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Te Kaporeihana Āwhina Hunga Whara

Brief Report

Work-related risk factors for Tenosynovitis

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Important Note:

- *The purpose of this brief report is to summarise the best evidence for the relationship between tenosynovitis of the forearm, hand and wrist and workplace physical factors. It has not been systematically developed according to a predefined methodology.*
- *It is not intended to replace clinical judgement, or be used as a clinical protocol.*
- *A reasonable attempt has been made to find and review papers relevant to the focus of this report, however it does not claim to be exhaustive*
- *The document has been prepared by the staff of the Research Unit, ACC. The content does not necessarily represent the official view of ACC or represent ACC policy*
- *This report is based upon information supplied up to February 2014.*

Executive Summary

The purpose of this report is to provide a narrative for the findings of the AUT review dated 2010 and update these finding with any relevant recent published after 2011. The evidence described in this report is aimed to facilitate decision making by the ACC Work-Related Gradual Process Diseases and Infections team (WRGPDI) for work-related physical factors and tenosynovitis.

Eight primary studies from the AUT review and one systematic review were discussed in this report. Studies were first graded by two ACC reviewers using the Scottish Intercollegiate Guidelines Network criteria (SIGN, Appendix 3) in an attempt to ensure the best evidence available was presented. Risk factors were described in the literature as either single (force, repetition, posture, and vibration) or combined (force and repetition; repetitive lifting and extreme postures). It is important to note that across these studies there was a lack of standardised terminology for tenosynovitis.

The heterogeneity with the definitions and diagnoses of tenosynovitis limited how the work-related factors could be interpreted across these studies. There appeared to be no consistency in the diagnoses, or diagnostic criteria with studies. For example, while some studies looked exclusively and implicitly at de Quervain's tenosynovitis, others used differing diagnostic labels to describe what may or may not be the same clinical entity (e.g. tendinitis, tenosynovitis) without specifying exactly what the diagnostic label covers. This let to variation between studies and conflicting evidence across this literature base and it was not possible to make any strong conclusion between work tasks and tenosynovitis. This is in agreement with the high quality evidence on this topic from a systematic review published in late 2013[6].

Overall this review provides both quick reference material and more in-depth summaries for the reader. Quick reference material is provided in the form of a Summary Table (Table 2) that outlines the main results for each physical risk factor. In the subsequent sections (Single Risk Factors and Combined Risk Factors) a more comprehensive outline of the evidence is provided, including specific study results in the form of odds ratios and related statistics (95% confidence intervals and statistical significance). This is followed by a short conclusion and discussion into the limitations within the evidence base. Descriptions of the individual papers used in this report are found in the evidence tables (Tables 4 and 5 in Appendix 4 at the end of this report).

Recommendations for the WRGDPI unit:

Due to variation between studies and conflicting evidence within the best evidence identified in this report and the AUT report for Tenosynovitis, when considering an individual claim, other factors such as the Bradford-Hill Criteria, the specifics of the case, and expert opinion should be considered.

Table of Contents

List of Tables

List of Abbreviations

AUT	Auckland University of Technology
CI	Confidence Interval
DQD	De Quervain's Disease
GP	General Practitioner
MSD	Musculoskeletal Disorders
OR	Odds Ratio
SIGN	Scottish Intercollegiate Guidelines Network
STROBE	Strengthening of Reporting in Observational Trials
WRGPDI	Work-Related Gradual Process Diseases and Infections team

Definition of Tenosynovitis

The terms tenosynovitis, tendinitis and de Quervain's disease (DQD) are often used to describe the same, or similar, clinical entities. The various terms actually describe different pathological processes, but are unfortunately used in the literature interchangeably, leading to confusion. The 2009 ACC Distal Upper Limb Guideline[1]:

De Quervain's disease refers to a fibrous stenosing tendovaginitis of the first wrist extensor compartment. Tenosynovitis of the first wrist extensor compartment is a condition that involves the synovial sheaths of either, or both the abductor pollicis longus (APL) and extensor pollicis brevis (EPB). Some authors use the term 'de Quervain's tenosynovitis' as a synonym to define 'classic' tenosynovitis of the first wrist extensor compartment.

Pathophysiologic processes vary with respect to these clinical entities:

- *With regard to de Quervain's disease, the primary pathologic observation is reactive fibrosis and thickening of the extensor retinaculum where it overlies the first wrist extensor compartment. Concurrent pathology involving the underlying synovial sheaths may or may not be evident.*

- *With regard to tenosynovitis of the first wrist extensor compartment, pathologic changes involving the synovial sheaths of the APL and EPB are liable to reflect its aetiology and duration, and may vary from inflammatory to fibrotic.*

The primary pathologic involvement of the APL and EPB tendon bodies in these conditions has not been explored.

De Quervain's disease and/or tenosynovitis are characterised by localised dorsal radial wrist pain (that may radiate proximally or distally), and/or localised tenderness over the tendon structures contained within the first wrist extensor compartment. Additional features that may be present include localised tissue swelling or thickening, crepitus and triggering of the thumb. Clinical signs and tests for de Quervain's disease and/or tenosynovitis may include:

- *Localised pain on palpation immediately overlying the APL and EPB tendons, and*

- *Symptomatic pain reproduction from: Finkelstein's test, resisted thumb abduction or resisted thumb extension.*

The prevalence of tenosynovitis in the general working population is estimated to be between 1 and 2% with a slightly higher prevalence in females than males[1].

For the purposes to this report, we have used the term 'tenosynovitis' as an umbrella term to cover all of the clinical entities' described above. Where it is necessary to differentiate between the different pathological processes, we have done so using a specific description. For further information regarding the diagnosis, management and prognosis of tenosynovitis, please refer to the ACC Distal and Upper Limb Guidelines (2009)[1].

Methodology

The purpose of this report is to provide a narrative to the findings of the AUT review and summarise the best evidence for the relationship between tenosynovitis and workplace physical factors.

Outline of studies included in this report

The AUT report included a total of 14 primary studies. These studies were used as a starting point for this paper. Ten studies included in the AUT report gave information solely on the prevalence or incidence of tenosynovitis within certain job titles and did not thoroughly report the specifics of the job tasks involved. As these studies are only relevant to the worker groups studied, they cannot be generalised to other industries and thus were not included in this report. This information is less useful to the Gradual Process team because: 1) It is impossible to know if the job tasks involved in a claimants job match those in the studies even for jobs with the same job title 2) Claims are received from many different industries, not only those that have been subject to investigation. For these reasons only studies from the AUT report that adequately described work-related risk factors were included in this report (n=4).

