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Report by the Industrial Injuries Advisory Council in accordance with Section 171 of the Social Security Administration Act 1992 considering prescription for Dupuytren's contracture in workers exposed to hand-transmitted vibration.

Presented to Parliament by the Secretary of State for Work and Pensions
By Command of Her Majesty
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Dear Secretary of State

Review of Dupuytren's contracture and hand-transmitted vibration

We present our review of Dupuytren's disease and work involving hand-transmitted exposure to vibration.

Dupuytren's disease is a disorder of the hand in which thickening of fibrous tissue of the palm and finger tendons leads, in more advanced cases, to the digits becoming permanently bent (flexed) into the palm, this last state being called "Dupuytren's contracture". Our review has been triggered by correspondence from an MP requesting that the Council consider prescription for this condition.

Appraisal of the scientific research literature, new analyses of data held by experts in the field, and a call for evidence have led us to conclude that, given sufficient exposure to hand-held vibrating tools, risks of Dupuytren's disease and contracture can be more than doubled (the normal threshold employed by the Council when recommending prescription).

Early (pre-contracture) stages of the disease are not significantly disabling, however, and would be unlikely to qualify for benefit. For this reason we recommend that only the contracture stage of disease, namely that involving fixed flexion deformity of one or more of the digits as defined in this report, be added to the list of prescribed diseases for which Industrial Injuries Disablement Benefit (IIDB) is payable. The report outlines a 'table top' test, which can be used as a simple screen to help identify disease of this severity. Qualifying exposures would be those arising from work for ten years or more in aggregate which involves the use of hand-held powered tools whose internal parts vibrate so as to transmit vibration to the hand for at least two hours per day on three or more days per week.

Yours sincerely

Professor Keith Palmer
IIAC Chairman

May 2014

Summary

1. This report reviews the link between work with hand-held vibratory tools and a disorder of the hand called Dupuytren's disease, in which thickening of fibrous tissue in the palm and tendons of the fingers leads, in more advanced cases, to the digits becoming permanently bent (Dupuytren's contracture).

2. This condition has various established non-occupational causes. Additionally, associations have long been suspected with occupational use of hand-held powered vibratory tools, and evidence on this has grown over time.

3. The Industrial Injuries Advisory Council's (IIAC's) inquiries in this area have included a detailed review of the research literature, consultation with experts in the field, and fresh analyses of three existing datasets held by other parties. When taken together, the evidence indicates that risks of the disease can be more than doubled (the threshold commonly employed in deciding on prescription under the IIDB Scheme), provided that exposures to vibration are sufficiently long.

4. The Council recommends that Dupuytren's contracture be added to the list of prescribed diseases for which IIDB is payable following work for ten or more years in aggregate which involves use of hand-held powered tools whose internal parts vibrate so as to transmit vibration to the hand for at least two hours per day on three or more days per week.

5. Dupuytren's disease exists across a wide spectrum of severity, but the majority of cases cause little or no functional loss. To encourage claims activity only in circumstances where the assessed level of disablement is likely to contribute meaningfully to the award of benefit, the Council proposes that cases affecting only the palm and with no involvement of the fingers should be excluded from consideration; for the purposes of prescription, the disease should involve fixed flexion deformity (contracture) of one or more of the digits. The report outlines a 'table top' test, which can be used in clinical practice as an aid to define disease of this severity.

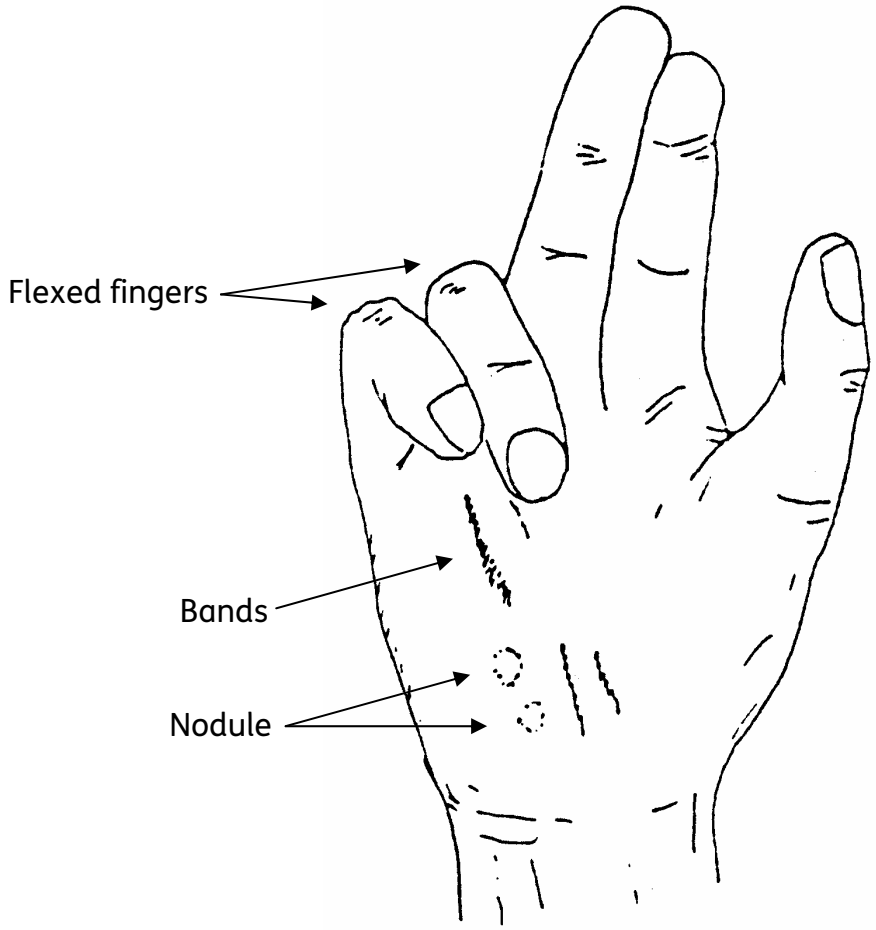
   This report contains some technical terms, the meanings of which are explained in a concluding glossary.

