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Vocational rehabilitation for enhancing return-to-work in workers with traumatic upper limb injuries (Review)

Hou WH, Chi CC, Lo HL, Chou YY, Kuo KN, Chuang HY

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[Intervention Review]

Vocational rehabilitation for enhancing return-to-work in workers with traumatic upper limb injuries

Wen-Hsuan Hou[1,2], Ching-Chi Chi[3,4], Heng-Lien Lo[5], Yun-Yun Chou[6], Ken N Kuo[7], Hung-Yi Chuang[8]

[1]School of Gerontology Health Management and Master Program in Long-Term Care, College of Nursing, Taipei Medical University, Taipei, Taiwan. [2]Department of Physical Medicine and Rehabilitation, Taipei Medical University Hospital, Taipei, Taiwan. [3]Department of Dermatology, Chang Gung Memorial Hospital, Linkou, Taoyuan, Taiwan. [4]College of Medicine, Chang Gung University, Taoyuan, Taiwan. [5]Division of Quality Improvement, Joint Commission of Taiwan, New Taipei City, Taiwan. [6]Shared Decision Making Resource Center, Taipei Medical University-Shuang Ho Hospital, New Taipei City, Taiwan. [7]Cochrane Taiwan Research Center, Taipei Medical University, Taipei, Taiwan. [8]Occupational and Environmental Medicine, Kaohsiung Medical University Hospital and Kaohsiung Medical University, Kaohsiung City, Taiwan

Contact: Ching-Chi Chi, Department of Dermatology, Chang Gung Memorial Hospital, Linkou, 5, Fuxing St, Guishan Dist, Taoyuan, 33305, Taiwan. chingchi@cgmh.org.tw, chingchichi@gmail.com.

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ABSTRACT

Background

Traumatic upper limb injury is a leading cause of work-related disability. After return-to-work (RTW), many survivors of injuries are able to regain a quality of life (QoL) comparable with the normal population. Since RTW plays an important role in economic productivity and regaining health-related QoL, enhancing RTW in workers with traumatic limb injuries is the primary goal of rehabilitation. Vocational rehabilitation has been commonly employed in the field of occupational safety and health to increase the number of injured people returning to the labour market, prevent illness, increase well-being, and reduce disability.

Objectives

To assess the effects of vocational rehabilitation programmes for enhancing RTW in workers with traumatic upper limb injuries.

Search methods

This is an update of a Cochrane review previously published in 2013. We updated our searches of the following databases: the Cochrane Central Register of Controlled Trials (CENTRAL; 2017, Issue 9), MEDLINE (to 30 August 2017), EMBASE (to 3 September 2017), CINAHL (to 6 September 2017), and PsycINFO (to 6 September 2017), and we handsearched the references lists of relevant review articles.

Selection criteria

We aimed to include all randomised controlled trials (RCTs) comparing vocational rehabilitation with an alternative (control) intervention such as standard rehabilitation, a limited form of the vocational rehabilitation intervention (such as advice on RTW, referral information, or liaison with employer), or waiting-list controls.

Data collection and analysis

Two authors independently inspected abstracts, and we obtained full papers when necessary. When the two authors disagreed about the inclusion of a study, we resolved disagreements by discussion. A third author arbitrated when necessary.

Main results

Our updated search identified 466 citations. Based on assessments of their titles and abstracts, we decided to evaluate the full texts of five records; however, none met our inclusion criteria.

Authors' conclusions

There is currently no high-quality evidence to support or refute the efficacy of vocational rehabilitation for enhancing RTW in workers with traumatic upper limb injuries. Since injured people in occupational settings frequently receive vocational rehabilitation with the aim of decreasing work disability, enhancing RTW, increasing productivity, and containing the welfare cost, further high-quality RCTs assessing the efficacy of vocational rehabilitation for workers with traumatic upper limb injury are needed to fill this gap in knowledge.

PLAIN LANGUAGE SUMMARY

Vocational rehabilitation for helping workers return to work after injuring their fingers, hand, or arm

What is the aim of this review?

We wanted to find out if vocational rehabilitation can help workers return to work after injuring their fingers, hand or arm.

Key messages

There is no evidence provided by randomised controlled trials (RCTs) to say if vocational rehabilitation can help workers with upper limb injuries return to work. These studies are needed, and they should be conducted and reported according to agreed standards for high-quality research. They should describe the content of vocational rehabilitation in detail. They should also report the number of workers that have returned to work at the end of follow-up or the time it took for them to return to work.

What was studied in the review?

Workers who injure their fingers, hand, or arm often cannot continue working normally. In many countries law compels employers to help workers when injuries affect their work ability. This help is often referred to as vocational rehabilitation. Vocational rehabilitation refers to ways to help disabled workers return to work or to find a new job. Return-to-work can be supported by helping the injured worker cope better, by workplace adjustments, or by physical exercises. Although all these strategies are used in practice, it is still unclear which approach is best and in which circumstances. This is an update of a Cochrane review previously published in 2013.

What are the main results of the review?

We examined all the research published up to 30 August 2017. We wanted to include only studies that randomly assigned participants to receive either vocational rehabilitation or some other treatment. This way of conducting research, commonly known as RCT, is the best way to ensure that any measured improvement is really caused by the treatment. We did not find any RCTs that had studied whether vocational rehabilitation can help workers with upper limb injuries return to work.

How up-to-date is this review?

We searched for studies up to 30 August 2017.

BACKGROUND

Description of the condition

The World Health Organization (WHO) defines injury as "a bodily lesion at the organic level, resulting from acute exposure to energy in the work environment (mechanical, thermal, electrical, chemical or radiant) in amounts that exceed the threshold of physiological tolerance. In some cases (e.g. drowning, strangulation, freezing), the injury results from an insufficiency of a vital element" (Baker 1984). Among the various injuries, traumatic upper limb injuries frequently occur in mechanised industry when people interact with machines, at home, during transportation, and in recreation and sports activities (King 1992). Due to the complex physical arrangement, traumatic upper limb injuries often involve varying degrees of damage to, or even loss of, tissue such as the skin, tendons, nerves, blood vessels, bones, or the whole upper limb. Because traumatic upper limb injuries affect multiple systems (including the musculoskeletal, vascular, and nervous systems), the resulting impairment is often devastating (Cooper 2007). The disability caused by traumatic upper limb injuries significantly reduces physical (e.g. immobility), psychological (e.g. depression), and socioenvironmental well-being (e.g. work and leisure activities) and can cause very severe health problems among workers (Hou 2013a). However, the ability to work after sick leave is strongly associated with improved health, self-esteem, financial reward, connections with others in the community, and health-related quality of life (Post 2006a).Therefore, a comprehensive return-to-work (RTW) rehabilitation programme following traumatic upper limb injuries aims to enable resumption of participation in work and leisure activities (Blackmore 1992).