To supplement the studies included in the AUT report an additional literature search was undertaken repeating the same search strategy used by AUT to identify any additional studies published since, or not included in the AUT report. This search identified one systematic review/meta-analysis of the work-related causes of de Quervain's Tenosynovitis published in 2013[2] and three additional primary studies[3-5] that address the question of interest.

A short description of the methodologies and populations investigated for each study included in this report can be found in Appendix 2.

Primary studies

Primary research from one prospective cohort study[6] and seven cross-sectional studies[3-5, 7-9] are included in this report. Evidence tables for the included studies are also presented in Table 4 and 5 at the end of this report. Where possible studies were assessed for quality and assigned a level of evidence using the Scottish Intercollegiate Guidelines Network (SIGN) criteria (Appendix 1).

Secondary literature

One study identified during this search was excluded due to low reporting quality and likely methodological flaws[10] and another because it reproduced the same data presented in another study, which had already been included[11]. Thus the evidence for this report comes from secondary research in the form of one systematic review[2].

Assessment of quality of studies included in report

The studies were assessed for quality and assigned a level of evidence using the Scottish Intercollegiate Guidelines Network (SIGN) criteria (Appendix 3).

The relationship between Tenosynovitis and occupational risk factors was most commonly reported as odds ratios. This provides the reader with quantification that the likelihood that the outcome (in this case Tenosynovitis) will occur if a particular risk factor (e.g. high forces) is present. The descriptors shown in Table 1 below provides a context of how strong and in which direction the OR (association) is - the higher the OR the higher the odds of Tenosynovitis occurring if that particular risk factor is present[12]. A more in-depth description of ORs can be found in Appendix 1.

Table 1 Odds Ratios and relevant descriptor outlining the strength of evidence

Odds Ratio	Descriptor
<1.0	Protective
1.0 – 2.4	Weak
2.5 – 3.9	Moderate
>4.0	Strong

Summary of Findings: Work-related risk factors for Tenosynovitis

The findings of this report indicate an overall lack of evidence on the topic of occupational risk factors and tenosynovitis of the forearm, wrist and hand. This fits with the conclusions of both the AUT report and a recently published comprehensive systematic review/meta-analysis[2]. This high quality, thorough review collated all of the evidence on this topic published up until October 2012. The authors assessed all cohort and cross-sectional studies against the Strengthening of Reporting in Observational Trials (STROBE) criteria[13] to determine the quality of the papers. The authors also undertook a meta-analysis combining the results of five of the published studies, and applied the Bradford Hill criteria to test for causation.

This review concluded that "no sufficient scientific evidence was provided to confirm a causal relationship between de Quervain's tenosynovitis and occupation risk factors" (Stahl et al, 2013, p: 1479) and that "the cause of de Quervain's tenosynovitis remains unknown" (Stahl et al, 2013, p: 1490). "Neither the level of evidence, the quality of reporting or the Bradford Hill criteria support the hypothesis that de Quervain's tenosynovitis is caused by repetitive, forceful or ergonomically stressful hand motions" (Stahl et al, 2013, p:1490). Overall while the meta-analysis of five papers did show increased odds of de Quervain's tenosynovitis with occupational risk factors (OR 2.89; 95% CI 1.4-5.97; p=0.004), the authors questioned the validity of this finding because of the studies included in the analysis were low quality[2].

All seven of the primary studies identified during our review of the AUT report and subsequent literature search were included in the Stahl systematic review[2]. The findings of the primary studies investigating the single and combined work –related risk factor are summarised in the summary table below (Table 2). This is followed by more detailed descriptions of the information in the subsequent sections. Evidence tables providing details of individual studies are included in Table 4 and 5 at the end of this

document. It is important to note when reading this report that the evidence comes from mainly cross-sectional studies which cannot assess causation.

Table 2. Summary of Findings for physical risk factors associated with Tenosynovitis

Risk Factor	Findings
Repetition	Based on two cross-sectional studies of variable quality and one low to medium quality prospective cohort study were found the main findings were: repetitive hitting may be weakly associated with wrist tendinitis; repetitive one-way workflow may be strongly associated with tenosynovitis of the finger flexors; repetitive wrist movements and driving screws may be moderately to strongly associated with de Quervain's disease.
Force	Based on one good quality cross-sectional study, jobs with high physical demand may be moderately associated with de Quervain's disease.
Posture	Based on one good quality and one low to moderate quality cross-sectional study: jobs involving precise finger movements; pressing with the base of the palm; wearing gloves or grips mimicking an eastern style tennis racquet grip may be moderately to strongly associated with de Quervain's disease.
Vibration	Based on one good quality and one low quality cross-sectional study, vibration may be moderately associated with de Quervain's disease and is strongly associated with upper limb pain generally.
Combinations of risk factors	Based on two low quality cross-sectional studies. The combination of high force and high repetition, and the combination of repetitive lifting and extreme postures may be moderately to strongly associated with tendinitis/tenosynovitis of the hand, wrist and forearm.

Single risk factors

Evidence for single risk factors in association with de Quervain's tenosynovitis is discussed in this section. The single risk factors outlined are repetition, force, posture and vibration. Each section provides a brief description of findings from the AUT review followed by further primary and secondary evidence.

Repetition

The AUT report concluded that there was insufficient evidence of an association between repetition and tenosynovitis based on two cross-sectional studies. Three of the studies included in this paper investigated this association and offer limited evidence as follows.

Le Clerc et al (2001): A low to medium quality prospective cohort study that reported a **non-significant association between repetitive hitting and wrist tendinitis** (OR 2.16; 95% CI: 0.96-6.44). This study also found that eight other repetitive physical work factors were not significantly associated with wrist tendinitis. These included: turn and screw; tighten with force; work with force other than tighten; press with the hand; press with the elbow; holding in position; pulling and pushing).

Amano et al (1988): A low quality cross-sectional study that reported a **strong association between repetition and tenosynovitis of the finger flexors but not the thumb**. In shoe manufacturing, assembly line workers were compared with non-exposed controls. They found increased odds of finger flexor tenosynovitis in the left hand (OR 7.2; 95% CI: 3.5 - 14.8) and in the right hand (OR12.8; 95% CI: 5.5 - 29.8) but these odds were both variable. The authors of this paper concluded that constrained one way work flow and transferring was the main difference between working actions in assembly line workers and the control group.

Petit le Manac'h et al (2001): A good quality cross-sectional study that reported a **moderate to strong association between de Quervain's disease and highly repetitive tasks** (OR 2.4; 95% CI: 1.3 - 4.4, p=0.003). A moderate and statistically significant association was found for repeated or sustained wrist bending for two or more hours per day (OR 3.8; 95% CI: 2.1-7.1, p<0.001), and repeated or sustained movement that involved turning while driving screws for two or more hours per day (OR 5.9; 95% CI: 3.0-11.5; p <0.001).