Background to the review

6. In January 2011, a Member of Parliament (MP) asked the Industrial Injuries Advisory Council (IIAC) to consider prescription for Dupuytren's contracture (Dupuytren's disease) in relation to coal mining. This request triggered the present report.

7. Dupuytren's contracture is a connective tissue disorder of the hand and fingers, in which the fingers of the hand become bent (flexed) into the palm so that they cannot be straightened (Figure 1). The ring finger and little finger are most commonly affected, and less often the middle finger and the index finger, with the thumb nearly always spared. The condition bears the name of Baron Guillaume Dupuytren, who first described it in 1831.

Figure 1 Hand with Dupuytren's disease.



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8. Slowly and painlessly over time, the fibrous tissue in the palm (palmar fascia) thickens. Typically, nodular thickenings, skin puckering and then fibrous bands become manifest in the palm. Eventually the connected digital tendons shorten and cannot move freely. The associated disablement arises because the affected digits have reduced function and grip may be impaired. The deformity may also cause distress, although, not infrequently, people accept it.

9. In severe cases the mainstay of treatment is surgical correction, which is effective, but is frequently followed by recurrence. Other modalities of treatment exist, a recent option involves the injection of an enzyme designed to weaken and dissolve the fibrous contractures.

10. A rough guide to severity is provided by the so-called 'table top' test – that is, the inability of a patient to place their hand flat against a hard surface, such as a table, because of fixed digital deformity. The disease can be staged clinically according to the presence of nodules, bands and degree of contracture. Although practices vary somewhat, many authorities suggest that surgery should be considered when:

    (a) the metacarpophalangeal joint (the joint intersecting with the palm at the base of the finger) is bent forwards by 30 to 45 degrees and cannot be straightened; or

    (b) the proximal interphalangeal joint (the second joint from the finger tip) is bent permanently by 10 to 20 degrees. Intervention at this point is recommended to promote a good surgical outcome.

11. Dupuytren's contracture is a fairly common disorder amongst the general population, although estimates of frequency vary greatly depending on the age profile, clinical characteristics, nationality of surveyed samples and the criteria employed in case definition. The condition is comparatively rare before age 40 and becomes more common with age. Cases can run in families and are more common in certain countries (for example, Norway, Iceland, Scotland) than in others (for example, Japan), suggesting a genetic contribution to disease occurrence. Other recognised associations include diabetes, epilepsy (especially treatment with the antiepilieptic drug phenytoin), heavy alcohol consumption and cirrhosis of the liver. Often, however, none of these risk factors are present.

12. Several estimates of disease frequency have been made in the UK. In 1951, Herzog examined the hands of 3,000 steel workers, miners, and office clerks from Northern England and estimated that 2 per cent had Dupuytren's disease of any extent. In men over 40 years of age the prevalence rose to 4.3 per cent.

13. In 1962, Early surveyed 4,688 employees of a large engineering works, together with a cross-section of the population in Leigh, Lancashire and residents of a care of the elderly home. Some 3.8 per cent of men and 2.3 per cent of women were affected. Rates were higher at older ages. Thus, 7.4 per cent of men from the locomotive works aged 45 to 74 years had Dupuytren's disease. In almost 80 per cent of cases, however, involvement was confined to the palm, without associated digital contracture.

14. Early's findings imply that cases of the disease are often mild. Similarly, Mackenney (1983) in reporting a prevalence of 5 per cent among men and 3.5 per cent in women, chosen at random from 919 adults attending orthopaedic clinics in the Cotswolds and Chilterns, noted that the disease was confined to the palms in 58 per cent of assessed cases. Two other surveys imply that the disease is under-recorded in general practice records, probably because medical help is not always sought. Geoghegan *et al.* (2004) identified only 821 cases in a computerised database of more than 300,000 patients aged 20 years or more (less than 0.3 per cent), while Khan *et al.* (2004) reported a new consultation rate in general practice of only 0.034 per cent per year in a survey covering 500,000 patients.

15. Finally, according to Lennox *et al*. (1993), in consecutive patients aged over 60 years from hospitals in Aberdeen, finger contracture was less common than palmar nodules in isolation (diagnosed orthopaedically in 35 of 400 assessed hands).

16. The available research suggests two broad links with occupational activity – with manual work and with exposure to hand-transmitted vibration (possibly, but not clearly consequent on the manual aspects of handling powered vibratory tools). A link with occupation was first suggested in the context of hand injury, although some uncertainty exists over how such an association with injury could arise. It is possible, for example, that mild forms of the condition might come to medical attention for the first time following assessment of an injury (diagnostic bias), or that the contracture could make hand accidents more likely (reverse causation). Preliminary data on associations were small-scale and studies were ill-equipped to address confounding, for example, by age. Somewhat inconclusive findings prompted several orthopaedic textbooks (and current websites) to record the case for work causation as unproven.

