Work-Related, Upper-Limb Disorders

Peter Buckle, A Kilbom, A Grieco, Keith Palmer, Cyrus Cooper, Malcolm Harrington et al. Scandinavian Journal of Work, Environment and Health Supplement. June (2001) Vol.27 suppl 1.

A group of highly regarded European epidemiologists/ergonomists have produced this extensive review of diagnosable upper limb disorders. Their stated aims were:

- to define acceptable diagnostic criteria for use with individuals and surveys of populations and,
- to define a decision regime for the assessment of work-relatedness on a case by case basis.

It is known that some senior figures in the EC are keen to learn and apply the lessons from a similar ergonomics standard that was temporarily enshrined in US law earlier this year.

The authors insist that the standard produced here should be used for the purpose of identifying suitable changes in systems of work. That is, when people present with diagnosable work related upper extremity disorders, every effort should be made to identify and correct the cause. Using the real experiences of people in the work place as an adjunct to hypothetical risk assessment, should prove more accurate than risk assessment by itself and will provide identifiable problems for managers to solve as opposed to the purely hypothetical findings of risk assessments. Adoption of this feedback approach to risk management would be contrary to the general approach adopted by HSE, which has tended to rely very heavily on risk assessment and underplay the value of health surveillance.

The standard should also provide more quantifiable assistance with risk assessment, even in absence of complaints from employees. As such it may become adopted as a standard for the duty of care.

In our view, it is likely that the standard, or a derivative of it, will tend to be relied upon by EC figures who wish to define/regulate a duty of care and may even be cited in private claims for personal injury.

The main findings of the report will be described here, though a thorough analysis is beyond the scope of this publication. A thorough analysis may be of value if and when the EC show signs of adopting the findings without independent criticism or further refinement. A thorough analysis may also prove useful if the standard is cited as evidence in a claim.

Extensive literature reviews and consensus meetings were undertaken by the authors, for each of the following diagnostic headings:

- Radiating Neck Complaints
- Rotator Cuff syndrome
- Epicondylitis
- Ulnar Nerve Compression (Cubital tunnel Syndrome)
- Radial nerve compression (Radial tunnel syndrome)
- Flexor-extensor peritendinitis wrist/forearm
- De Quervain's disease
- Carpal Tunnel Syndrome
- Guyon canal syndrome
- Raynaud's Phenomenon and Hand Arm Vibration Syndrome
- Osteoarthritis
- Non specific Upper Extremity Musculo skeletal disorder [this is equivalent to Diffuse RSI].

Significant occupational risk factors for each of these were recorded (where available). Our (relatively brief) experience of reviewing the same field of literature shows that very few of these headings have been studied sufficiently well to allow generalizations about risk factors for each one to be defined. It is possible that the general conclusions drawn by the authors are dominated by findings for relatively few of this list. Carpal Tunnel Syndrome dominates the literature both in quantity and quality.

Diagnoses
The diagnostic methods for each of the disorders listed were in line with those produced in the UK in 1997 (Harrington) and subsequently tested for accuracy (Palmer and Cooper). UK insurers were represented by LPC when these diagnostic criteria were developed.

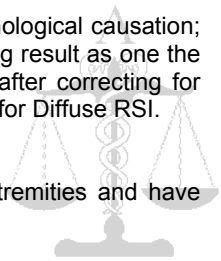
General findings for occupational causation
The definition of work-relatedness adopted by the authors was reportedly taken from the World Health Organisation: "…exposed to work activities and work conditions that significantly contribute to their development or exacerbation but not acting as the sole determinant of causation".

In principle this definition excludes:

- Made to feel worse at work
- Makes work more difficult/impossible

If the authors strictly applied this exclusion then reports of pain associated with work would not be accepted, neither would cross-sectional studies of sickness absence associated with work factors. Only those prospective studies that report accurately diagnosed conditions would be accepted.

The authors report that they were unable to find any papers suggesting purely psychological causation; psychological factors were always accompanied by physical factors. This is a puzzling result as one the leading reviews cited by the authors, reports evidence of psychological risk even after correcting for physical factors. In our view, purely psychological causation cannot yet be dismissed for Diffuse RSI.



Specific risk factors
The authors have produced tables of risk factors for four regions of the upper extremities and have adopted the following shorthand:

"*Extreme posture*", means, equal to or greater than 50% of the full, active range of movement ROM. That is, if the wrist can be actively flexed by 80º then extreme posture means more than 40º.

"Repetitive", means, more than 2 to 4 times a minute.