These reports show a range of null to strong associations between repetition and de Quervain's tenosynovitis. Available evidence is mixed between studies. One good quality study did find a moderately significant association between repetitively bending the wrist, or turning while driving screws and de Quervain's. However this evidence is from a cross-sectional study so causality cannot be determined. This analysis is in agreement with the AUT review in that there is insufficient evidence of an association between repetition and de Quervain's tenosynovitis.

Force

The AUT report did not report on an association between force and tenosynovitis. Only one of the studies included in this paper investigated this association and offered limited evidence as follows.

Petit le Manac'h et al (2001): A good quality cross-sectional study, reported a **moderate association between high physical demand (defined as a score on the Borg Scale of 13 or more) and de Quervain's disease** (OR 2.7; 95%CI: 1.4-5.2; p=0.003).

No other studies investigated the association between force and tenosynovitis.

Posture

The AUT report did not report on an association between posture and tenosynovitis. Only two of the studies included in this paper investigated this association and offer limited evidence as follows.

Petit le Manac'h et al (2001): A good quality cross-sectional study that investigated the association between several different work postures and de Quervain's disease. This paper found **significant associations between de Quervain's disease and jobs involving precise finger movements for two or more hours per day** (OR 2.8; 95%CI: 1.5-5.4,; p=0.001); **pressing with the base of the palm for two or more hours per day** (OR 3.2; 95% CI: 1.4-7.4; p=0.007); **and wearing gloves for four or more hours per day** (OR 2.5; 95%CI: 1.3-4.8; p=0.006). This study also found that the use of hand tools for two or more hours per day and holding tools or objects in a pinch grip for more than four hours per day were not significantly associated with de Quervain's disease. Null or protective associations were determined for keying and computer work for four or more hours per day (OR 0.4; 95% CI: 0.2-0.9; p=0.03).

Tagliafico et al (2009): A poor to moderate quality cross-sectional study that reported a **strong but extremely variable association between the use of an eastern style forehand grip** *(see evidence Table 2)* **and de Quervain's disease in non-professional tennis players** (OR 15.9; 95% CI: 1.8-138.11, p=0.012). It concluded that different racket grips are related to the anatomical site of the lesion: eastern grip with radial sided injuries, and western grip with ulnar sided injuries. These findings may be applicable to jobs that involve similar wrist postures to that of holding a tennis racquet.

These two studies show moderate to strong associations between de Quervain's tenosynovitis and posture. Moderate associations were seen with precise finger movement and pressing with the base of the palm, although the same study found no association with pinch grip task[4]. The second study found strong evidence between a specific tennis forehand grip (eastern style) but it should be noted that these results were highly variable[5]. Overall although there is some evidence from cross-sectional studies that relate force posture to de Quervain's disease, but these data are limited.

Vibration

The AUT report concluded that there was insufficient evidence of an association between vibration and tenosynovitis based on one cross-sectional study[8]. Two of the studies included in this paper investigated this association and offer limited evidence as follows [4, 8].

Petit le Manac'h et al (2001): A good quality cross-sectional study, reported a **moderate association between de Quervain's disease and the use of vibrating hand tools for two or more hours per day** (OR 2.6; 95% CI: 1.2-6.0; p=0.021).

Bovenzi et al (1991): A low quality cross-sectional study that reported **evidence of a dose dependent association between persistent pain in the wrist and forearm with vibration** in forestry workers. This paper reported an adjusted odds ratio for risk of persistent pain (of all types, not only tenosynovitis) as a function of vibration exposure. Exposure to daily vibration less than 7.5m/s^2 resulted in an increased risk of persistent pain (OR 10.3 for hand; 6.4 for the wrist) while greater exposure to daily vibration (> 7.5m/s) resulted in even higher odds ratios (OR 22.1 for hand, 11.3 for the wrist).

Combined risk factors

The AUT report did not report on an association between combined risk factors and tenosynovitis. Two of the studies included in this paper investigated this association and offer limited evidence as follows.

Armstrong et al (1987): A low quality cross-sectional study that investigated the association between wrist and hand tendinitis and various combinations of force and repetition. This paper reported that the **combination of high force (greater than 40N) with high repetition (cycle time of less than 30 seconds, or more than 50% of cycle time performing the same kind of motion pattern) as significantly associated with hand and wrist tendinitis**. Although authors of this paper reported the odds ratio for this association to be 29.4 (p=0.001) when the ratio is re-calculated from the raw data, it appears to be only OR 4.46 (95% CI: 2.08-9.55; p=0.0001). No association was found between wrist and hand tendinitis and the other three combinations of force and repetition investigated (i.e. Low Force with Low Repetition, High Force with Low Repetition and Low Force with High Repetition).

Luopajarvi et al (1979), a low quality cross-sectional study, investigated an assembly line packing job that involving a **combination of repetitive motion at high speed, static muscle work, extreme work positions of hands/wrist and repetitive lifting. This paper reported moderate to strong associations of this job with tenosynovitis** of the wrist extensors (OR 12.3; 95% CI: 5.6-27.0), tenosynovitis of the wrist flexors (OR 2.8; 95% CI: 1.3-6.0), peritendinitis of the forearm extensors (OR 8.8; 95% CI: 3.4-23.9) and peritendinitis of the forearm flexors (OR 6.7; 95% CI: 2.3-19.6).

These studies both provide evidence that combined risk factors are moderately to strongly associated with tenosynovitis. Although these studies did not look at de

Quervain's tenosynovitis specifically, wrist and hand tendinitis and tenosynovitis was reported with the combination of high force and high repetition[3], high repetition and extreme postures as well as peritendinitis of the forearm flexors and extensors[9].

Limitations of the evidence base

Overall, the literature investigating the role of occupational risk factors in the development of tenosynovitis of the forearm, wrist and hand is limited in both number of studies and quality. Relatively few studies on this topic have been published to date when compared with other gradual process injuries affecting the upper limb. This review identified only seven primary studies that address the question of interest.

Overall the methodological quality of available studies is low, as the overwhelming majority of studies conducted to date have been cross-sectional in design. This review identified only one prospective cohort study, whereas the balance of the evidence comes from cross-sectional studies. As cross-sectional studies examine data on the prevalence of a specific disorder (in this case tenosynovitis) at one point in time, the relationship between exposure and the disorder cannot be established[14]. This means they are able to give an indication of association only, and cannot be used to determine causation. It should be noted that cross-sectional studies are usually not assigned a SIGN level of evidence however to enable the reader to understand their level of evidence with the prospective cohort studies and systematic review included in this report they have been allocated one. These limitations should be considered when reading the remainder of this report. Furthermore the majority of the studies informing this review have additional methodological limitations or flaws that mean they are open to one or more potential sources of bias.