17. Dupuytren's disease was last considered by the Council in the course of its review *Work-related upper limb disorders*, Cm 6868 (2006). At that time a literature search identified some evidence on occupational causation, including a body of reports reviewed by Liss and Stock in 1996. These authors had concluded that there was 'good support for an association between vibration and Dupuytren's contracture', but the Council found the data insufficient to meet the normal threshold for prescription.

18. Since then, however, further evidence has accumulated. This present review commenced with an updated search of the literature. At this scoping stage new reports were found both in relation to manual work and occupational exposure to hand-transmitted vibration.

19. The Council concluded, however, that 'manual work' covered such a broad spectrum of occupational activities, and was defined so openly and generally in research reports, as to render untenable the practical definition of coverage for this group of workers. It was decided, therefore, to limit the review to potential prescription for Dupuytren's contracture in workers exposed to hand-transmitted vibration, the focus of the MP's original inquiry.

The Industrial Injuries Disablement Benefit Scheme

20. IIAC is an independent statutory body set up in 1946 to advise the Secretary of State for Work and Pensions in Great Britain, and the Department for Social Development in Northern Ireland on matters relating to the Industrial Injuries Scheme. The major part of the Council's time is spent considering whether the list of prescribed diseases for which benefit may be paid should be enlarged or amended.

21. The Industrial Injuries Disablement Benefit (IIDB) Scheme provides a benefit that can be paid to an employed earner because of an occupational accident or prescribed disease.

The legal requirements for prescription

22. The Social Security Contributions and Benefits Act 1992 states that the Secretary of State may prescribe a disease where he is satisfied that the disease:

    a) ought to be treated, having regard to its causes and incidence and any other relevant considerations, as a risk of the occupation and not as a risk common to all persons; and

    b) is such that, in the absence of special circumstances, the attribution of particular cases to the nature of the employment can be established or presumed with reasonable certainty.

23. In other words, a disease may only be prescribed if there is a recognised risk to workers in an occupation, and the link between disease and occupation can be established or reasonably presumed in individual cases.

24. In seeking to address the question of prescription for any particular condition, the Council first looks for a workable definition of the disease. It then searches for a practical way to demonstrate in the individual case that the disease can be attributed to occupational exposure with reasonable confidence. For this purpose, reasonable confidence is interpreted as being based on the balance of probabilities according to available scientific evidence.

25. Within the legal requirements of prescription it may be possible to ascribe a disease to a particular occupational exposure in two ways – from specific clinical features of the disease or from epidemiological evidence that the risk of disease is at least doubled by the relevant occupational exposure.

Clinical features

26. For some diseases attribution to occupation may be possible from specific clinical features of the individual case. For example, the proof that an individual's dermatitis is caused by his/her occupation may lie in its improvement when s/he is on holiday and regression when they return to work, and in the demonstration that they are allergic to a specific substance with which they come into contact only at work. It can be that the disease only occurs as a result of an occupational hazard (for example, coal workers' pneumoconiosis).

Doubling of risk

27. Other diseases are not uniquely occupational. Moreover, when caused by occupation, they are indistinguishable from the same disease occurring in someone who has not been exposed to a hazard at work. In these circumstances, attribution to occupation on the balance of probabilities depends on epidemiological evidence that work in the prescribed job, or with the prescribed occupational exposure, increases the risk of developing the disease by a factor of two or more.

28. The requirement for at least a doubling of risk follows from the fact that if a hazardous exposure doubles risk, for every 50 cases that would normally occur in an unexposed population, an additional 50 would be expected if the population were exposed to the hazard. Thus, out of every 100 cases that occurred in an exposed population, 50 would do so only as a consequence of their exposure while the other 50 would have been expected to develop the disease, even in the absence of the exposure. Therefore, for any individual case occurring in the exposed population, there would be a 50 per cent chance that the disease resulted from exposure to the hazard,

and a 50 per cent chance that it would have occurred even without the exposure. Below the threshold of a doubling of risk only a minority of cases in an exposed population would be caused by the hazard and individual cases therefore could not be attributed to exposure on the balance of probabilities; above it, they may be.

29. The epidemiological evidence required should ideally be drawn from several independent studies, and be sufficiently robust that further research at a later date would be unlikely to overturn it.

30. Dupuytren's contracture has established non-occupational causes and does not have clinical features that differ in cases alleged to arise in an occupational context. The argument for prescription rests, therefore, on reliable evidence of a doubling or more of risk in exposed workers.

Method of investigation

31. The Council's Research Working Group conducted a literature review, focusing on research reports on occupation and Dupuytren's contracture. Account was taken, in particular, of a recent systematic review of evidence by Descatha *et al.* (2011), which in turn cited nine primary research reports, seven of which indicated a more than doubling of risk from hand-transmitted vibration under some circumstances of exposure. These papers and others identified by the Council's search were retrieved and evaluated. Additionally, correspondence was conducted with authors of three of the papers, requesting re-analyses particular to the Council's needs; and one of the Council's members supplied additional relevant data from a national survey of vibration. Several experts in the health effects of hand-transmitted vibration were also consulted (Appendix 1).