In the UK, upper limb injuries were the most frequent type (47.3%) of non-fatal injury to employees from 2010 to 2011 (HSE 2012). In Australia, there were 16,712 cases (32%) of work-related hand and wrist injuries resulting in hospitalisations from 1 July 2002 to 30 June 2004; in Victoria alone, 12,491 (32.7%) of emergency department presentations were work-related hand and wrist injuries (ASCC 2008). In the US, 25.1% of nonfatal occupational injuries and illnesses causing work absences per 10,000 full-time workers were related to upper limb injuries in 2010 (BLS 2010). In Taiwan, traumatic upper limb injuries are the most frequent type of occupational injury and the major cause of functional impairment and work-related disability (accounting for 45% of 14,261 occupational injuries and 55.8% of occupational permanent disability benefits in 2010) (CLA 2011). Many traditional factories in Taiwan are of medium to small scale and usually demand skilled manual labour. Factories commonly have inadequate occupational safety training programmes, or their staff is insufficiently knowledgeable and incapable of seeking adequate vocational rehabilitation (VR) programmes, which results in high hand injury-related disability (Hou 2008). In addition to the inability to perform essential functions required at work, such as lifting and grasping, some injured workers also have great difficulties in daily activities such as bathing, dressing, and toileting independently.

Undoubtedly traumatic upper limb injuries cause considerable losses in working days and productivity (Ebel 2004). However, survivors of severe injuries can achieve a quality of life (QoL) comparable with the normal population after returning to their previous jobs (Post 2006). On the other hand, the permanent dysfunction of limb-injured workers not only limits their daily activities but also directly affects their outcomes in their RTW. For a worker with traumatic upper limb injuries, RTW plays an important role in economic productivity and regaining meaningfulness in life. Therefore, the goals of rehabilitation for patients with traumatic upper limb injuries should be functional independence and RTW.

Description of the intervention

A person's ability to work can be profoundly affected by their disease, disability, and a range of contextual factors. Rehabilitation medicine is integral to the process that enables people to go back to working life following illness or injury, but other rehabilitation disciplines are also essential. It is important to clarify what rehabilitation physicians or trainees in rehabilitation medicine need to know about vocational rehabilitation (VR).

VR is defined as a process that enables persons with functional, psychological, developmental, cognitive and emotional impairments or health disabilities to overcome barriers to accessing, maintaining or returning to employment or other occupation (VRA 2013). On the other hand, general rehabilitation focuses on facilitating the functional recovery from injury, illness, or disease to its original state as possible. Therefore, VR consists of a range of techniques involving the provision of health advice and promotion, supporting self-management of health conditions, making adjustments to the impact of a disability, case management, service coordination, job analysis, job development, career counselling, and functional or work capacity evaluations, which could effectively help disabled workers return to work or to find a new employment (VRA 2016).

VR is a process whereby those disadvantaged by illness or disability can access, maintain, or return to employment. This applies to those with temporary and permanent impairments. Miscellaneous VR programmes are involved, in parallel, during the process of returning to the labour market after an injury. Therefore, VR may be used synonymously with either clinical rehabilitation services or any other types of interventions involved in the community settings such as work disability prevention, prevention of job loss, or work reintegration. Furthermore, the personnel delivering VR include a range of practitioners such as rehabilitation specialists, occupational therapists, occupational physicians, and social security officers (Waddell 2008). According to the British Society of Rehabilitation Medicine, VR aims to maximise the ability of an individual to return to meaningful employment, improve work and activity tolerance, avoid illness behavior, prevent deconditioning, and reduce pain and the effects of illness or disability (BSRM 2000). In this review, we define VR as changes or interventions with the aim of facilitating a worker's employment after injury. These may include one or more of the following: education, follow-up by a case manager, occupational therapy, worksite visits, on-site management, vocational guidance, occupational health services, work hardening, work modification, job accommodation, work adjustments, work reintegration plans, and ergonomic interventions. VR deals mainly with rehabilitation on the basis of the International Classification of Functioning, Disability and Health (ICF)-level of 'participation' (WHO 2001).

Workers who have not returned to work within 3 months after injury are at high risk of disability and dropping out of the work arena completely (Frank 1996). Therefore, encouraging early RTW by intervening at the workplace may be an efficient way to minimise socioeconomic and personal consequences (Elders 2004).

How the intervention might work

VR targets promoting employment opportunities for the disabled. When a defect due to trauma affects functional capacity for work or employment, VR may be necessary (Gobelet 2006). There are various factors influencing RTW. The chance of RTW is higher among younger people and men and among those with higher education, white collar work, less injury severity, less disability, more self-efficacy, and better psychological or QoL condition (Chamberlain 2009). Factors may be personal or medical, and some are external influences, such as activity, participation, and environmental factors in the ICF, which are categorised in the ICF as environmental factors (WHO 2001).

Although VR interventions vary, their purpose is in general "to maximise the ability of an individual to return to meaningful employment" (BSRM 2000). In other words, the best rehabilitation practice in RTW enhances work and activity tolerance, prevents illness behavior, and reduces pain and the effects of illness or disability (Gobelet 2006). Therefore, VR helps the injured people in mitigating work disability, accelerating return to meaningful employment, minimising lost workdays, increasing the productivity of injured workers, reducing premature retirement, and containing the welfare cost (Disler 2001).

Alhough the Association of British Insurers has suggested that functional and vocational rehabilitation for severe injuries should be administered only after reaching a medical plateau, when the worker's medical condition has stabilised and further significant medical improvement is unlikely (ABI & TUC 2002). From that time on, early intervention and the patient's active involvement can decrease deconditioning, that is, the decrease of physiological adaptation to normal conditions due to immobility, and illness behavior, fostering higher RTW rates (ABI & TUC 2002). Early VR programmes are likely to increase both job and physical well-being and to decrease the need for a disability pension and sick leave. According to a review on the general effects of rehabilitation on unspecified disability by Kuoppala 2008, VR and multimodal medical treatment combined with VR increase RTW. Moreover, VR delivered to people at risk of job loss (but still employed) can delay job loss (Allaire 2003). In this respect, VR can improve patients' QoL and well-being as well as reduce workforce attrition.

Why it is important to do this review

Several VR programmes have been used for traumatic upper limb injuries without a critical appraisal of their benefits. Traditional rehabilitation has emphasised training to improve strength, endurance, sensory function, and range of motion. However, recent reviews have shown that various novel VR programmes are effective in enhancing RTW in workers with various diseases or conditions (Aas 2011; Arends 2012; De Boer 2011; Khan 2009; Schaafsma 2010; Van Vilsteren 2015; Vogel 2017). Yet only a few systematic reviews have examined the effectiveness of VR in enhancing early RTW. According to the systematic review by Franche 2005, there is moderate to strong evidence that five kinds of VR, including early contact by the workplace, work accommodation, contact between healthcare provider and workplace, an ergonomic worksite intervention, or the use of a RTW coordinator, can shorten the duration of work disability (Franche 2005). In addition, a recent Cochrane Review focused on the effectiveness of RTW coordination programmes for workers on sick leave compared with usual practice (Vogel 2017). The Van Vilsteren 2015 review, on the other hand, focused on people with low back pain, recurrent musculoskeletal disorders, mental health problems, chronic work-related upper extremity disorders, or workers with cancer (Van Vilsteren 2015). Other published Cochrane Reviews have assessed the effectiveness of measures to improve RTW in a range of patient populations including those with brain injuries (Nair 2008), back pain (Schaafsma 2010), neck pain (Aas 2011), multiple sclerosis (Khan 2009), and cancer (De Boer 2011), which are all different from our target population of people with traumatic upper limb injuries. The first published version of this review found no randomised controlled trials (RCTs) on VR interventions for enhancing RTW in workers with traumatic upper limb injuries (Hou 2013).