The lack of standardised terminology is the other significant limitation of this body of evidence. There appears to be no consistency in the diagnoses, or diagnostic criteria, that have been used in studies published to date. While some look exclusively and implicitly at de Quervain's tenosynovitis, others use differing diagnostic labels to describe what may or may not be the same clinical entity (e.g. tendinitis, tenosynovitis) without specifying exactly what the diagnostic label covers.

There was heterogeneity in diagnoses between studies. For example, some studies specified if the disorder affected the finger, wrist, hand or forearm, or a particular muscle (e.g. flexor carpi radialis). Some studies also specified if the disorder affected the flexor or extensor mechanisms, while others do not differentiate between the two. Others considered the entire distal upper limb as one entity and one study presented findings for only 'upper limb pain' of any source. One study included intersection syndrome and trigger finger along with de Quervain's disease. This heterogeneity in diagnoses makes comparison between studies problematic.

Conclusions

The literature investigating the role of occupational risk factors in the development of tenosynovitis of the forearm, wrist and hand is limited. Due to the low number of studies investigating each factor, the low quality of the studies published to date, and

heterogeneity in the diagnostic criteria used, it is not possible to make any strong conclusions about the association between work tasks and tenosynovitis. This is in agreement with the high quality evidence on this topic from a systematic review published in late 2013(6). This review concluded that "neither the level of evidence, the quality of reporting nor the Bradford Hill criteria support the hypothesis that de Quervain's tenosynovitis is caused by repetitive, forceful or ergonomically stressful hand motions".

Very limited evidence investigating the association between tenosynovitis and repetition, force, posture, vibration and combination risk factors exists from the seven primary studies included in the paper. However, all of these studies have methodological limitations that undermine the validity of the results, and this should be taken into account when interpreting these findings.

Recommendations for the WRGDPI team when considering physical risk factors and Tenosynovitis

Due to variation between studies and conflicting evidence within the best evidence identified in this report and the AUT report for Tenosynovitis, when considering an individual claim, other factors such as the Bradford-Hill Criteria, the specifics of the case, and expert opinion should be considered.

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Appendix 1.

Background

ACC Research was commissioned by the Work-Related Gradual Process Diseases and Infections (WRGPDI) team to provide them with a brief report to support day-to-day decision-making as they carry out case assessments. The report uses an evidence-based approach to summarise the evidence regarding the relationship between specific occupational risk factors and Tenosynovitis. The purpose of this report is to provide decision-making support to the WRGPDI team and, in particular, to summarise and explain the current evidence regarding LE and occupational risk factors across multiple studies. Additional information is included in other resources used by the team, including a quick reference decision-support spreadsheet.

AUT Investigation Analysis

In 2009, a group of researchers specialising in occupational health at Auckland University of Technology (AUT) were commissioned by ACC to complete a series of independent systematic reviews of the risk factors associated with 16 gradual process conditions, including carpal tunnel syndrome[15]. The authors searched an extensive set of databases up to October 2010, and all relevant cross-sectional, case-control and cohort studies meeting inclusion criteria were appraised for quality. Studies which did not meet a pre-determined quality assessment score were excluded from further analysis, the remaining studies were summarised in evidence tables (Table 4 at the end of this document) and summary data was extracted. Due in part to the methodology utilised in these reviews, and the presentation and length of the final reports, ACC Research was requested to complete a brief narrative report describing the findings of the primary studies included in the AUT report, and any additional studies which had been published subsequently.

Horizon Scanning for future upper limb disorder research

A large multi-centre prospective cohort study of distal upper-extremity musculoskeletal disorders also known as the WISTAH hand study started in 2012[16]. Two purposes of this study are to quantify the risks of upper limb disorders, including LE and address weaknesses seen in prior research studies. Steps have been taken in this study to obtain high quality data; this includes using prospective methods, data collection from diverse population's nerve conduction studies in all subjects, baseline measurements and monthly follow-ups.

For this study over 1,000 workers from 17 different employment settings have been recruited. The settings include: (i) poultry processing, (ii) manufacturing and assembly of animal laboratory testing equipment, (iii) small engine manufacturing and assembly, (iv) small electric motor manufacturing and assembly, (v) commercial lighting assembly and warehousing, (vi) electrical generator manufacturing and assembly, (vii) metal automotive engine parts manufacturing (three facilities), (viii) plastic and rubber automotive engine parts manufacturing and assembly (ix) red meat processing, (x) apparel manufacturing, (xi) office work, (xii) cabinet manufacturing, (xiii) airbag manufacturing, (xiv) light valve assembly, and (xv) small metal parts fabrication. The aim of including this distribution was to include participants with low, medium and high physical demands at work.

One paper from this study has been published[17] . However the focus of this study is to determine how indicative two metrics (e.g. the Threshold Limit Value for Hand Activity Level) are as risk predictors for CTS[17] and thus do not add to this brief report. No further information was available regarding future publications from this study.

Measures

The relationship between tenosynovitis and occupational risk factors was most commonly reported as odds ratios. This is because of the nature of the research base (cross-sectional or case-control studies which are conducted at a point in time, rather than prospective studies conducted over a prolonged period). An odds ratio reports the likelihood of an outcome being present (e.g. tenosynovitis) when a particular exposure (e.g. forceful work) has been present, compared with the probability of the outcome being present when the exposure has not been present[18-19]. If the odds ratio is 1 then the outcome is equally as likely in the exposed group as the non-exposed group. If the odds ratio is greater than 1, then the outcome occurs more often in the exposed group. If it is less than 1, it occurs more often in the non-exposed group. The higher the odds ratio, the stronger is the association between the exposure and the outcome. The 95% confidence interval (95% CI) measures the precision of the odds ratio – wide confidence intervals indicate a low level of precision. It is important to note that odds ratios report probability based on association at a point in time. Using the odds ratio (OR) as a proxy for Relative Risk (RR) is based on an assumption that any such association arises because of a causal link, and this assumption cannot always be relied on.