Consideration of the evidence

32. Bovenzi *et al.* (1994) studied 828 working-aged men from Italy, comprising stone workers (145 quarry drillers and 425 stonecarvers) and 258 manual controls. The exposed population was long-serving (mean exposure duration 17.4 years) with little turnover, and few workers are likely to have been selected out of employment because of the disease. Levels of exposure to hand-transmitted vibration would have been relatively high.

33. Risks (odds ratios (OR)) were elevated more than two-fold and there was evidence of a dose-response relationship. However, exposure levels in the report were defined in terms of a complex composite of vibration magnitude and time, potentially unusable within the context of the IIDB Scheme. Professor Bovenzi, when requested, kindly provided an alternative analysis of the original data (Table 1) with exposures defined in four bands of lifetime duration of exposure. (In generating these risk estimates a simplifying assumption was made that in each band the mean vibration magnitude matched that of the overall average of 8.7 m/s^2 (A(8)). Risks were more than doubled overall in stone workers versus manual controls, and among workers with a median exposure >10 years. Findings became statistically significant in bands defined as having at least 13 years of exposure. Some 95 per cent of workers were estimated to have a daily vibration exposure of about two or more hours per day (M. Bovenzi, personal communication).

Table 1 Risk of Dupuytren's contracture in Italian stone workers (adapted from Bovenzi, 1994, Tables 1, 4, 5 and 7) with additional analyses provided by M. Bovenzi (personal communication).

Exposure	Odds ratio (95% confidence interval (CI))§	Exposure duration
By occupation (versus controls):		
Stone workers	2.60 (1.24–5.49)	17.4 years (mean)
Quarry drillers	2.58 (1.07–6.20)	18.3 years (mean)
Stone carvers		
Group A	1.85 (0.74–4.61)	14.9 years (mean)
Group B	3.23 (1.44–7.23)	18.9 years (mean)
By vibration dose (versus controls):		
Band 1 (lowest)	1.93 (0.64–5.84)	~1–6 years (median 3.0 years)*
Band 2	2.25 (0.88–5.72)	~7–12 years (median 10 years)*
Band 3	2.57 (1.04–6.36)	~13–25 years (median 19 years)*
Band 4 (highest)	3.20 (1.39–7.37)	~25–50 years (median 34 years)*

§ ORs adjusted for age, smoking, alcohol consumption, and upper limb injuries

** M Bovenzi, personal communication – derived from Table 7, assuming that in each quartile of lifetime vibration dose the vibration magnitude was the overall average of 8.7 m/s^2 (A(8)).*

34. Lucas *et al*. (2008) reported on 212 cases of Dupuytren's contracture, diagnosed among 2,406 male civil servants employed at the French Ministry of Equipment in 1998. Diagnosis required thickening of the palmar fascia, with or without flexion contracture in any of the four fingers. The prevalence of disease was higher (12.3 per cent) in users of powered vibratory tools than in non-users (7.5 per cent), but the types of tool giving rise to risk were not reported. Again, the index of exposure was a composite one, involving a combination of number of years worked and of broad groupings of annual frequency. However, upon request, Professor Descatha kindly provided a new analysis of the data (Table 2) with exposures re-expressed in three bands, each involving regular use during a year (for 6 to 12 months) and differing according to the average number of years worked to this extent. The highest risks were found in those with the longest exposures, risks being almost doubled among workers who had worked for a mean of 13 years and a median of ten years to this extent annually.

Table 2 Risk of Dupuytren's contracture in manual workers from France (adapted from Lucas *et al*. (2008)) with additional analyses supplied by A. Descatha (personal communication).

Exposure band	Prevalence %	Odds ratio (95%CI)§
Low	7.50	1
Intermediate	10.97	1.81 (1.18–2.76)
High¶	13.43	1.95 (1.33–2.86)

§ Adjusted for age, family history, history of diabetes, history of epilepsy, hand trauma, alcohol consumption (> 5 drinks/day).

¶ High exposure corresponded to 6–12 months per year of vibration exposure for a mean of 13 years (median 10 years).

35. A separate report by the same research group (Descatha *et al*., 2012) considered risks in 2,161 men aged 20 to 59 years employed by private companies in the Pays de Loire region in west-central France. These were selected randomly from those undergoing regularly scheduled mandatory health surveillance between 2002 and 2005. Dupuytren's contracture was deemed to be present if one or more digits were bent permanently or there were fibrous nodules in any of the four fingers; the assessing doctors were pre-trained to standardise diagnosis. Exposures were defined in relation to a daily threshold (two hours/day) within the past year and in terms of being exposed to at least this extent for more than ten years. Information was lacking, however, on the type of industry, the types of vibratory tool, and their vibration magnitudes. Cases were comparatively few (27 in all), but a stronger relationship was found with use of vibratory tools than in other studies, the OR for use over more than ten years exceeding ten (Table 3).

Table 3 Risk of Dupuytren's contracture in manual workers from France (Descatha *et al*., 2012).

Use of vibrating tools (versus never) in hours/day:	Odds ratio (95%CI)§
<2h/d, past 12 months	4.8 (1.7–13.5)
≥2h/d, past 12 months	6.2 (2.5–15.7)
≥2h/d, for >10 years	10.8 (3.4–34.6)

§ Adjusted for age and diabetes.