OBJECTIVES

To assess the effects of vocational rehabilitation programmes for enhancing RTW in workers with traumatic upper limb injuries.

METHODS

Criteria for considering studies for this review

Types of studies

We planned to include all RCTs that compared VR with an alternative (control) intervention such as standard rehabilitation, a more limited VR intervention (such as advice on RTW, referral information, or liaison with employer), or waiting-list controls.

Types of participants

We planned to include trials where participants were working-age adults (18 to 65 years) who had been in paid employment (employee or self-employed) at the time of sustaining an acute episode of traumatic upper limb injury involving any parts of the fingers, hand, wrist, forearm, elbow, or arm, regardless of injury type and mechanism. We excluded participants with shoulder injuries. We excluded trials where participants had been suffering from a subacute or chronic upper limb injury for over three months.

When a study included workers with various kinds of injuries, we planned to include it if 50% or more of the participants had sustained upper limb injuries and the study authors reported separate analyses for them.

We excluded studies where participants had cumulative trauma disorders or repetitive strain injuries such as tendonitis or tendosynovitis, epicondylitis, carpal tunnel syndrome, or the like. We also excluded studies where participants had coexisting injuries to the central nervous system (that is brain or spinal cord), or to internal organs.

Types of interventions

We planned to include any type of intervention for enhancing RTW. Interventions may have been carried out either with an individual or in a group, and in a clinical setting or in the community. Interventions could primarily focus on different factors that influence RTW, for example on coping (in psychological interventions), workplace adjustments (in vocational interventions), or physical exercises (in physical interventions). Interventions are divided into the following.

- Psychological: any type of psychological intervention such as counselling, education, training in coping skills,

cognitive behavioral interventions, and problem-solving therapy undertaken by any qualified professional (such as a psychologist, social worker, or nurse).

- Vocational: any type of intervention focused on employment. Vocational interventions may be person-directed or work-directed. Person-directed vocational interventions incorporate programmes that aim to encourage RTW, VR, or occupational rehabilitation in individuals. Work-directed vocational interventions include workplace adjustments such as modified work hours, modified work tasks, modified workplace, and improved communication with or between managers, colleagues, and health professionals.
- Physical: any type of physical training (such as functional capacity training, work hardening training), physical exercises (such as tendon exercises, nerve gliding exercises), or training of bodily functions (such as muscle strengthening, balance training, endurance training, sensory re-education, range of motion).
- Multifaceted: a combination of psychological, vocational, and physical interventions.

Where there were multiple intervention groups within a trial, we planned to conduct pairwise comparisons of an intervention versus no intervention, placebo, or another intervention.

Types of outcome measures

Primary outcomes

RTW included return to either full- or part-time employment, to the same or a reduced role, and to either the previous job or any new employment (Clay 2010). We planned to consider two types of RTW data.

- RTW measured as event data, such as RTW rates, or as (change in) disability pension rates (Arnetz 2003; Loisel 2003).
- RTW measured as time-to-event data, such as number of days between reporting sick and any work resumption, or the number of days on sick leave during the follow-up period (Ebel 2004; MacKenzie 1998; MacKenzie 2006).

Secondary outcomes

- Functional status: measures related to job demands or activities of daily living expressed in terms of 'can perform the task' or 'cannot perform the task' (Burke 1994; Pransky 2005; Soberg 2010).
- Quality of life (QoL), measures including overall QoL, physical QoL, emotional QoL, and pain (Bültmann 2007; Post 2006).

Search methods for identification of studies

Electronic searches

For this update, we searched the following electronic databases from the date of the last search in the previous version of the review.

1. Cochrane Central Register of Controlled Trials (CENTRAL; 2017, Issue 9) in the Cochrane Library (searched 3 September 2017), using the search strategy in Appendix 1.
2. MEDLINE (15 November 2012 to 30 August 2017), using the search strategy in Appendix 2.
3. EMBASE (28 November 2012 to 3 September 2017), using the search strategy in Appendix 3.
4. CINAHL (5 May 2013 to 6 September 2017), using the search strategy in Appendix 4.
5. PsycINFO (7 December 2012 to 6 September 2017), using the search strategy in Appendix 5.

After discussion with the Editorial Base, we did not search the OSH UPDATE database for this update as it did not yield any relevant results for the previous version of this review (Hou 2013).

Searching other resources

In an effort to identify further published, unpublished, and ongoing studies, we:

1. scanned the reference lists of relevant review articles and planned to scan the reference lists of included studies;
2. contacted experts in the field of occupational health and safety;
3. planned to write to the authors of included studies to obtain additional references, unpublished trials, and ongoing trials, or to obtain missing data not reported in the original publication.

We set no limitations on publication language, publication status, or date of publication.

Data collection and analysis

Selection of studies

Two authors (WHH and CCC) independently selected suitable studies for inclusion in this review by screening the titles and abstracts of studies identified from the electronic databases. If the title and abstract provided sufficient information to determine that the inclusion criteria were not met, we excluded the study. We further checked the full text of the study if we could not confidently exclude it based on the abstract. When the two authors disagreed about the inclusion of a study, we resolved disagreements by discussion. A third author (HLL) arbitrated when necessary. We listed the studies we excluded after reading the full text and provided the reasons for exclusion in the 'Characteristics of excluded studies' table.

Data extraction and management

We planned to extract and summarise details of included studies using a standardised data extraction form. Where studies had been published more than once, we planned to extract data from all reports and consider the one with the greatest amount of data as the primary reference. Two authors (WHH and CCC) planned to independently extract the following data.

- Author, title, source of reference, country, and publication year.
- Number and description of participants.
- Intervention and comparison.
- Concomitant interventions.
- Person(s) delivering the intervention.
- Primary and secondary outcome data and methods of measurement.
- Duration of follow-up.

Assessment of risk of bias in included studies

Two authors (WHH and CCC) planned to independently assess each included study using the Cochrane tool for assessing risk of bias as described in the *Cochrane Handbook for Systematic Reviews of*

Interventions (Higgins 2011). This tool addresses specific domains, namely random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of biases (for example extreme baseline imbalance); see Appendix 6 for details of the criteria. We planned to assess the blinding and completeness of the outcome data for each outcome separately and generate a 'Risk of bias' table for each included study. When the two authors disagreed about a particular judgment for the risk of bias, we planned to resolve disagreements by discussion and a third author (HLL) would arbitrate if necessary.

We planned to present the 'Risk of bias' assessments in a summary figure to illustrate all of the judgments in a cross-tabulation of studies.

Measures of treatment effect

We planned to plot the results of each RCT as point estimates, such as RRs for dichotomous outcomes, means, and standard deviations (SDs) for continuous outcomes, or other types of data as reported by the authors of the studies. When we could not plot the results, we planned to describe them in the 'Characteristics of included studies' table or enter the data into 'Additional tables'.

We planned to plot time-to-event data as hazard ratios (HRs). If Kaplan-Meier curves were presented, we planned to extract the data from the graphs and calculate HRs according to the methods given in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).

Unit of analysis issues

All observed participants in the intervention and control groups were the planned primary unit of analysis. For studies that employed a cluster-randomised design but did not make an allowance for the design effect, we planned to calculate the design effect based on a fairly large assumed intra-cluster correlation of 0.10. We based this assumption, by analogy, on studies about implementation research (Campbell 2001). We planned to follow the methods stated in the *Cochrane Handbook for Systematic Reviews of Interventions* for the calculations (Higgins 2011).