The use and interpretation of odds ratios has been debated extensively in the literature, especially when compared with the use of relative risk[18]. It is emphasised in the literature that the odds ratio is not a representation of risk, but of probability or odds, and that this can make it more difficult to interpret[20]. The use of odds ratios has been criticised for exaggerating the strength of association between an exposure and an outcome when it is applied as a measure of risk. When an outcome is rare (initial risk <10% in both the exposed and non-exposed groups), for instance in the case of RCS where the prevalence in the normal population is estimated to be 1.3%, the odds ratio is said to be a valid approximation of the true relative risk and the strength of the association can be interpreted accordingly. However, as the prevalence of the outcome increases, the odds ratio moves further away from the true relative risk. Whereas the accepted relative risk cut-off for determining whether an outcome can be attributed to a particular exposure is >2.0[21], the cut-off for odds ratios is not clear and depends on the prevalence of the outcome.

Appendix 2. Outline of methodology of included studies

Stahl et al (2013) A comprehensive and rigorous systematic literature review, meta-analysis and application of the Bradford Hill Criteria to papers published up to October 2012 to investigate a relationship between de Quervain's tenosynovitis and repetitive, forceful, and ergonomically stressful work .

Level of evidence: 1+

Amano et al (1988) A cross-sectional study in Japan that investigated 102 female shoe manufacturing assembly line workers. The workers, whose roles involved assembly of sneakers by hand, manually handing shoes to co-worker sitting on either right or left repeatedly (without the use of a conveyer belt) were compared with a control group of office clerks, dry nurses, telephone operators, cooks and key punchers an bank clerks who used their dominant hand more frequently but did not have a direction element in their work. Subjects underwent a medical examination as well as video recording of their job tasks.

Level of evidence: 2- Low quality cross-sectional study (hypothesis of causation only)

Luopajarvi et al (1979) A cross-sectional study of 152 female assembly-line packers in a food production factory and 142 female shop assistants from a department store. Subjects underwent a clinical examination and were diagnosed with tendinitis (when the wrist was involved) or peritendinitis (when forearm involved) according to predetermined criteria. An analysis of the work tasks involved was also completed by an on-site visit as well as video analysis.

Level of evidence: 2- Low quality cross-sectional study (hypothesis of causation only)

Le Clerc et al (2001) A cohort of 700 workers were investigated in five occupational sectors involving repetitive work who completed a questionnaire regarding work activities and examined by a physician based at their workplace. The sectors included assembly line manufacturing, shoe and clothing manufacturing; food industry (mainly meat); packaging; and supermarket cashiering. A subsample of the original cohort were followed up 3 years later (n=598) based on the availability of the original workplace physician. Work factors assessed by the questionnaire included working with force, pressing with the hand or elbow, screwing or tightening with force, hitting, pulling, pushing and holding in position. Respondents were asked to indicate whether they did these repetitively, not repetitively or never.

Level of evidence: 2+

Bovenzi et al (1991) A cross-sectional study of n=65 forest operators using chain-saws and 31 control workers (mechanics, electricians, painters in a hospital) who performed manual activities but were not exposed to vibration). Subjects underwent a medical interview asking about symptoms in the past two years and neurological and orthopaedic assessment by a Physiatrist who made diagnosis of 'tenosynovitis of the wrist and forearm' using specific criteria. Job analysis was made by direct observation & vibration measurements on chainsaws.

Level of evidence: 2- Low quality cross-sectional study (hypothesis of causation only)

Tagliafico et al (2009) A cross-sectional study of n=370 non-professional tennis players playing in an official tennis tournaments in Italy. A questionnaire was distributed at a tournament check in that asked about wrist injuries in previous three years and also asked players to identify which of four grips they used for their forehand stroke: Continental, Eastern, Semi-Western, Full-Western (see evidence Table 3 for figures). Wrist injuries were categorised into either ulnar sided injuries (Triangular Fibrocartilage or Extensor Carpi Ulnaris injuries including tenosynovitis) or Radial sided injuries (de Quervain's, Intersection Syndrome or Flexor Carpi Radialis tenosynovitis). Players reporting a history of wrist injury were interviewed and their clinical notes plus any imaging studies available were reviewed to confirm or exclude the injury declared on the questionnaire

Level of evidence: 2- Good quality cross-sectional study (hypothesis of causation only)

Petit le Manac'h et al (2011) A cross-sectional study of n=3710 workers (58% male) randomly selected from workers across having annual health examination in one region of France. Industries examined included: meat processing and manufacturing, construction, agriculture and service. Subjects completed a questionnaire and if non-specific upper-extremity pain was confirmed in the answers then subjects underwent a

standardised physical assessment by an Occupational Physician and were diagnosed with or without de Quervain's (along with several other disorders) according to predetermined criteria. Work tasks assessed using self-administered questionnaire.

Level of evidence: 2- Good quality cross-sectional study (hypothesis of causation only)

Armstrong et al (1987): A cross-sectional study of n=652 workers from seven worksites covering: electronics, sewing, appliances and bearing fabrication/assembly and investment moulding plants. Study used purposive sampling from job types to gather a sample covering all four combinations of force and repetitiveness: 1) Low Force/Low Repetition, 2) High Force/Low Repetition, 3) Low Force/High Repetition and High Force/High Repetition. Subjects underwent standardised interviews and non-invasive physical examinations to diagnose tendinitis of the wrist or hand. Jobs were defined as either high (>40N) or low (<10N, force and high (cycle time of <30 sec or more than 50% of cycle time involved in performing the same kind of motion pattern) or low repetition (cycle time of >30 sec or less than 50% of cycle time involved in performing the same kind of motion pattern).

Level of evidence: 2- Low quality cross-sectional study (hypothesis of causation only)

Appendix 3.

Table 3. Scottish Intercollegiate Guidelines for Levels of Evidence

1++	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort or studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Appendix 4. Evidence Tables:

Table 4. Evidence tables summarising secondary literature which evaluates the association between physical work characteristics and tenosynovitis

Reference and Methodology	Inclusion/exclusion criteria	Outcome Measures	Findings
Stahl et al (2013) Plastic and Reconstructive Surgery 132 (6) p:1479-1491 Research Question: To investigate a relationship between de Quervain's tenosynovitis and repetitive, forceful, and ergonomically stressful work through three methods: 1) Systematic literature review 2) Meta-analysis 3) Application of the Bradford Hill Criteria Methodology Described: Systematic review & Meta-Analysis	Quality score (STROBE criteria)	Meta-analysis: weighted OR Bradford Hill Criteria score for strength of association, consistency, specificity, temporality, biological plausibility, biological gradient, coherence, interventional studies, analogy	**Results:** Quality: on average only 36% of the STROBE criteria were fulfilled, indicating overall low quality studies on the topic Meta-analysis: of n=5 articles found a significant correlation between DQD and repetitive, forceful, or ergonomically stressful work: weighted OR 2.89 (95% CI 1.4-5.97, p=0.004). However, the validity of this OR is undermined by the low quality scores found. Bradford Hill Criteria: on average studies reached a score of 7 on a scale 0-21, implying poor or no causal association. None of the studies identified had the statistical power needed to evaluate the strength of an association between DQD and occupational risk factors. **Biases/Weaknesses:** • Few - high quality, thorough review using systematic approach **Authors Conclusion:**