36. Thomas and Clarke (1992) investigated the occurrence of Dupuytren's contracture in 500 men (steel workers, shipbuilders, construction workers and miners) with an average age of 64 years, who were seeking compensation for vibration-induced white finger (VWF), the comparator being 150 similarly aged men admitted to a general surgical ward of a hospital with mixed health problems. In all, 19.9 per cent of VWF claimants (all aged more than 45 years) were judged to have the condition as compared with 10.7 years of surgical referents, almost a doubling of risk.

37. In a far larger study, Burke *et al*. (2007) assessed the effects of exposure to vibration on the prevalence of Dupuytren's disease in 97,537 British miners and ex-miners, aged 25 to 95 years, who were seeking compensation for Hand-arm Vibration Syndrome (HAVS) under an assessment scheme of the Department of Trade and Industry (DTI), including 7,927 claimants diagnosed with the condition. This very large study found no relationship with years of exposure to vibration when risk increase was analysed 'per year' of vibration exposure.

38. It should be noted that this analytic approach (treating exposure as a continuous measure) tests for, and assumes, a steady linear relationship between exposure time year on year and risk of disease. However, if risks rise abruptly after an interval and then level out, remaining elevated thereafter, then this form of analysis can potentially miss an association. (A real example of this effect was drawn to the Council's attention during this inquiry. The underlying principles are described in standard textbooks – e.g. Checkoway *et al*., 2004. In this respect, Thomas *et al*. (1992) found a non-linear exposure-response in claimants of HAVS, with risks of contracture raised three-fold after ten years of exposure but changing very little thereafter.)

39. An association might also be missed if those analysed have little exposure contrast (too similar a level of exposure), as might perhaps apply to a group of heavily exposed claimants; or conversely if claimants are too young to aggregate sufficient exposure to develop the disease (Dupuytren's disease is uncommon before age 40 years, but 29 per cent of the miners seeking compensation for HAVS in the Burke *et al*. study were younger than this and the modal age band (that which included the most miners) was 40 to 44 years). Finally, since the background prevalence of Dupuytren's disease rises with age, risks may no longer be as much as doubled in much older claimants (12 per cent of claimants were 70 years or older).

40. The issues raised in relation to exposure-response and exposure contrast in the report by Burke *et al*. can be tested by supplementary analysis in which risk is assessed by exposure time defined in bands (e.g. 5 to 10 years, 10 to 15 years), rather than per year. The Council, therefore, sought access to the dataset by approaching the original investigators and the Department for Energy and Climate Change, which has assumed ownership of this DTI legacy responsibility. However, access for purposes of reanalysis, did not prove possible. In consequence, the uncertainty expressed in paragraphs 38 to 39 limits interpretation of the report by Burke *et al*.

41. A further report by Cocco *et al*. (1987), presented data on Dupuytren's contracture among 14,557 patients attending the Cagliari Medicine at Work Institute during 1970-1985. These included 180 subjects with the condition, defined on the basis of flexion deformity (bent digits), but not isolated nodules or thickening in the palm (Table 4). Criteria for attendance at the Institute were not given. Risk estimates, which appeared unadjusted for other factors, were made in relation to years of professional exposure to mine drilling, using 'moto-picks', and also years in a broad range of exposed jobs (mine driller, stone cutter, stone dresser, building worker, chainsaw user, timber worker, milling worker, grinder and polisher). Risks were more than doubled overall, both in workers from exposed occupations and from those specifically involved in mine drilling, this threshold being crossed in the first group after more than ten years of cumulative employment, and in the latter after more than 20 years (risks being raised 1.84-fold in the exposure band 11 to 20 years).

Table 4 Risk of Dupuytren's contracture in Italian workers (Cocco *et al.* 1987)

Exposure	Odds ratio (95%CI)§
In an exposed job¶ (versus never):	
Overall	2.31 (1.48–4.36)
< 10 years	1.74 (0.90–3.36)
11–20 years	2.35 (1.30–6.67)
≥21 years	2.95 (1.30–6.67)
Professional exposure to mine drilling:	
Overall	2.12 (1.34–3.35)
< 10 years	1.44 (0.65–3.21)
11–20 years	1.84 (0.98–3.47)
≥21 years	3.43 (1.81–6.51)

¶ Mine driller, worker using a 'moto-pick', stone cutter, stone dresser, building worker, chainsaw user, timber worker, milling worker, grinder, polisher. Those without exposure were chosen to be similar in age to those in exposed jobs (within five years).

42. A German case-control study, by Seidler *et al.* (2001), compared work histories in patients with Dupuytren's contracture attending surgical and specialist hand clinics, and in controls, comprised of subjects identified by random digit dialling and an electoral roll. A relative risk (RR) of 1.3 was estimated in miners exposed for more than 20 years at more than 20 hours per week; but the study was limited by a poor response rate and was small, the estimate of RR at the 95 per cent CI upper confidence limit being elevated 2.7-fold.

43. A further report by Chanut (1963) was considered, but proved uninformative. Although data were collected on duration of exposure to pneumatic tools, these were not used in analysis, other than within a general comparison of manual versus administrative workers.