Dealing with missing data

We planned to contact study authors to obtain missing data. Where we could not obtain missing data from study authors, we planned to judge the trials with incomplete outcome data according to the criteria recommended by the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). For example, if statistics were missing, such as SDs, we planned to calculate them from other available statistics such as P values.

Assessment of heterogeneity

We planned to assess clinical homogeneity based on similarity of population, intervention, outcomes, and follow-up. We planned to categorise study participants into jobs with high hand load, such as typing or lifting small objects, and into jobs with low upper limb load, such as in monitoring or receptionist work. Otherwise we planned to consider study populations as similar if the participants had been in paid employment when 50% or more of them had sustained an acute episode of traumatic upper limb injury involving any parts of the fingers, hand, wrist, forearm, elbow, or arm, regardless of injury type and mechanism, and regardless of occupation or type of work. We planned to consider interventions as similar if they fell into one of the predefined categories of interventions (as stated in the paragraph on criteria for including studies). We planned to consider the RTW outcomes and sick leave duration outcomes as similar. We planned to regard follow-up periods of less than 3 months, 3 months to 1 year, and more than 1 year as different. In addition, we planned to test for statistical heterogeneity by means of the Chi^2 test as implemented in the forest plots in Review Manager 5 (RevMan 5) software (RevMan 2014). This test examines the percentage of total variation across studies due to heterogeneity rather than to chance. We planned to use a significance level of $P < 0.10$ to indicate whether there was considerable heterogeneity. Moreover, we planned to quantify the degree of heterogeneity using the I^2 statistic, where an I^2 value of 25% to 50% indicates a low degree of heterogeneity; 50% to 75%, a moderate degree of heterogeneity; and more than 75%, a high degree of heterogeneity (Higgins 2003).

Assessment of reporting biases

We planned to reduce the effects of reporting bias by including studies and not publications to avoid the introduction of duplicate data. Following the Cho 2000 statement on redundant publications, we attempted to detect duplicate studies and, if more than one article reported on the same study, we planned to extract data only once. We prevented location bias by searching across multiple databases. We prevented language bias by not excluding any article based on language. If sufficient data, meaning at least ten studies with a similar comparison, are available in future updates of this review, we will assess publication bias with a funnel plot.

Data synthesis

We planned to pool data from studies judged to be clinically homogeneous using RevMan 2014. If sufficient data were available, we planned to perform meta-analyses. When studies were statistically heterogeneous, we planned to use a random-effects model; otherwise we planned to use a fixed-effect model. When using the fixed-effect model, we planned to conduct a sensitivity analysis by using the random-effects model to test if there were differences in the results. We planned to include 95% CIs for all estimates. For the analysis of HRs, we planned to use the inverse variance method in RevMan 2014. For RTW outcomes we planned to deem time to RTW, the rate of RTW, and the number of days on sick leave sufficiently similar to be combined in a meta-analysis. We planned to use effect sizes to combine continuous and dichotomous RTW outcome data. We planned to use the mean number of days off work to calculate the effect size for the days on sick leave with the following formula: mean change difference over SD (Håland 2002). For the HRs and rate ratios, we planned to take their natural logarithms and transform them into effect sizes as recommended in the *Cochrane Handbook for Systematic Reviews of Interventions* (Chinn 2000; Higgins 2011). We planned to use effect sizes and their standard errors as input in the meta-analysis using the generic inverse variance method. After meta-analysis, we planned to re-calculate a mean difference in time-to-RTW from the pooled effect size using the median SD of the included studies in the formula: pooled mean difference = pooled effect size × median SD.

We planned to use the GRADE approach as described in Higgins 2011 and implemented in the GRADEPro 3.6 software to present the quality of evidence and 'Summary of findings' tables (GRADEpro).

The downgrading of the quality of a body of evidence for a specific outcome would be based on five factors.

1. Limitations of study.
2. Indirectness of evidence.
3. Inconsistency of results.
4. Imprecision of results.
5. Publication bias.

The GRADE approach specifies four levels of quality (high, moderate, low, and very low) (Van Tulder 2003).

Subgroup analysis and investigation of heterogeneity

If sufficient data are available in future updates of this review, we will perform subgroup analyses according to injury severity or body parts, setting, and quality of the study, because these variables could potentially affect the intervention effect estimates.

Similarly, if sufficient data are available in future updates of this review, we will also perform separate subgroup analyses of: return to the previous role (either under the same or a new employer), return to a reduced role (either under the same or a new employer), change from full-time to part-time employment, and change to a reduced pay employment.

Sensitivity analysis

If sufficient data are available in future updates of this review, we will conduct a sensitivity analysis to test the robustness of our meta-analysis results by excluding studies judged to be at high risk of bias.

RESULTS

Description of studies

Results of the search

In the previous version of our review (Hou 2013), we identified a total of 332 records. We identified a total of 466 records in this update. See Figure 1 for the PRISMA study flow diagram.

Figure 1. PRISMA study flow diagram.

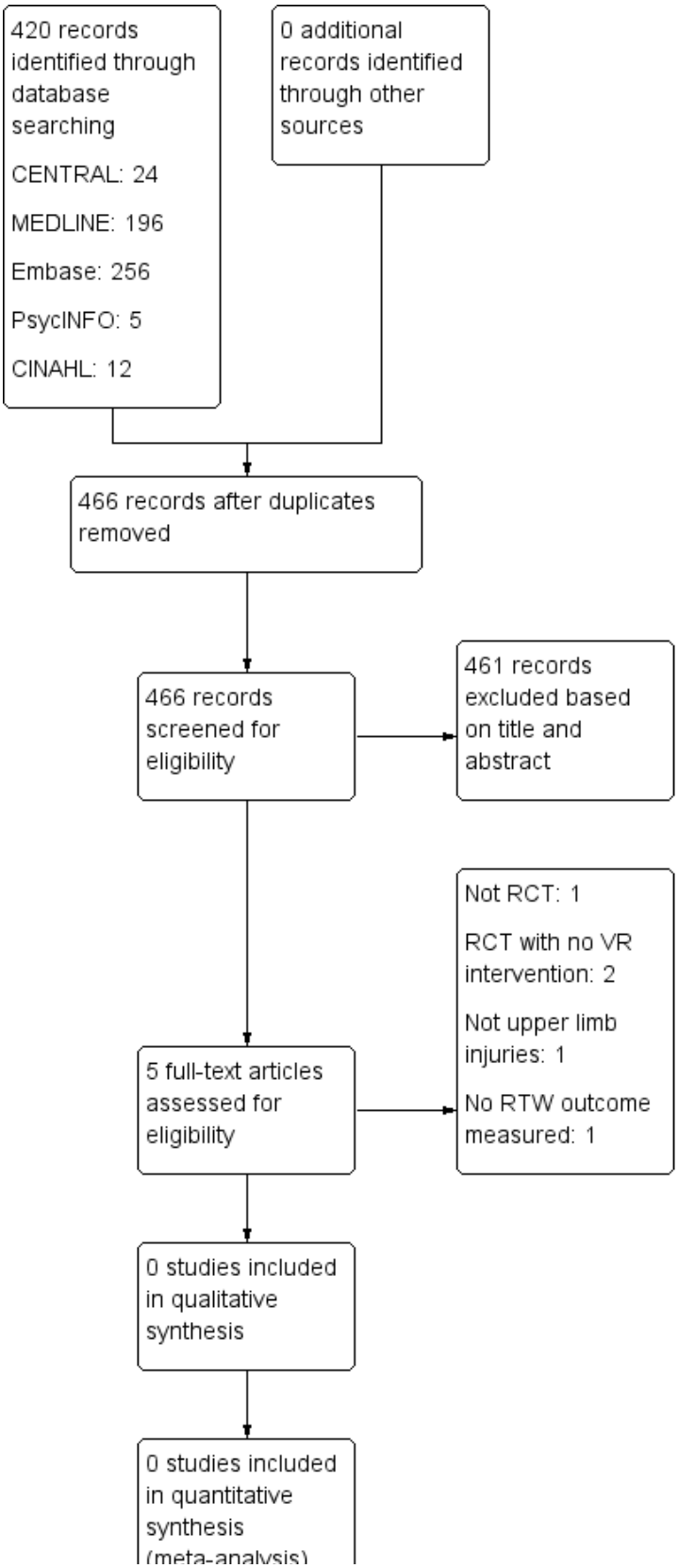
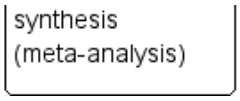