"Most of the day", means, more than 4 hours per workday.

"Substantial", means, more than 2 hours per workday.

"High force", means, more than 4 Kg.

"Low social support", means, less than 25% of full scale.

"High psychological demand", means, more than 75% of full scale.

"Insufficient recovery time", means, less than 10 minutes.

It may appear surprising that these standards should apply uniformly across all regions of the upper extremity, all builds, all levels of fitness and independently of the presence of other risk factors. The simplicity of such generalizations (if accurate) should however allow relatively ready assessment of work relatedness.

These standards (if accurate) would almost certainly be used to define a duty of care and provide very strong guidance for risk assessment.

Four Steps to Causation Assessment
The following four steps are suggested for the assignment of work-relatedness. Step 4 requires the use of a matrix of combinations of answers to the first three steps. The matrix generates outcomes analogous to traffic lights:

- Code Red indicates a workplace cause (or aggravation) which requires corrective action.
- Code Yellow indicates that action planning is required as a preparation for the possibility that another case comes to light, which may be coded red.
- Code Green indicates no action at work is required.

The matrix for step four is reproduced below.

Step1		Step 2		Step 3		Step 4
Yes	+	Green	+	No	→	Yellow
Yes	+	Green	+	Yes	→	Yellow
Yes	+	Yellow	+	Yes	→	Yellow
Yes	+	Yellow	+	No	→	Red
Yes	+	Red	+	Yes	→	Red
Yes	+	Red	+	No	→	Red
No	+	Green	+	Yes/No	→	Green
No	+	Red	+	Yes/No	→	Yellow

It is immediately apparent that only one solution gives the all clear.

Step 1

"Did the symptoms begin, recur or worsen after the current job (task) was started".

If yes – the least consequence is a code yellow – plan action.

Comment
On the face of it, this is a question based at the very least, on common sense. The presumption is that pain is an essential element associated with the pathogenesis of all the upper limb disorders listed above. Although quite a reasonable presumption, to our knowledge very few prospective studies of pain free, never injured people have been followed through to the diagnoses listed above. Anecdotal evidence gathered at history taking seems to be consistent across the broad spectrum of specialist assessors, but this is not science.

Step 1 does not require that exposure to task and the pain-of-interest, are concurrent, thereby allowing for pain to develop several hours after exposure. In theory, there ought to be an upper time limit for delay between exposure to task and pain if they are to be causally associated, but as stated above, the necessary prospective studies simply have not been done.
A person who answers "no" to step 1 might still have a genuinely work related injury, hence the last line of the decision matrix, where the answer "NO", results in a requirement to plan some action if the result of step 2 is a code red.

Perhaps the least attractive feature of this test is the reliance on perception of pain as an indicator of occupational cause. Perception of pain is not a reliable indicator of tissue damage or aggravation. Pain that increases or becomes noticeable at work could simply indicate that sensitivity to pain or objection to pain is increased at work.

Adoption of this temporality test seems to be counter to the definition of work related as stated by WHO and quoted above, which was "significantly contribute to their development or exacerbation", unfortunately something which is almost never measured.

Overall, it would appear that the test in step 1 is aimed at maximum sensitivity as opposed to specificity. In that way everyone with a genuinely work related ULD would be given an action code (either Red or Yellow). This should not be of concern to insurers, if the subsequent steps in the determination of work-relatedness restore the balance towards specificity.

Step 2

"Are there exposures factors known
(believed by the authors) to be
(significant) risk factors
for that part of the body?"

See tables directly following this report.

The tables effectively set standards for good and bad ergonomic practice at work. Definitions of repetitive, substantial etc. are listed above.

The presumption is that bad ergonomic (and psychosocial) practices lead to injuries in body regions to which they are directly, bio-mechanically linked. This may well be true for mechanical injury but there is growing evidence that some injuries in the list, can be indirectly affected.

A complete review of the evidence for these presumptions and standards would be beyond the scope of this report in this Journal. The key references are provided in the original article.

Review of the tables shows that, by and large, a code green is achieved only when all the code red indicators are absent. Code red is achieved when any, some or all of the indicators are present. In statistical terms it is very unlikely that a task would return a code green. According to the authors; each and every bad practice, entirely on its own, could produce the injury in question.

Non physical factors are allowed to produce a code red, only if accompanied by at least one physical factor at work. This presents some difficulty; injuries sustained outside the workplace could be made to feel worse by poor psychosocial conditions at work. It seems unlikely from the general tenor of this publication that the authors intended such a loop-hole.