44. Supplementing this literature, a member of the Council conducted a new analysis, based on a pre-existing dataset, to inform this enquiry (Palmer *et al.*, 2014). In 1997–98 a questionnaire on exposure to vibration and health was mailed to 22,415 subjects aged 16 to 64 years selected at random from the registration lists of 34 British general practices and the central pay registers of the Armed Forces (Palmer *et al.*, 2000). A checklist of vibratory tools was included, identified by the European Committee for Standardization (CEN) as requiring type testing or known through literature review to pose a risk of HAVS (for example, road breakers, chipping hammers, rammers, needle guns, chainsaws, clinching and flanging tools). Personal daily vibration exposures (A(8)) for the past week were estimated from information on the tools used, their duration of use, and their likely vibration magnitudes (imputed for each tool family from published and other sources of data). Dupuytren's contracture was assessed using the question 'Is your little finger (or little and ring finger) of

either hand permanently bent as shown opposite [*a diagram was supplied*] so that you cannot straighten it, even with the other hand?' When analysis was confined to male respondents in work, at work in the past week and with complete information, a graduation in risk of the condition was found. Relative to workers who had never been exposed occupationally to hand-transmitted vibration, the OR in those exposed in the past week, but below a (then prevailing) Health and Safety Executive A(8) action limit of 2.8 ms^{-2}, was elevated, but less than doubled; but in workers exposed above the action limit it was more than tripled ($P<0.05$). No information was obtained on the duration of employment with exposures of this degree and some information was missing on weekly exposure times. Typically, however, these reached two or more hours per day on three or more days of the working week.

45. Descatha *et al*. (2011), in reviewing the evidence on work and Dupuytren's contracture, combined several of the aforementioned published risk estimates in a process called meta-analysis (a statistical process of pooling quantitative information across studies). For vibration at work, the meta-OR was 2.88 (95 per cent CI 1.36 to 6.07), and in a sub-analysis, confined to reports considered to be of higher quality, was 2.14 (95 per cent CI 1.59 to 2.88). This review considered the report by Burke *et al*. (paragraph 37), but excluded it from analysis, deeming that it did not to have an appropriate comparator group.

Conclusions

46. In evaluating this body of evidence, the Council has noted individual limitations in some of the papers. Specifically, some reports lacked a clear account of the tools giving rise to exposure and their magnitude of exposure (Lucas *et al*. 2008, Descatha *et al*, 2012) or the duration of long-term exposure (Palmer *et al*., 2011). Some reports did not clearly specify how study samples had been assembled (Lucas *et al*., 2008; Cocco *et al*., 1987) or were potentially unrepresentative in focusing on self-selecting groups of compensation claimants (Thomas and Clarke, 1992, Burke *et al*. 2007).

47. Striking, however, was the consistency with which increased risks were reported, including RRs above the Council's usual threshold of two. Added weight was also given to the report by Bovenzi *et al*., in which representative data from a heavily exposed long-serving population demonstrated an exposure-response pattern. Several studies indicated that RRs can be more than doubled, given a long enough exposure time, in the range of 10 to 20 years (Bovenzi, 1994; Lucas *et al*., 2008; Descatha *et al*., 2012; Cocco *et al*., 1987), notably for tools of sufficient vibration magnitude (Bovenzi, 1994; Cocco *et al*.,1987). A further study, while not providing data on cumulative duration of exposure, underscored the relevance of daily exposure to vibration, as influenced by vibration magnitude and hours of tool use (Palmer *et al*., 2014).

48. RRs were also almost doubled in one study of claimants of HAVS (Thomas and Clarke, 1992). By contrast, no elevation in risk was found in the very large DTI study of British miners and ex-miners (Burke *et al*., 2007), although the potential limitations of this analysis have been aired above; and risks were less than doubled in German miners in the small case-control study described in paragraph 42 (Seidler *et al*., 2001).

49. Broadly speaking, however, and with the notable exception of the Burke report, the research evidence indicates a more than doubling of risks, consistent with the meta-estimates in Descatha's 2012 review. On this basis, the Council concludes that the case is made for recommending prescription.

50. In considering a workable definition of the qualifying exposure(s), the Council feels that a *duration* of exposure at least ten years in aggregate (to the extent of two or more hours per day on three or more days per week) would be an appropriate cut-point. (The cut-point of ten years in aggregate would be supported by the studies of Bovenzi, 1994; Lucas *et al*., 2008; Descatha *et al*., 2012 and Cocco *et al*., 1987, and the two hour daily value by those by Descatha *et al*., 2012, Bovenzi, 1994 and Palmer *et al*., 2014).

51. The qualifying *activities and tools* have been harder to define, as some reports fail to specify these closely (Lucas *et al*., 2008, Descatha *et al*., 2012, Thomas and Clarke, 1992). One option the Council explored was to model prescription on the tools and activities currently listed in relation to PD A11 (those of sufficiently high magnitude to give rise to Hand-arm Vibration Syndrome). In support of this choice, the study by Bovenzi *et al*. (1994) and the report by Cocco *et al*. (1987) involved certain of the vibratory tools that are presently listed in relation to PD A11 (chain saws, rotary tools used in grinding, sanding and polishing, percussive metal-working tools, and percussive drills or hand-held percussive hammers in mining, quarrying, or demolition), while the National Survey of Vibration, although also counting other sources of exposure, made use of the tools listed in PD A11 in its inquiries. However, as the link between the evidence base and the exposure schedule for PD A11 is only partial, there being studies that did not define the relevant tools or which included other choices, the Council proposes instead that prescription be modelled on that for PD A12(a): the use of hand-held powered tools whose internal parts vibrate so as to transmit that vibration to the hand, but excluding those tools which are solely powered by hand.