Figure 1. (Continued)



Included studies

None of the studies identified met our inclusion criteria for this update.

Excluded studies

In the previous version of our review (Hou 2013), we considered 15 studies potentially eligible and retrieved their full texts. However, all of them failed to meet the inclusion criteria and therefore we excluded them. In this update, we considered five studies potentially eligible and retrieved their full texts. However, all five failed to meet our inclusion criteria. We present descriptions of all five studies with the reasons for exclusion in the Characteristics of excluded studies table.

Risk of bias in included studies

We did not include any RCTs, so there was no risk of bias to assess.

Effects of interventions

We did not include any RCTs, so we did not conduct any analyses.

DISCUSSION

Summary of main results

In this update, we did not identify any RCTs addressing the efficacy of VR in enhancing RTW in workers with traumatic upper limb injuries. Most of the studies identified from the searches evaluated the effects of range of motion exercise and physical training to facilitate early RTW. A number of identified RCTs compared different policies of workplace accommodation, counselling, case management, or worksite visits for workers with chronic musculoskeletal problems of the upper extremities (Cheng 2007; Haahr 2005; Li 2006). There were also clinical trials comparing surgical intervention and medical rehabilitation (that is splinting, mobilising, or strengthening) for upper limb injuries during hospitalisation (Feehan 2004; Lubbert 2008; Unsworth-White 1994). Various VR programmes have been developed to help workers who have sustained traumatic upper limb injury to return to the labour market. However, we found no high-quality evidence to either support or refute the effects of VR for enhancing RTW in workers with traumatic upper limb injuries.

Overall completeness and applicability of evidence

The absence of randomised controlled trials eligible for inclusion in this review illustrates that the evidence on VR for enhancing RTW in workers with traumatic upper limb injuries is unclear and incomplete. All of the studies that we retrieved in the searches assessed the effects of different rehabilitation after immobilisation or enhancing range of motion strategies at acute medical stages, which we had pre-specified as exclusion criteria for this review.

Potential biases in the review process

We made every attempt to limit bias in the review process by ensuring a comprehensive search for potentially eligible studies. The authors' independent assessments of eligibility of studies for inclusion in this review minimised the potential for additional bias.

Agreements and disagreements with other studies or reviews

We found a systematic review of early prognostic factors for RTW following orthopaedic trauma (Clay 2010). This review used prospective and retrospective cohort studies and explored prognostic factors either at pre-injury or at the early postinjury phase. Two prospective studies that used survival analysis found that providing strong practical support and modified work increased the likelihood of RTW to 1.7 and 1.24 times, respectively (MacKenzie 1998; Seland 2006). However, none of the studies included in the Clay 2010 review assessed the effectiveness of VR interventions for acute orthopedic injuries.

There are several RCTs focusing on the effects of rehabilitation interventions for adults with distal radial fractures, and a previous Cochrane Review has pooled their results (Handoll 2006). The types of rehabilitation interventions examined in these studies are limited to hand therapy or medical rehabilitation, and do not include further VR programmes for patients with orthopaedic trauma.

AUTHORS' CONCLUSIONS

Implications for practice

Despite a thorough search for evidence relating to the efficacy of VR for enhancing RTW in workers with traumatic upper limb injuries, we found no relevant RCTs. This updated Cochrane review therefore found no high-quality evidence on the effects of VR for enhancing RTW in workers with traumatic upper limb injuries.

Implications for research

VR programmes have been proposed to help injured people in mitigating work disability, accelerating return to meaningful employment, minimising lost workdays, increasing productivity, reducing premature retirement, and containing the welfare cost (Disler 2001). Despite the lack of high-quality evidence for its efficacy, VR has been constantly provided as part of occupational health care in this population. This underlines the necessity of RCTs evaluating this intervention.

To fill the evidence gap, RCTs on VR in persons with traumatic upper limb injuries are needed. Participants in these studies should preferably be restricted to persons who suffer from traumatic upper limb injury with or without amputation, and a clear description of the pre-accident job held.

We need RCTs because the effects of the intervention are probably small and can easily be confounded by age or gender differences, for example. New RCTs should test at least the following VR techniques.

1. Improvement of work and activity tolerance through education to avoid illness behaviour and exercises to prevent deconditioning and reduce pain.
2. Enhanced work accommodations that facilitate return to work.

Studies should compare differences in outcomes between the index VR techniques versus usual rehabilitation, placebo, or no interventions. Studies should measure the effectiveness of VR using the following outcomes preferably extending follow-up to one year.

1. Proportion returned to any type of work at six months' follow-up because at six months about 60% of participants with traumatic hand injuries are expected to return to work (Shi 2014).
2. Return to participants' previous, modified, or other work in terms of gainful employment.
3. Time to return to work.

To achieve a sufficient a sample size, we assume that 60% of the participants in the control group will return to work and that a moderate and relevant effect of the intervention would increase this by 20% such that a total of 80% of the participants return to work. With a power of 80% and a significance level of 0.05, the needed number of participants in each study arm is 84 (Petrie 2009). However, if smaller effect sizes are expected, the sample size would dramatically increase. For example, if only a 10% increase of return to work rate can be achieved, then 364 participants will be required for each arm. A process evaluation is helpful to show how well the intervention is implemented and to explain the effects of the intervention. Reporting should conform to the Consolidated Standards of Reporting Trials (CONSORT) statement (www.consortstatement.org), which will enable accurate appraisal and interpretation of results and accurate judgments about the risk of bias as well as the overall quality of the evidence.

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CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Cheng 2007	This study is a randomised controlled trial comparing two types of VR: clinic-based work hardening (CWH) groups and workplace-based work hardening (WWH) groups. We excluded this study because the participants had sustained shoulder injury, which did not meet our inclusion criteria of acute upper limb injury.
Crowley 2013	This study is a randomised controlled trial comparing the effects of active mobilisation and thumb spica immobilisation, which are not forms of vocational rehabilitation.
Faux 2015	This study is a randomised controlled trial comparing the effectiveness of an early rehabilitation intervention versus a brief education intervention following road trauma on RTW. We excluded this study because the participants were not workers with upper limb trauma.
Murad 2011	This is a RTW assessment validation study from the same Malaysian research team that conducted the Murad 2013 study. We excluded this study because it did not evaluate the effectiveness of an intervention.
Murad 2013	This is a social policy RTW survey programme for workers with musculoskeletal disorders that did not employ a randomised controlled trial design to evaluate intervention effectiveness. What is more, only 19 out of 102 (18.6%) recruited participants had upper limb injuries, which did not meet our inclusion criteria of 50% or more participants having sustained an acute episode of traumatic upper limb injury involving any parts of the fingers, hand, wrist, forearm, elbow, or arm.