Types of study included: Search identified all methodologies Only Prospective cohort, retrospective cohort, cross-sectional studies with and without a control group assessed for quality and had Bradford Hill Criteria applied Literature Search: Ovid Medline. EMBASE, Cochrane Library Date of search: October 10, 2012 How funded: Disclosure statement included specifies no funding was received from commercial sources and no conflicts of interest exist			• No sufficient scientific evidence was provided to confirm a causal relationship between de Quervain's tenosynovitis and occupation risk factors • The cause of DQD remains unknown • Neither the level of evidence, the quality of reporting nor the Bradford Hill criteria support the hypothesis that DQD is caused by repetitive, forceful or ergonomically stressful hand motions. ***Level of evidence: 1+*** **High quality systematic review and meta-analysis of literature published up to October 2012 concluding there is a lack of evidence to confirm a causal relationship between DQD and any occupational risk factors**

Table 5 Evidence tables summarising primary literature which evaluates the association between physical work characteristics tenosynovitis

Reference and Methodology	Participants	Method	Findings/Results
Amano et al (1988) Japanese Journal of Industrial Health, 30, 3-12. Research Question: To investigate the characteristic actions of female worked engaged in sneaker manufacturing assembly lines and the association with occupational cervicobrachial disorders Methodology Described: Cross-sectional How funded: Not reported	n= 102 female shoe manufacturing assembly line workers Role involved the assembly of sneakers by hand, manually handing shoes to co-worker sitting on either right or left repeatedly (no conveyer belt) Compared with control group: office clerks, dry nurses, telephone operators, cooks, key punchers an bank clerks who used their dominant hand more frequently but did not have a direction element involved	Medical examination including neurological testing, palpation, pinch power, tapping test, pain sensibility, vibration sensibility Analysis of video recording of the workers in action Diagnostic criteria not given	**From examination:** Significantly higher prevalence of tenosynovitis in fingers, but not thumbs in assembly line workers Right Fingers: 8% in control versus 48% in assembly line workers Right Thumb: 0% in control versus 48% in assembly line workers Left Fingers: 0% in control versus 3% in assembly line workers Left Thumb: 0% in control versus 1% in assembly line workers Calculated Odds Ratios: Right Finger Flexor Tenosynovitis: OR 7.2 (95% CI 3.5-14.8) Left Finger Flexor Tenosynovitis: OR 12.8 (95% CI 5.5-29.8) Thumb flexor Tenosynovitis: no significant difference **Video analysis:** Summarised task involved in job into 4 main categories: 1. Grasping 2. Extending the arms 3. Bending the arms 4. Static positioning of the arms Repeated 3,400 times per day Constrained one way work flow and transferring was found to be the main difference between working actions in assembly line workers and the control group

			Biases/Weaknesses • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation • Small sample size: large odds ratios with wide confidence intervals may indicate study was underpowered • Inadequate detail in report to determine method for selecting subjects – study may be open to selection bias • No clear diagnostic criteria used • Conducted in early 1980's – shoe manufacturing is now largely mechanized, may be relevant to other roles where there is the repetitive, constrained one way work flow and transferring • Did not control for all known co-founders **Authors conclusion**: Authors conclude that the results imply that excessive workloads exist in the fingers and the arms (but not thumbs) of assembly line workers. Constrained one way work flow and transferring was found to be the main difference between working actions in assembly line workers and the control group. The authors found that rotating the position of workers to be handing shoes to the opposite side reduced the prevalence of disorders and concluded that this inferred causality.
			Low quality cross-sectional study presenting evidence of a strong association between finger flexor tenosynovitis and repetition

Reference and Methodology	Participants	Method	Findings/Results
Luopajarvi et al (1979) Scandinavian Journal of Work, Environment and Health 5 (s3) p.48-55 Research Question: To examine and compare the status of the neck and upper extremities of two occupation groups; assembly line packers in a food production factors and shop assistants with variable tasks Methodology Described: Cross-sectional How funded: Not reported	n= 152 female assembly-line packers in a food production factory And: 142 female shop assistants from department store (excluding cahiers)	**Clinical examination:** Active and passive test movements, isometric muscle tests, measurements, palpations and observations) Findings recorded and then diagnostic labels applied by predetermined criteria **Labelled as:** *Tenosynovitis*: if located at the tendon sheath area of the dorsal or palmar side of the wrist *Peritendinitis:* when structures higher up the forearms were involved (did not separately report de Quervain's) Work task analysis on site by group consisting of a foreman, a worker, a	Tenosynovitis Extensors Wrist: OR 12.3 (95% CI 5.6-27.0) Tenosynovitis Flexors Wrist: OR 2.8 (95% CI 1.3-6.0) Peritendinitis Forearm Extensors: OR 8.8 (95% CI 3.4-23.9) Peritendinitis Forearm Flexors: OR 6.7 (95% CI 2.3-19.6) Tenosynovitis affected the extensors more significantly than the flexors **Packing jobs involved:** Repetitive motion at high speed (25,000 cycles per workday) Static muscle work Extreme work positions of hands (full extension of thumb and fingers) and of wrists(full flexion or extension or radial deviation) Lifting: 200g-27kgs, total of 5,000kgs over the day from 19-160cm high **Biases/Weaknesses** • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation • High prevalence of tenosynovitis even in control group (14%) exceeding population estimate (1-2%) – possible related to diagnostic criteria used • Study did not analyse biomechanical aspects of the packing job individually – therefore it is not possible to know which of the factors was associated with the increased incidence of tenosynovitis/peritendinitis

		labour safety officer and an occupational physiotherapist + video analysis of work tasks by work study engineer and physician	• Inadequate detail in report to determine method for selecting subjects – study may be open to selection bias • Female only sample • Did not control for all known co-founders **Authors Conclusion**: *A relationship between some work load factors and some disorders of the upper extremities is probable*
			Low quality study presenting evidence of a moderate to strong association between wrist tenosynovitis and forearm 'peritendinitis' and combined repetition action with extreme posture