52. The Council has also considered the matter of case severity. Diagnosis is straight forward, other than in the very early stages of disease – simple clinical examination by a doctor should suffice. However, in its early stages, and often for many years or even a lifetime, the disease is so minor in effect as to cause no disablement. It would be wasteful of the Scheme's resources and unhelpful to potential claimants to encourage a large volume of claims activity when assessment will not give rise to any degree of assessed disablement. On the other hand, even comparatively low levels of award (below the 14 per cent threshold required to trigger entitlement to benefit) might benefit some claimants, by virtue of aggregation with other prescribed diseases, of which several are linked with hand-transmitted vibration (PD A10, A11 and A12), although only to the extent that this does not happen already.

53. The Council has sought advice from the Department for Work and Pensions on the likely degree of assessed disablement that alternative choices of case definition would attract. It has been informed that each assessment is individualised, reflecting that the impact on disablement will vary considerably according to the circumstances of different claimants. As such, prescriptive guidance is not available. It seems unlikely, however, that palmar nodules and thickenings in the absence of fixed flexion deformity would attract any meaningful degree of disablement, their impact on function being minimal (less than 1 per cent).

54. Moreover, the table of Statutory Scheduled Assessments defines the disablements attached to certain physical injuries arising from occupational accidents within the Scheme. In assessing fixed flexion deformity in Dupuytren's disease, any loss of function would be related to loss of a ring finger or little finger by amputation, which is considered to be a disablement of 7 per cent. The actual impact in an individual with Dupuytren's contracture could be more or less, depending, for example, on the degree of contracture, other occupational and non-occupational factors limiting function and the extent and distribution of the disease.

55. Mindful of the considerations in paragraphs 52 to 54, the Council recommends that Dupuytren's contracture be defined, for purposes of benefit, in such a way as to require fixed flexion deformity of at least one of the digits. In general, this would mean that the claimants who might benefit from prescription, directly or in aggregation, would be those who failed the table top test (i.e. were unable to place their palm flat on a table top by virtue of their Dupuytren's disease), and this criterion could be used as a filter for discouraging claims that would not attract benefit.

56. It should be noted that the condition is treatable. In logic and fairness, surgery or other treatment that corrected fixed flexion deformity should prompt consideration of the need for reassessment.

Recommendations

57. The Council recommends that Dupuytren's contracture be added to the list of prescribed diseases for which benefit is payable, when severe enough to involve fixed flexion deformity, and following exposure of at least ten years in aggregate to the tools and activities presently scheduled in relation to PD A12(a).

58. The recommendations for prescription are described in the table below.

Disease	Occupation
Dupuytren's contracture resulting in fixed flexion deformity of one or more digits	Any occupation involving the use of hand-held powered tools whose internal parts vibrate so as to transmit that vibration to the hand, but excluding those tools which are solely powered by hand, where the use of those tools amounts to a period or periods in aggregate of at least ten years and where, within that period or those periods, the use of those tools amounts to at least two hours per day for three or more days per week and where the onset of the disease fell within the period or periods of use specified in this paragraph.

Presumption

59. The data that indicate a doubling of risk (e.g. Bonvenzi *et al*., 1994, Lucas *et al*., 2008; Descatha *et al*., 2012, Palmer *et al*., 2014) arise in subjects of working age, while risk estimates have tended to be lower in samples containing an important proportion of retired workers (for example, in the study by Siedler *et al*., 44 per cent of cases were aged more than 60 years). The Council recommends, therefore, that Dupuytren's contracture should receive the benefit of presumption under Regulation 4 of the Social Security (Industrial Injuries) (Prescribed Diseases) Regulation 1985), provided that onset is developed while in or within one month of leaving a job that meets the schedule's specification. For the purpose of diagnosis, contracture resulting in fixed flexion deformity of one or more digits should be present within the job or shortly thereafter, and not simply the onset of nodules or palmar thickening during employment.

60. In the Council's view, the presence of non-occupational risk factors for Dupuytren's contracture (for example, epilepsy, diabetes, heavy alcohol intake) should not be construed as grounds for rebuttal of presumption, assuming that the qualifying conditions of exposure are met; and nor should the age or racial origin of the claimant. Onset should be after first exposure to hand-transmitted vibration and not before.

Prevention

61. In principle, the relation between Dupuytren's contracture could arise, at least in part, from the manual aspects of using heavy industrial equipment and not solely or simply the vibration imparted to the hand: a link has also been described with manual labour in jobs that do not entail use of vibratory tools. Therefore, prevention should focus both on reducing exposures to hand-transmitted vibration and on appropriate risk control measures in relation to manual handling.

62. Risks from hand-transmitted vibration and manual handling can be minimised by good work practices. Where possible, tasks that entail exposure to hand-transmitted vibration and manual handling should be avoided. If this is not possible, then steps should be taken to assess and control the risk to health as far as is reasonably practicable – for example, by using tools with grips of a style compatible with the job in hand (pistol, 'D', straight, angle, etc.), by using tools which emit less vibration into operators' hands, reducing the duration of use of tools, or by using ergonomic aids to support the weight of tools and reduce forces applied by the operator. Health surveillance is a requirement for many workers who are regularly and frequently exposed to hand-transmitted vibration. Use of mechanical lifting aids and the provision of suitable training and instructions will help reduce the risks posed by manual handling. Management controls should be reviewed periodically to ensure they remain effective.