RTW: return-to-work; VR: vocational rehabilitation.

APPENDICES

Appendix 1. CENTRAL search strategy and results

Database CENTRAL

Date Run: 3 September 2017 (YYC)

ID	Search
#1	MeSH descriptor: [Hand Injuries] explode all trees
#2	"hand injury" or "hands injury" or "hand injur*" or "hands injur*" :ti,ab,kw (Word variations have been searched)
#3	MeSH descriptor: [Tendon Injuries] explode all trees
#4	"tendon injury" or "tendon injur*":ti,ab,kw (Word variations have been searched)
#5	MeSH descriptor: [Forearm Injuries] explode all trees
#6	"forearm injury" or "forearm injur*" or "forearms injur*":ti,ab,kw (Word variations have been searched)
#7	MeSH descriptor: [Wrist Injuries] explode all trees
#8	"wrist injuries" or "wrist injury" or "wrist injur*" or "wrists injur*":ti,ab,kw (Word variations have been searched)
#9	MeSH descriptor: [Humeral Fractures] explode all trees
#10	"humeral fracture" or "humeral fractures" or "humeral fractur*" or "humerus fracture" or "humerus fractur*" or "humeri fracture" or "humeri fractur*":ti,ab,kw (Word variations have been searched)
#11	MeSH descriptor: [Shoulder Fractures] explode all trees
#12	"shoulder fractur*" or "brachium fractur*" or "brachial fractur*":ti,ab,kw (Word variations have been searched)
#13	MeSH descriptor: [Radius Fractures] explode all trees
#14	"radius fractur*" or "radii fractur*":ti,ab,kw (Word variations have been searched)
#15	MeSH descriptor: [Ulna Fractures] explode all trees
#16	MeSH descriptor: [Upper Extremity] explode all trees
#17	"ulna fractur*":ti,ab,kw (Word variations have been searched)
#18	injur* and #16:ti,ab,kw (Word variations have been searched)
#19	"upper extremity injury" or "upper extremity injur*":ti,ab,kw (Word variations have been searched)
#20	MeSH descriptor: [Finger Injuries] explode all trees
#21	"finger injur*" or "digit injur*":ti,ab,kw (Word variations have been searched)
#22	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #17 or #18 or #19 or #20 or #21
#23	MeSH descriptor: [Occupational Medicine] explode all trees

(Continued)

#24	#23 or "occupational medicine":ti,ab,kw (Word variations have been searched)
#25	MeSH descriptor: [Occupational Health] explode all trees
#26	#25 or "occupational health":ti,ab,kw (Word variations have been searched)
#27	MeSH descriptor: [Occupational Health Services] explode all trees
#28	#27 or "occupational health service*":ti,ab,kw (Word variations have been searched)
#29	MeSH descriptor: [Rehabilitation] explode all trees
#30	#29 or "rehabilitation":ti,ab,kw (Word variations have been searched)
#31	MeSH descriptor: [Employment] explode all trees
#32	#31 or "employment":ti,ab,kw (Word variations have been searched)
#33	MeSH descriptor: [Work] explode all trees
#34	#33 or "working":ti,ab,kw (Word variations have been searched)
#35	[Education] explode all trees
#36	[Educational Status] explode all trees
#37	#35 or #36 or "education":ti,ab,kw (Word variations have been searched)
#38	#24 or #26 or #28 or #30 or #32 or #34 or #37
#39	[Rehabilitation, Vocational] explode all trees
#40	[Counseling] explode all trees
#41	[Vocational Guidance] explode all trees
#42	"work rehabilitation":ti,ab,kw (Word variations have been searched)
#43	vocational*:ti,ab,kw (Word variations have been searched)
#44	"counseling*" or "counsell*":ti,ab,kw (Word variations have been searched)
#45	"training*":ti,ab,kw (Word variations have been searched)
#46	"occupational rehabilitation*":ti,ab,kw (Word variations have been searched)
#47	"workplace intervention*":ti,ab,kw (Word variations have been searched)
#48	"workplace accomodation*":ti,ab,kw (Word variations have been searched)
#49	"workplace adjustment*":ti,ab,kw (Word variations have been searched)
#50	"modified-duty" or "modified-duties" or "modified work*":ti,ab,kw (Word variations have been searched)
#51	"case manager*":ti,ab,kw (Word variations have been searched)

(Continued)

#52	"work reintegration*":ti,ab,kw (Word variations have been searched)
#53	"work-site-visit*" or "work site visit":ti,ab,kw (Word variations have been searched)
#54	"workplace vocational*":ti,ab,kw (Word variations have been searched)
#55	#54 or "vocational workplace*":ti,ab,kw (Word variations have been searched)
#56	#39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #49 or #50 or #51 or #52 or #53 or #55
#57	MeSH descriptor: [Absenteeism] explode all trees
#58	#57 or "absenteeism*":ti,ab,kw (Word variations have been searched)
#59	MeSH descriptor: [Sick Leave] explode all trees
#60	#59 or "sick leave*" or "sickness leave*" or "sickness absence*":ti,ab,kw (Word variations have been searched)
#61	#58 or #60
#62	"return-to-work" or "return to work":ti,ab,kw (Word variations have been searched)
#63	MeSH descriptor: [Unemployment] explode all trees
#64	#63 or "unemployment" or "unemployed":ti,ab,kw (Word variations have been searched)
#65	"employability" or "employable" or "employee*":ti,ab,kw (Word variations have been searched)
#66	#62 or #64 or #65
#67	"disability management":ti,ab,kw (Word variations have been searched)
#68	"work ability" or "work activity":ti,ab,kw (Word variations have been searched)
#69	"work disability" or "work disabilities":ti,ab,kw (Word variations have been searched)
#70	"work status":ti,ab,kw (Word variations have been searched)
#71	"work retention" or "job retention":ti,ab,kw (Word variations have been searched)
#72	"workability":ti,ab,kw (Word variations have been searched)
#73	#67 or #68 or #69 or #70 or #71 or #72
#74	#38 or #56
#75	#61 or #66 or #73
#76	#22 and #74 and #75 (Trials)

Appendix 2. MEDLINE search strategy and results

Database: MEDLINE

Date run: 30 August 2017 (YYC)

ID	Search
#1	hand injury
#2	tendon injury
#3	forearm injury
#4	wrist injury
#5	humeral fractures
#6	humeri fracture
#7	humeri fractures
#8	shoulder fractures
#9	shoulder fracture
#10	brachium fracture
#11	brachium fractures
#12	brachial fracture
#13	brachial fractures
#14	radius fracture
#15	radius fractures
#16	radii fractures
#17	radii fracture
#18	ulna fracture
#19	ulna fractures
#20	Upper extremity injury
#21	Upper extremity injuries
#22	finger injury
#23	fingers injury
#24	fingers injuries
#25	digit injury
#26	digit injuries