Reference and Methodology	Participants	Method	Findings/Results
Le Clerc et al (2001) Scandinavian Journal of Work, Environment and Health 27 (4) p.268-278 Research Question: To study the predictability of personal and occupational factors with respect to the incidence of upper-limb disorders	Cohort of workers exposed to repetitive work in one of five industries: 1) assembly line workers 2) clothing or shoe industry manufacturing works 3) food industry workers (preparation) 4) food industry packaging 5) supermarket	Standardised clinical exam by physician with checklist of diagnoses/criteria that included 'Wrist Tendinitis' defined as either: 1) **Hand or wrist extensor peritendinitis or tenosynovitis:** pain in the dorsal wrist, swelling of the affected tendons or palpable crepitus of the affected tendon	Odds ratios for Wrist Tendinitis adjusted for age and gender **Results:** Of the 9 physical work factors examined, only repetitive hitting repetitively was significantly associated with Wrist Tendinitis Repetitive hitting: OR 2.16 (95% CI 0.96-6.44) *** Repetitive physical work factors not associated with wrist tendinitis • Turn and screw • Tighten with force • Work with force (other than tighten) • Press with the hand • Press with the elbow

Methodology Described: Prospective Cohort How funded: Financial support received from INSERM (National Institute on Health and Medical Research) - France	cashiers From 18 different employers Baseline taken in 1993/1994, followed up 3 years later 58% of cohort lost to follow up Follow up n= 598	2) **Hand or wrist flexor peritendinitis or tenosynovitis:** pain in the ventral wrist, swelling of the affected tendons, palpable crepitus of the affected tendons, or finger extension and flexion deficits. 3) **De Quervain's disease:** pain on the radial side of the wrist, tender swelling, or pain produced by thumb extension, thumb abduction or the Finkelstein test Looked at contribution of personal/occupational, biomechanical/postural and psychosocial factors Self-reported questionnaire regarding work activities: working with force, pressing with the hand or elbow, screwing or tightening with force, hitting, pulling, pushing and holding in position. Respondents were asked to indicate whether they did	• Pulling • Pushing • Holding in position **Biases/Weaknesses** • Participants were selected based on the availability of their workplace physician • 15% of initial cohort was lost to follow-up (n=102) • Only used physical exam so only captured those who "had" at time of examination – did not capture those who had it in between examinations but were symptom free at the time • Physical exam was undertaken by a large number of physicians – this may have resulted in inconsistent application of diagnostic criteria • Used self-assessment of the biomechanical tasks involved in the role - potential for reporting bias, authors felt there may have been some limitations to the questionnaire • *95% CI for OR crosses 1 • Did not control for all known co-founders **Authors Conclusion**: The authors concluded that wrist tendinitis is related to the action of repetitively hitting but no other biomechanical demands

		these repetitively, not repetitively or never.	
			Low – medium quality prospective cohort study presenting evidence of a weak association between repetitive hitting and wrist tendinitis

Reference and Methodology	Participants	Method	Findings/Results
Bovenzi et al (1991) Ergonomics 34 (5): 547-562 Research Question: to investigated the prevalence rates of cumulative trauma disorders and musculoskeletal injuries occurring in the neck and upper limbs of vibration-exposed forestry workers using chain saws Methodology Described: Cross-sectional How funded:	n= 65 forest operators using chain-saws and: 31 control workers (mechanics, electricians, painters in a hospital, manual activity but not exposed to vibration)	Medical interview asking about symptoms in the past 2 years Persistent pain was defined as pain lasting for most days for one month during the past two years Also underwent neurological and orthopaedic assessment by a Physiatrist Clinical diagnosis was made based on pre-determined criteria- **Tenosynovitis of the wrist and forearm:** muscle pain during effort, local swelling, local ache at rest, tenderness along the course of the tendon or muscle-tendon junction, swelling, pain during movement, weakness in gripping	Crude and adjusted Odds Ratio for the risk of persistent pain and diagnosis of tenosynovitis in forestry works versus controls exposed to manual work but not vibration **Results:** **Tenosynovitis of wrist and forearm:** Prevalence 15.4% of forestry workers compared with 0% of controls ** unable to calculate OR* This represented a significant difference until results were adjusted for age and body composition when they became not significant Adjusted odds ratio for risk of **persistent pain** (of all types) in forestry workers compared to controls: Daily vibration < 7.5m/s Hand = 10.3, Wrist = 6.4 Daily vibration > 7.5m/s Hand = 22.1, Wrist = 11.3 **Biases/Weaknesses** • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation

Not reported		Job analysis by direct observation & vibration measurements on chainsaw	• Unable to calculate OR for tenosynovitis specifically as no cases were found in control group, study only gives OR for persistent pain in wrist or hand, not tenosynovitis specifically • Small sample size: unable to re-calculate OR/confidence intervals for results given above raw data not given • Did not control for known confounders, specifically did not control for previous injury or other diseases • Unclear how subjects were recruited – may be open to selection bias **Authors Conclusion**: The authors concluded that the result of the study indicated that musculoskeletal impairment to the upper limbs was more severe in the forestry operators and that there is an dose-effect relationship that suggests vibration stress is an important contributor to the development of disorders in this group
			Low quality study presenting evidence of strong dose dependent association between persistent pain in the wrist and forearm and vibration

Reference and Methodology	Participants	Method	Findings/Results
Tagliafico et al (2009) The American Journal of Sports	N=370 non-professional tennis player playing in an official tennis tournaments in Italy	Questionnaire was distributed at tournament check in and asked about wrist injuries in previous 3	**Out of 50 positive cases:** De Quervain's n= 6 Intersection Syndrome n=1

Medicine 37 (4), p:760-767 Research Question: To investigate if there is an association between use of different tennis grips and the pattern of wrist injuries in non-professional tennis players Methodology Described: Cross-sectional How funded: Not reported		years Asked players to identify which of 4 grips they used for their forehand stroke: Continental, Eastern , Semi-Western, Full-Western Players reporting a history of wrist injury were interviewed and their clinical notes plus any imaging studies available were reviewed to confirm or exclude the injury declared on the questionnaire *Diagnoses included :* **Ulnar sided injuries:** Triangular Fibrocartilage Extensor Carpi Ulnar is injuries (including tenosynovitis) **Radial sided injuries:** De Quervain's Intersection Syndrome Flexor Carpi Radials tenosynovitis	Extensor Carpi Ulnaris injuries (including tenosynovitis) n=30 Flexor Carpi Radialis tenosynovitis n=5 Reported a positive association between radial sided lesions and eastern grip OR of having De Quervain's if use eastern style grip compared with western = 15.9 (95% CI = 1.8-138.11, p=0.0121) OR of having Flexor Carpi Radials tenosynovitis if use eastern style grip compared with western = not significant OR of having Extensor Capri Ulnaris injury (including tenosynovitis) if use eastern style grip compared with western = not significant Unable to calculate OR for Intersection Syndrome as no cases in unexposed group Eastern style grip = classic forehand grip where "base knuckle" (metacarpal phalangeal joint of the index finger) in on face 3 and heel pad between 2 and 3 Racquet weight was not associated with injury **Biases/Weaknesses** • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation

			• Methods section missing some data • Did not control for all known co-founders • Looked specifically at tennis players but may be relevant for occupation using similar grip • Study was based on players recall of injuries over 3 year period – design may be open to recall bias • Findings may not be generalizable to other occupational – care should be taken extrapolating the results **Authors Conclusion**: *In nonprofessional tennis players with wrist injuries, different grips of the racket are related to the anatomical site of the lesion: eastern grip with radial sided injuries.*
Eastern Grip 	**Western Grip** 	**Semi-Western Grip** 	**Continental Grip** 
			Poor – moderate quality cross-sectional study presenting evidence that using an eastern style forehand grip is strongly associated with de Quervain's disease in nonprofessional tennis players

Reference and Methodology	Participants	Method	Findings/Results
Petit le Manac'h et al (2011) Scandinavian Journal of Work Environment and Health 37 (5) p: 394-401 Research Question: To assess the prevalence and relative importance of personal and occupational risk factors for DQD in a large sample of workers representative of the working population of the region. Methodology Described: Cross-sectional How funded: French National Research Agency and French Institute for Public Health Surveillance	n=3710 workers (58% male) randomly selected from workers across having annual health examination in one region of France Industries included: Meat processing and manufacturing Construction Agriculture Service	Subjects completed a questionnaire – if non-specific upper-extremity pain was confirmed in answers then subject underwent standardised physical assessment by Occupational Physician performing the mandatory annual health check-up for the company. Diagnosed De Quervain's (along with several other disorders) according to predetermined criteria: 1. Intermittent pain or tenderness localised over the radial side of the wrist, possibly radiating proximally to the forearm or distally to the thumb 2. Present currently or for more than 4 days in the preceding 7 days 3. Positive Finklestein's test with distinct right and left	Numerous biomechanical factors were associated with DQD **OR for DQD disease compared with non-exposed group (with 95% CI):** **High Repetitiveness:** 2.4 (1.3-4.4, p0.003) **High physical demand (Borg Scale 13 or more):** 2.7 (1.4-5.2, p=0.003) **Repeated or sustained movement turning driving screw (2 or more hrs/day):** 5.9 (3.0-11.5 p <0.001) **Repeated or sustained wrist bending (2 or more hrs/day):** 3.8 (2.1-7.1, p<0.001) **Precise finger movements (2 or more hrs/day):** 2.8 (1.5-5.4, p=0.001) **Pressing with the base of the palm (2 or more hours per day):** 3.2 (1.4-7.4, p=0.007) **Wearing gloves (4 or more hours per day)** 2.5 (1.3-4.8, p=0.006)

		difference Work tasks assessed using self-administered questionnaire – subjects were asked about a variety of work tasks and reported how often they did it these	**Use of vibrating hand tools (2 or more hours per day)** 2.6 (1.2-6.0, p=0.021) **Keying and computer work (4 or more hours per day)** 0.4 (0.20-0.9 p=0.03) * "protective" **Association not statistically significant (at p<0.05)** Exposure to cold temperatures Use of hand tools (2 or more hours per day Holding tools or objects in a pinch grip (>4hrs/day)
			Biases/Weaknesses • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation • Did not physically exam on subjects who answered no to questionnaire – may have introduced selection bias • Used self-report of work tasks – may have introduced confirmation bias • Did not control for all potential confounders **Authors Conclusion**: *Personal and work-related factors were associated with DQD in the working population; wrist bending and movements associated with the twisting or driving of screws were the*

			most significant of the work-related factors
			Good quality cross-sectional study presenting evidence of a moderate to strong association between DQD and repetition, force, posture and vibration (in isolation)

Reference and Methodology	Participants	Method	Findings/Results
Armstrong et al (1997) The Journal of Hand Surgery 12a (5 part 2) p.830-837 Research Question: To evaluate the relationship between repetitiveness, forcefulness and selected cumulative trauma disorders of the hand and wrist in the industrial population Methodology Described: Cross-sectional How funded:	N=652 workers from 7 worksites covering: Electronics Sewing Appliance Bearing fabrication and assembly Investment moulding plants Purposive sampling from job types to gather sample covering all four combination of force and repetitiveness: -Low Force/Low Repetition -High Force/Low Repetition	Standardised interviews and non-invasive physical examinations Three specific diagnoses: **DQD:** pain in the anatomical snuffbox, possibly radiating into forearm, no history of fracture, symptoms > 1 week or occurred > 20 times in past year, positive Finklestein's test with pain score of 4 or more out of 8, no signs of radial nerve entrapment **Trigger Finger:** palpable nodule at base of finger and finger locked in extension or flexion **Tendinitis or Tenosynovitis:** localised pain and/or swelling	**Results:** **Null associations:** **Low Force Low Repetition:** no significant association **High Force Low Repetition:** no significant association **Low Force, High Repetition:** no significant association **High Force, High Repetition:** *Paper presents OR as 29.4 but calculated OR is 4.46 (95% CI is 2.08-9.55, p=0.0001)

Not reported	-Low Force/High Repetition -High Force/High Repetition High force defined at >40N	over muscle/tendon structure for > 1 week, pain increased by resisted movements, possible crepitus but no pain on passive ROM testing, pronounced asymmetrical grip strength > 4kgs Subjects included only if positive on both interview AND physical examination Jobs were defined as either high (>40N) or low force <10N), and high (cycle time of <30 sec or more than 50% of cycle time involved in performing the same kind of motion pattern) or low repetition (cycle time of >30 sec or less than 50% of cycle time involved in performing the same kind of motion pattern)	**Biases/Weaknesses** • Cross-sectional study so can only indicate association not causation – on its own this study presents only a hypothesis of causation • Did not control of all potential cofounders • Poor description of methods, including statistical methods undertaken to calculate OR • Not possible to separate 3 diagnoses from each other • Excluded subjects with positive findings on only one of physical exam or interview (n=16 were excluded from analysis) – may have introduced selection bias • *Reported OR differed significantly from calculated ones **Authors Conclusion**: *The risk of hand and wrist tendinitis is 29 times* higher in workers who perform highly repetitive and forceful jobs than those with jobs that are low in repetitiveness and force.*
			Low quality cross-sectional study, likely open to bias, presenting evidence of a strong association between combined repetition & force and the development of wrist and hand tendinitis