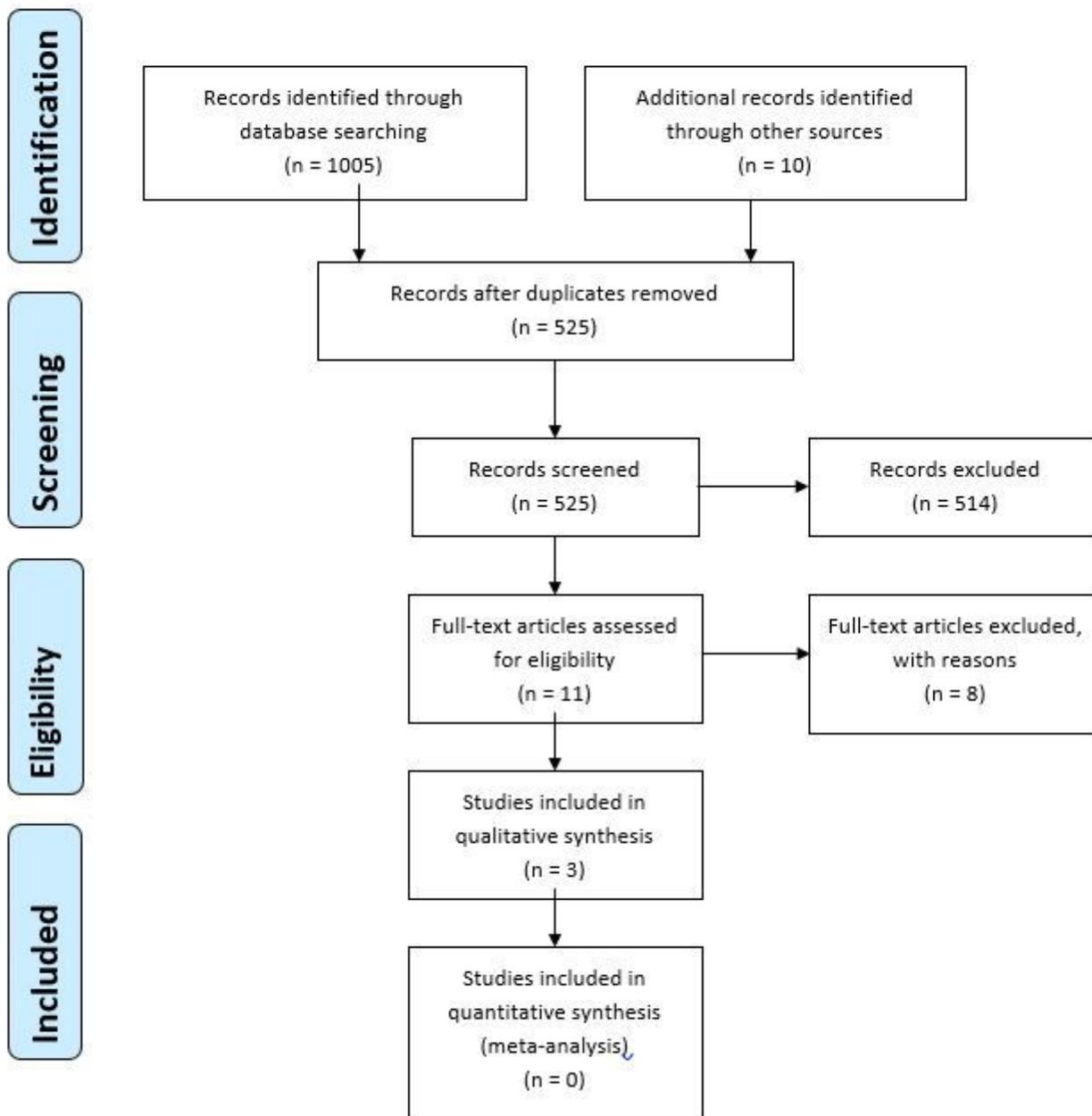


Figure 1

PRISMA flow diagram