(Continued)

#27	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR#26
#28	occupational medicine
#29	occupational health
#30	occupational health service
#31	occupational health services
#32	rehabilitation
#33	employment
#34	work
#35	education
#36	education status
#37	vocational rehabilitation
#38	counseling
#39	vocational guidance
#40	work rehabilitation
#41	training
#42	occupational rehabilitation
#43	workplace intervention
#44	workplace interventions
#45	workplace accommodation
#46	workplace adjustment
#47	modify duty
#48	modify duties
#49	modify work
#50	modify works
#51	case manager
#52	case managers
#53	work reintegration
#54	work-site-visit

(Continued)

#55	workplace vocational
#56	#28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55
#57	#27 AND #56
#58	absenteeism
#59	sick leave
#60	sickness leave
#61	sickness absence
#62	return to work
#63	unemployed
#64	employable
#65	employee
#66	disability management
#67	work ability
#68	work activity
#69	work activities
#70	work disability
#71	work disabilities
#72	work status
#73	work retention
#74	job retention
#75	#58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 OR #71 OR #72 OR #73 OR #74
#76	#75 AND #57
#77	Limit RCT OR Controlled clinical trial
#78	Limit Human

Appendix 3. EMBASE search strategy and results

Database: EMBASE

Date run: 3 September 2017 (YYC)

ID	Search
#1	'hand injury'/exp OR 'hand injury'
#2	'tendon injury'/exp OR 'tendon injury'
#3	'arm injury'/exp OR 'arm injury'
#4	'wrist injury'/exp OR 'wrist injury'
#5	'humerus fracture'/exp OR 'humerus fracture'
#6	'shoulder fracture'/exp OR 'shoulder fracture'
#7	'radius fracture'/exp OR 'radius fracture'
#8	'ulna fracture'/exp OR 'ulna fracture'
#9	'hand'/exp OR hands OR hand
#10	'injury'/exp OR injur*
#11	#9 AND #10
#12	'tendon'/exp OR tendon
#13	#12 AND #10
#14	arm'/exp OR arm OR arms
#15	#14 AND #10
#16	'wrist'/exp OR wrist OR wrists
#17	#16 AND #10
#18	humerus'/exp OR humerus
#19	fracture'/exp OR fracture
#20	#18 AND #19
#21	'shoulder'/exp OR shoulder OR shoulders
#22	#21 AND #19
#23	brachium
#24	brachial
#25	#23 OR #24
#26	#25 AND #19
#27	radius'/exp OR radius

(Continued)

#28	#27 AND #19
#29	ulna'/exp OR ulna
#30	#29 AND #19
#31	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #11 OR #13 OR #15 OR #17 OR #20 OR #22 OR #25 OR #26 OR #28 OR #30
#32	'occupational medicine'/exp OR 'occupational medicine'
#33	'occupational health'/exp OR 'occupational health'
#34	'occupational health service'/exp OR 'occupational health service'
#35	'rehabilitation'/exp OR rehabilitation
#36	'employment'/exp OR employment
#37	'work'/exp OR work
#38	'education'/exp OR educat*
#39	'educational status'/exp OR 'educational status'
#40	#32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39
#47	'disability'/exp OR disability
#48	'management'/exp OR management
#49	#47 AND #48
#50	'work'/exp OR work AND ('ability'/exp OR ability) OR workability
#51	'work'/exp OR work AND ('disability'/exp OR disability)
#52	'work'/exp OR work AND activity
#53	'work'/exp OR work AND retention OR 'job'/exp OR job AND retention
#54	'work'/exp OR work AND status
#55	#47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54
#56	#31 AND #40 AND #55
#57	#56 AND ('clinical trial'/de OR 'controlled study'/de OR 'randomized controlled trial'/de)
#58	#57 AND ('clinical trial'/de OR 'controlled study'/de OR 'randomized controlled trial'/de) AND [embase]/lim NOT [medline]/lim
#59	#58 AND ('clinical trial'/de OR 'controlled study'/de OR 'randomized controlled trial'/de) AND [embase]/lim NOT [medline]/lim AND [humans]/lim

Appendix 4. CINAHL search strategy and results

Database: CINAHL

Data run: 6 September 2017 (YYC)

ID	Search
S1	hand injuries
S2	hand injur*
S3	hands injur*
S4	tendon injuries
S5	tendon injur*
S6	forearm injuries
S7	forearm injur*
S8	forearms injur*
S9	wrist injuries
S10	wrists injur*
S11	wrist injur*
S12	humeral fractures
S13	humeral fractur*
S14	humerus fractur*
S15	brachium fractur*
S16	brachial fractur*
S17	wrist fractures
S18	wrists fractur*
S19	radius fractures
S20	ulna fractures
S21	ulna fractur*
S22	upper extremity
S23	upper extremity injur*
S24	finger injuries

(Continued)

S25	finger injur*
S26	fingers injur*
S27	digit injur*
S28	arm injuries
S29	arms injur*
S30	arm injur*
S31	elbow fractures
S32	elbow fractur*
S33	elbows fractur*
S35	elbow injuries
S34	elbow injur*
S36	elbows injur*
S37	S1 OR ˜ S36
S38	Occupational Medicine
S39	Occupational Medicine
S40	Occupational Health Nursing
S41	Occupational Health Nursing
S42	Work Environment
S43	Work Environment
S44	Rehabilitation, Vocational
S45	Vocational Rehabilitation
S46	Occupational health
S47	Occupational health
S48	Occupational health services
S49	Occupational health service*
S50	rehabilitation
S51	rehabilitation
S52	Occupational rehabilitation

(Continued)

S53	workplace rehabilitation
S54	training
S55	counseling
S56	counseling
S57	counselling
S58	job accommodation
S59	job accommodation
S60	workplace accommodation
S61	S38 OR ˜ S60
S62	S61 AND S37
S63	return to work
S64	return-to-work
S65	unemployment
S66	unemployment
S67	employment of disable
S68	employment of disabled
S69	absenteeism
S70	absenteeism*
S71	employability
S72	employable
S73	employee*
S74	work ability
S75	work activity
S76	work disabilit*
S77	sick leave
S78	sick leave
S79	S63 OR˜S78
S80	S79 AND S62

(Continued)

S81	Limit RCT

Appendix 5. PsycINFO search strategy and results

Database: PsycINFO

Date run: 6 September 2017 (YYC)

ID	Search
S1	hand injuries
S2	hand injur*
S3	hands injur*
S4	tendon injuries
S5	tendon injur*
S6	forearm injuries
S7	forearm injur*
S8	forearms injur*
S9	wrist injuries
S10	wrists injur*
S11	wrist injur*
S12	humeral fractures
S13	humeral fractur*
S14	humerus fractur*
S15	brachium fractur*
S16	brachial fractur*
S17	wrist fractures
S18	wrists fractur*
S19	radius fractures
S20	ulna fractures
S21	ulna fractur*
S22	upper extremity

(Continued)