63. A European Directive on controlling the risks from vibration came into force on 6 July 2002. British Regulations transposing the Directive came into force on 6 July 2005. The Regulations set requirements for control of risk from hand-arm vibration. The regulations include an exposure action value and an exposure limit value. The Manual Handling Operations Regulations 1992 (MHOR), which implement a European Directive on manual handling, set out a clear ranking of measures for dealing with risks from manual handling. Further information on these Directives and the British Regulations can be found at www.hse.gov.uk which is the Health and Safety Executive's (HSE's) website.

Diversity and equality

64. IIAC is aware of issues of equality and diversity and seeks to promote equality and diversity as part of its values. The Council has resolved to seek to avoid unjustified discrimination on equality grounds, including age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, gender and sexual orientation. During the course of the review of Dupuytren's contracture in workers exposed to hand transmitted vibration, no diversity and equality issues were apparent.

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Appendix 1 Experts consulted[1]

Professor Alexis Descatha, Professor of Occupational Health, Institut National de la Santé et de la Recherche Médicale (INSERM), Garche, France.

Professor Massimo Bovenzi, Professor of Occupational Medicine, University of Trieste, Trieste, Italy.

Dr Frank Burke, Consultant Hand Surgeon, Derbyshire Royal Infirmary, Derby.

Professor Michael Griffin, Head of Human Factors Research Unit, Institute of Sound and Vibration Research, University of Southampton, Southampton.

Professor Bradley Evanoff, Chief of the Division of General Medical Sciences and Section Head of Occupational and Environmental Medicine, Department of Internal Medicine, Washington University, St Louis, USA.

[1] The Council wishes to thank the experts consulted and to note that inquiries were restricted to matters of fact rather than the opinions of individuals on the merits of prescription.

Glossary of terms used in this report

Types of study

Case-control study: A study which compares people who have a given disease (cases) with people who do not (controls) in terms of exposure to one or more risk factors of interest. Have cases been exposed more than non-cases? The outcome is expressed as an **Odds Ratio**, a form of **Relative Risk**.

Cross-sectional study: A study which compares the relative frequency or odds of characteristics between groups at a given point in time or over a given interval.

Measures of association

Statistical significance and P values: Statistical significance refers to the probability that a result as large as that observed, or more extreme still, could have arisen simply by chance. The smaller the probability, the less likely it is that the findings arise by chance and the more likely they are to be 'true'. A 'statistically significant' result is one for which the chance alone probability is suitably small, as judged by reference to a pre-defined cut-point. (Conventionally, this is often less than 5 per cent ($P<0.05$)).

Relative Risk (RR): A measure of the strength of association between exposure and disease. RR is the ratio of the risk of disease in one group to that in another. Often the first group is exposed and the second unexposed or less exposed. *A value greater than 1.0 indicates a positive association between exposure and disease*. (This may be causal, or have other explanations, such as bias, chance or confounding.)

Odds Ratio (OR): A measure of the strength of association between exposure and disease. It is the odds of exposure in those with disease relative to the odds of exposure in those without disease, expressed as a ratio. For rare exposures, odds and risks are numerically very similar, so the OR can be thought of as a **Relative Risk**. *A value greater than 1.0 indicates a positive association between exposure and disease*. (This may be causal, or have other explanations, such as bias, chance or confounding.)

Other epidemiological terms

Confidence Interval (CI): The **Relative Risk** reported in a study is only an *estimate* of the true value in the underlying population; a different sample may give a somewhat different estimate. The CI defines a plausible range in which the true population value lies, given the extent of statistical uncertainty in the data. The commonly chosen 95 per cent CIs give a range in which there is a 95 per cent chance that the true value will be found (in the absence of bias and confounding). *Small studies generate much uncertainty and a wide range, whereas very large studies provide a narrower band of compatible values*.

Other epidemiological terms (continued)

Confounding: Arises when the association between exposure and disease is explained in whole or part by a third factor (confounder), itself a cause of the disease,that occurs to a different extent in the groups being compared.

For example, smoking is a cause of lung cancer and tends to be more common in blue-collar jobs. An apparent association between work in the job and lung cancer could arise because of differences in smoking habit, rather than a noxious work agent.

Studies often try to mitigate the effects of ('control for') confounding in various ways such as: restriction (e.g. only studying smokers); matching (analyzing groups with similar smoking habits); stratification (considering the findings separately for smokers and non-smokers); and mathematical modelling (statistical adjustment).

Meta-analysis: A statistical process of pooling quantitative information across studies to produce an overall estimate of Relative Risk (meta-RR), taking account of their differing sizes.

Other technical terms

Dupuytren's disease: A disease of the palmar fascia involving thickening of fibrous bands on the palmar surface, and which may or may not include fixed contracture of the digits. (Where contracture occurs, the disease can also be described as **Dupuytren's contracture**; however, the umbrella term 'Dupuytren's disease' also encompasses earlier stages of the disease process.)

Dupuytren's contracture: A disease of the palmar fascia resulting in thickening and contraction of fibrous bands on the palmar surface, such that one or several digits become permanently bent. A form of **Dupuytren's disease** that does not solely affect the palm, but also involves fixed contracture of the digits.

Palmar nodule: Solid raised area under the skin, affecting the palm of the hand.

A(8): A daily exposure dose to hand-transmitted vibration. Injury risk is thought to relate to the total energy entering the hand: under this assumption, dose is expressed in terms of the equivalent acceleration of the tool (measured in three axes) that would impart the same amount of energy to that actually measured, when averaged (in a particular way) over a reference period of eight hours (as if exposure had been continuous over this time).

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