Overall, sensitivity seems to gain the upper hand over specificity. The only relief provided by this scheme seems to be that a red condition for one body region could not be blamed for an injury to an indirectly bio-mechanically linked region. The structure of the tables suggests a distinctly precautionary approach, but a final view of this could only be achieved after thorough review of the standards and evidence upon which they are reported to be based.

Step 3

"Ask whether or not there are non occupational origins for the symptoms"

Once again the question has drifted away from the WHO definition of work related. We are supposed to be talking about " significantly contribute to their development or exacerbation", not, self-reported symptoms.

Suggestions for non-occupational causes include hobbies which adopt bad ergonomic standards (as defined in the tables) and, related injuries such as bruising and fractures at home. The suggestions do not seem to take account of an increasing body of literature which promotes habitual isometric tension and sleep disorders/disturbed sleep as significant risk factors.

If the answer to the question is yes, the final action code can still be of a precautionary nature if there are workplace factors that are coded red. In this way even if work has not previously been at fault, the non-occupational injury can be protected from aggravation.

Step 4

"Make a decision about the level of work relatedness"

That is, use a combination of above findings to decide on action code.

Summary
A highly influential group of expert epidemiologists and ergonomists have defined a set of standards for the determination of work-relatedness. It is clearly possible that this approach will have implications for clarification of a duty of care and be used in support of civil claims.

The standards seem, without having extensively re-reviewed the suggested literature, to adopt a more precautionary approach than one that would described as establishing the balance of probabilities.

Detailed examination of the applicability of these standards to civil law in the UK is beyond the scope of this brief report.

Detailed Tables reproduced below:

Wrist/Hand – Green light

Green = acceptable if all factors are present

Physical Factors

Posture during a workday
- ❑ Not holding the wrist in extreme postures during a substantial part of the day.
- ❑ Not holding of tools or objects in pinch or grip position during most of the day.

Movement during a workday
- ❑ No highly repetitive movements of the wrist-hand or fingers during most of the day.

Force during a workday
- ❑ No high force exerted by the hand(s) during a substantial part of the day.

Combination of factors during a workday
- ❑ No computer or mouse work during most of the day.

For wrist-finger osteoarthritis, carpal tunnel syndrome and VWF and HAVS.
- ❑ No exposure to vibrating hand tools during a total of more than 1 hour per day.

For VWF
- ❑ No cold environment during most of the day.

Nonphysical Factors

- ❑ Not too little recovery time per hour when highly repetitive upper extremity movements are performed.
- ❑ No high psychological demands
- ❑ No low social support.

Wrist/Hand – Red light

Red = unsuitable if one or more physical risk factors are present

Physical Risk Factors

Posture during a workday
- ❑ Holding the wrist in extreme postures during a substantial part of the day.
- ❑ Holding of tools or objects in pinch or grip position during most of the day.

Movement during a workday
- ❑ Highly repetitive movements of the wrist-hand or fingers during most of the day.

Force during a workday
- ❑ High exertion by the hand(s) during a substantial part of the day (e.g. mediated by use of hand tools).

Combination of factors during a workday
- ❑ Combination of the aforementioned posture, repetition and force.
- ❑ Computer or mouse work during most of the day.

For wrist-finger osteoarthritis, carpal tunnel syndrome and VWF and HAVS.
- ❑ Exposure to vibrating hand tools during a total of more than 1 hour perworkday.

For VWF
- ❑ Cold environment during most of the day.

Nonphysical Risk Factors

Work:rest ratio during a workday

- ❑ Too little recovery time per hour when highly repetitive movements are performed.

Work characteristics in period before the complaints started

- ❑ High psychological demands
- ❑ Low social support.

Elbow and Forearm – Green light

Green = acceptable if all factors are present

Physical Factors	Nonphysical Factors
Posture during a workday ❑ Not holding the hand close to the upper body during a substantial part of the day (extreme elbow flexion). ❑ Not holding the elbow fully extended during a substantial part of the day. ❑ Not holding the forearm in an extreme twisted position during a substantial part of the day (pronation or supination). *Movement during a workday* ❑ No highly repetitive elbow and wrist movements during most of the day. *Force during a workday* ❑ No high forceful work for forearm muscles during a substantial part of the day (e.g. squeezing or pinching with the hands). *For elbow osteo arthritis* ❑ No exposure to vibrating hand tools during more than a total of 1 hour per workday.	❑ Not too little recovery time per hour when highly repetitive upper extremity movements are performed. ❑ No high psychological demands ❑ No low social support.