S23	upper extremity injur*
S24	finger injuries
S25	finger injur*
S26	fingers injur*
S27	digit injur*
S28	arm injuries
S29	arms injur*
S30	arm injur*
S31	elbow fractures
S32	elbow fractur*
S33	elbows fractur*
S35	elbow injuries
S34	elbow injur*
S36	elbows injur*
S37	S1 OR ˜ S36
S38	Occupational Medicine
S39	Occupational Medicine
S40	Occupational Health Nursing
S41	Occupational Health Nursing
S42	Work Environment
S43	Work Environment
S44	Rehabilitation, Vocational
S45	Vocational Rehabilitation
S46	Occupational health
S47	Occupational health
S48	Occupational health services
S49	Occupational health service*
S50	rehabilitation

(Continued)

S51	rehabilitation
S52	Occupational rehabilitation
S53	workplace rehabilitation
S54	training
S55	counseling
S56	counseling
S57	counselling
S58	job accommodation
S59	job accommodation
S60	workplace accommodation
S61	S38 OR ˜ S60
S62	S61 AND S37
S63	return to work
S64	return-to-work
S65	unemployment
S66	unemployment
S67	employment of disable
S68	employment of disabled
S69	absenteeism
S70	absenteeism*
S71	employability
S72	employable
S73	employee*
S74	work ability
S75	work activity
S76	work disabilit*
S77	sick leave
S78	sick leave

(Continued)

S79	S63 OR~S78
S80	S79 AND S62
S81	Limit RCT

Appendix 6. Risk of bias assessment

1. Was the allocation sequence randomly generated?

Yes, low risk of bias

The investigators describe a random component in the sequence generation process such as: referring to a random number table; using a computer random number generator; coin tossing; shuffling cards or envelopes; throwing dice; drawing of lots.

No, high risk of bias

The investigators describe a non-random component in the sequence generation process. Usually, the description would involve some systematic, non-random approach, for example: sequence generated by odd or even date of birth; sequence generated by some rule based on date (or day) of admission; sequence generated by some rule based on hospital or clinic record number.

Unclear

Insufficient information about the sequence generation process to permit judgement of 'yes' or 'no'.

2. Was the treatment allocation adequately concealed?

Yes, low risk of bias

Participants and investigators enrolling participants could not foresee assignment because one of the following, or an equivalent method, was used to conceal allocation: central allocation (including telephone, web-based and pharmacy-controlled randomisation); sequentially numbered drug containers of identical appearance; sequentially numbered, opaque, sealed envelopes.

No, high risk of bias

Participants or investigators enrolling participants could possibly foresee assignments and thus introduce selection bias, such as allocation based on: using an open random allocation schedule (e.g. a list of random numbers); assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or nonopaque or not sequentially numbered); alternation or rotation; date of birth; case record number; any other explicitly unconcealed procedure.

Unclear

Insufficient information to permit judgment of 'yes' or 'no'. This is usually the case if the method of concealment is not described or not described in sufficient detail to allow a definite judgment, for example if the use of assignment envelopes is described, but it remains unclear whether envelopes were sequentially numbered, opaque and sealed.

3. Blinding - was knowledge of the allocated interventions adequately prevented during the study?

Yes, low risk of bias

Any one of the following.

- No blinding, but the review authors judge that the outcome and the outcome measurement are not likely to be influenced by lack of blinding.
- Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, but outcome assessment was blinded and the non-blinding of others unlikely to introduce bias.

No, high risk of bias

Any one of the following.

- No blinding or incomplete blinding, and the outcome or outcome measurement is likely to be influenced by lack of blinding.
- Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, and the non-blinding of others likely to introduce bias.

Unclear

Any one of the following.

- Insufficient information to permit judgement of 'yes' or 'no'.
- The study did not address this outcome.

4. Were incomplete outcome data adequately addressed?

Yes, low risk of bias

Any one of the following.

- No missing outcome data.
- Reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias).
- Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size.
- Missing data have been imputed using appropriate methods.

No, high risk of bias

Any one of the following.

- Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size.
- 'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation.
- Potentially inappropriate application of simple imputation.

Unclear

Any one of the following.

- Insufficient reporting of attrition/exclusions to permit judgement of 'yes' or 'no' (e.g. number randomised not stated, no reasons for missing data provided).
- The study did not address this outcome.

5. Are reports of the study free of suggestion of selective outcome reporting?

Yes, low risk of bias

Any of the following.

- The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way.
- The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon).

No, high risk of bias

Any one of the following.

- Not all of the study's pre-specified primary outcomes have been reported.
- One or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified.
- One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect).
- One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis.
- The study report fails to include results for a key outcome that would be expected to have been reported for such a study.

Unclear

Insufficient information to permit judgement of 'yes' or 'no'. It is likely that most studies will fall into this category.

6. Other sources of potential bias

Yes, low risk of bias

The study appears to be free of other sources of bias.

No, high risk of bias

There is at least one important risk of bias. For example, the study:

- had a potential source of bias related to the specific study design used;
- stopped early due to some data-dependent process (including a formal-stopping rule);
- had extreme baseline imbalance;
- has been claimed to have been fraudulent;
- had some other problem.

Unclear

There may be a risk of bias, but there is either:

- insufficient information to assess whether an important risk of bias exists; or
- insufficient rationale or evidence that an identified problem will introduce bias.

WHAT'S NEW

Date	Event	Description
29 November 2017	New search has been performed	We updated this review with a new search on 30 August 2017.
29 November 2017	New citation required but conclusions have not changed	We expanded our implications for research to provide concrete advice to people planning new RCTs for evaluating the effectiveness of vocational rehabilitation for enhancing return-to-work in workers with traumatic upper limb injuries.

CONTRIBUTIONS OF AUTHORS

WHH initiated and planned the review. WHH and HLL wrote the draft of the protocol. KNK provided related information for the traumatic upper limb injury background. CCC and HYC revised the protocol. WHH, YYC and HLL planned the search strategy. YYC undertook the update search. WHH, CCC, and HLL participated in the decision-making process regarding inclusion and exclusion of trials. WHH, CCC, and HLL planned to participate in the data extraction and assessment of risk of bias of included studies. WHH is responsible for circulating progressive drafts of the review to all co-authors.

DECLARATIONS OF INTEREST

Wen-Hsuan Hou: None known.

Ching-Chi Chi: None known.

Heng-Lien Lo: None known.

Yun-Yun Chou: None known.

Ken Kuo: None known.

Hung-Yi Chuang: None known.

SOURCES OF SUPPORT

Internal sources

- Master Program in Long-Term Care and School of Gerontology Health Management, College of Nursing, Taipei Medical University, Taiwan.

  Salary and time to enable WHH to perform this review
- Department of Physical Medicine and Rehabilitation, School of Medicine, Taipei Medical University and Department of Physical Medicine and Rehabilitation, Taipei Medical University Hospital, Taiwan.

  Motivational and free electric database support for undertaking this review.
- Department of Dermatology, Chang Gung Memorial Hospital, Linkou and College of Medicine, Chang Gung University, Taiwan.

  Salary and time to enable CCC to perform this review.
- Cochrane Taiwan Research Center, Taipei Medical University, Taiwan.

  Methodological support to perform this review.

External sources

- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

In this update, we specified that we excluded studies that examined VR for enhancing RTW in patients with shoulder injury. For this update, we did not update the OSH UPDATE search as planned in the protocol because it did not identify any relevant studies in the previous version of this review (Hou 2013).

INDEX TERMS

Medical Subject Headings (MeSH)

*Rehabilitation, Vocational; *Return to Work; Arm Injuries [*rehabilitation]; Occupational Health

MeSH check words

Humans