Elbow and Forearm – Red light

Red = unsuitable if one or more physical risk factors are present

Physical Risk Factors	Nonphysical Risk Factors
Posture during a workday ❑ Holding the hand close to the upper body during a substantial part of the day (extreme elbow flexion). ❑ Holding the elbow fully extended during a substantial part of the day. ❑ Holding the forearm in an extreme twisted position during a substantial part of the day (pronation or supination). *Movement during a workday* ❑ Highly repetitive elbow and wrist movements during most of the day. *Force during a workday* ❑ High forceful work for forearm muscles during a substantial part of the day (e.g. squeezing or pinching objects or hand toolswith the hands). *Combination of factors during a workday* ❑ Combination of the aforementioned posture, repetition and force. *For elbow osteo arthritis* ❑ No exposure to vibrating hand tools during more than a total of 1 hour per workday.	*Work:rest ratio during a workday* ❑ Too little recovery time per hour when highly repetitive movements are performed. *Work characteristics in period before the complaints started* ❑ High psychological demands ❑ Low social support.

Shoulder and Upper Arm – Green light

Green = acceptable if all factors are present

Physical Factors	Nonphysical Factors
Posture during a workday ❑ Not holding the hand behind the trunk (extension) during a substantial part of the day. ❑ Not holding the hand before the opposite side of the trunk (extreme adduction) during a substantial part of the day. ❑ Not holding the shoulder in extreme outward rotation during a substantial part of the day. ❑ Not holding an unsupported arm away from the body for a couple of minutes during a substantial part of the day. *Movement during a workday* ❑ No work in which the hands move above shoulder height during a substantial part of the day. ❑ No highly repetitive upper-extremity movements during most of the day. *Combination of factors during a workday* ❑ Not applying high force together with high repetitive movements and extreme postures.	❑ Not too little recovery time per hour when highly repetitive upper extremity movements are performed. ❑ No high psychological demands ❑ No low social support.

Shoulder and Upper Arm – Red light

Red = unsuitable if one or more physical risk factors are present

Physical Risk Factors	Nonphysical Risk Factors
Posture during a workday ❑ Holding the hand behind the trunk (extension) during a substantial part of the day. ❑ Holding the hand before the opposite side of the trunk (extreme adduction) during a substantial part of the day. ❑ Holding the shoulder in extreme outward rotation during a substantial part of the day. ❑ Holding an unsupported arm away from the body for a couple of minutes during a substantial part of the day. *Movement during a workday* ❑ Moving the hands move above shoulder height during a substantial part of the day. ❑ Highly repetitive upper-extremity movements during most of the day. *Combination of factors during a workday* ❑ Applying high force with the aforementioned repetitive movements and posture.	*Work:rest ratio during a workday* ❑ Too little recovery time per hour when highly repetitive movements are performed. *Work characteristics in period before the complaints started* ❑ High psychological demands ❑ Low social support.

Neck – Green light

Green = acceptable if all factors are present

Physical Factors	Nonphysical Factors
Posture during a workday ❑ Not holding the chin opposite the breast bone during most of the workday. ❑ No sitting work during most of the day with static postures of the neck and upper extremity and without rest pauses. ❑ No unsupported arms when work with upper extremities is performed during most of the day. *Movement during a workday* ❑ No highly repetitive neck extension movements during most of the day. ❑ No highly repetitive extreme neck flexion movements during most of the day. ❑ No highly repetitive upper-extremity movements during most of the day.	❑ Not too little recovery time per hour when highly repetitive upper extremity movements are performed. ❑ No high psychological demands ❑ No low social support.

Neck – Red light

Red = unsuitable if one or more physical risk factors are present

Physical Risk Factors	Nonphysical Risk Factors
Posture during a workday ❑ Holding the chin opposite the breast bone during most of the workday (extreme neck flexion). ❑ Sitting work during most of the day with static postures of the neck and upper extremity and without rest pauses. ❑ Unsupported arms when work with upper extremities is performed during most of the day. *Movement during a workday* ❑ Highly repetitive neck extension movements during most of the day. ❑ Highly repetitive extreme neck flexion movements during most of the day. ❑ Highly repetitive upper-extremity movements during most of the day.	*Work:rest ratio during a workday* ❑ Too little recovery time per hour when highly repetitive movements are performed. *Work characteristics in period before the complaints started* ❑ High psychological demands ❑ Low social support.