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A review of the assessment and objective testing for the vascular component of hand arm vibration syndrome (HAVS)

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Position paper 43: A review of the assessment and objective testing for the vascular component of hand arm vibration syndrome (HAVS)

Background

1. At the Industrial Injuries Advisory Council's public meeting in 2017, the Council was asked about the application of the Prescription PD A11: Hand Arm Vibration Syndrome (Cm 6098, 2004). The concern related to the minority of claims for sensorineural (SN)-only Hand Arm Vibration Syndrome (HAVS). It was suggested that medical assessors might be rejecting claims on the basis that the numbness or tingling needed to be continuous instead of persistent, as intended.

2. In response, two members of the Council carried out an audit of 101 consecutive case records involving recently decided claims for PD A11. The conclusion of the audit was that there was no evidence that claimants with sensorineural symptoms were being disadvantaged and that the prescription was being applied as intended.

3. However, the audit highlighted some possible inconsistencies in the way in which assessors appeared to be making a judgement about the vascular component of HAVS (or vibration induced white finger, VWF) as it relates to prescribed disease PD A11. In the absence of any objective test for vascular function, the diagnosis of HAVS is reliant on a careful history. The audit found that a number of claims were being rejected with reference to the claimant's description of the time course over which the symptoms (onset and progression) were reported. It was clear that this was a critical and common reason why the prescription of PD A11 was not awarded.

4. In response, the Council decided to look again at the assessment of the vascular component of HAVS with particular attention to:

(i) whether there had been any important developments in objective testing of vascular function sufficient to recommend their inclusion within the prescription of PD A11; and

(ii) the problems of interpreting the history and time-course of symptoms presented by claimants.

The Industrial Injuries Disablement Benefit

5. The IIDB provides a non-contributory, 'no-fault' benefit for disablement because of accidents or prescribed diseases which arise during the course of employed earners' work. The benefit is paid in addition to other incapacity and disability benefits. It is tax-free and administered by the Department for Work and Pensions.

6. The legal requirements for prescription are set out in The Social Security Contributions and Benefits Act 1992 which states that the Secretary of State may prescribe a disease where they are satisfied 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.

7. Thus, a disease can 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.

The Role of the Industrial Injuries Advisory Council (IIAC) and prescription

8. IIAC is an independent statutory body established in 1946 to advise the Secretary of State for Social Security on matters relating to the IIDB scheme.

9. Much 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. The Council 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.

10. Some occupational diseases are relatively simple to verify, as the link with occupation is clear-cut. Some only occur due to particular work, or are almost always associated with work, or have specific medical tests that prove their link with work, or have a rapid link to exposure, or other clinical features that make it easy to confirm the work connection. However, many other diseases are not uniquely occupational, and when caused by occupation, 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 depends on research evidence that work in the prescribed job or with the prescribed occupational exposures causes the disease on the balance of probabilities. The Council thus looks for evidence that a particular occupational exposure or circumstance increases the risk of developing the disease by a factor of two or more. (Previous reports of the Council explain why this threshold was chosen.)

11. The health effects arising from occupational exposure to hand-transmitted vibration (HTV) cannot be distinguished reliably from similar effects that have other causes (see below), so the case for prescription rests on research evidence on the causal probabilities.

Anatomy and Physiology of finger skin blood flow

12. The hand has a complex and rich vascular network, which is mostly supplied by the radial and ulnar arteries in the wrist. The blood supply to the fingers is made up of a network of digital arteries arising from the superficial palmar arch. The blood vessels are under the control of tiny nerve fibres, which make up part of the sympathetic nervous system which are able to narrow or "constrict" the arteries or widen and "dilate" the arteries as needed. Typically, constriction is a normal response to cold or stress, when blood is diverted maximally to the heart, lungs and brain and away from the less essential parts of the body as part of the "fight or flight"

mechanism. In contrast, dilatation occurs when the body needs cooling due to external heat, high fever or intensive physical exercise.

Hand-arm Vibration Syndrome

13. The disorders of the upper limbs associated with hand-transmitted vibration (HTV) are collectively called the ‘Hand-arm Vibration Syndrome’ (HAVS). They include a form of Raynaud's phenomenon called vibration-induced white finger (VWF) and digital neuropathy (an injury to nerves supplying the fingers and thumbs). Carpal tunnel syndrome (an entrapment of a nerve supplying sensation to the hand) is another well-recognised complication of exposure. Affected individuals may have one or several of these disorders. Long term exposure to HTV under defined conditions can lead to Dupuytren’s contracture (Cm 8860).

Raynaud’s phenomenon

14. Raynaud's phenomenon is characterised by episodes of finger-blanching due to temporary interruption of blood flow to the extremities of the digits. During an episode, the extremity becomes cold, numb and marble white or blue. Typically, attacks are triggered by the cold. During the recovery phase (as the circulation restores), the affected parts become fiery red and tingle.

15. Primary Raynaud's phenomenon arises naturally in some 5-10% of men and 10-20% of women, with some variation in disease frequency by race, climate, geography and case definition. Less commonly, Raynaud's phenomenon can be secondary to certain rheumatic diseases, blood disorders and drugs, or can arise from traumatic injury.

Vibration White Finger (VWF)

16. VWF is the term given to Raynaud's phenomenon when caused by substantial exposure to HTV. It is a fairly common occupational disorder in the UK. In VWF, attacks of finger-blanching during cold exposure are associated with long-term exposure to vibration and are clinically similar in appearance to primary Raynaud’s phenomenon. Although the mechanism is not fully understood, it is thought that the normal responses between the blood vessels and their nerve supply become impaired, resulting in too much constriction and too little vasodilatation.

17. Clinical diagnosis of VWF is often said to rest on identifying Raynaud's phenomenon in a worker with substantial exposure to hand-arm vibration and excluding other rarer secondary causes of the disease. Such an approach tends to assume that all Raynaud's phenomenon in exposed workers is occupationally caused and none of it is primary (which is simplistic given the background prevalence of the disease, but precautionary in terms of the advice given to affected patients). VWF and primary Raynaud's phenomenon (the common patterns) are not distinguishable with certainty on clinical grounds. In VWF, the area of blanching may be localised to the part of the hand receiving the most vibration and in primary Raynaud's phenomenon perhaps more typically bilateral and symmetrical; however, such differences are not pathognomonic and in many situations both hands receive exposures to a similar degree. A further complicating factor is that exposure to

multiple vibrating tools or machines is commonplace in British workers (Palmer *et al*, 2000a). Where available, objective tests of finger blood flow, finger blood pressure and finger temperature can support the diagnosis of Raynaud's phenomenon, but they cannot reliably distinguish its cause, other than to confirm the fingers affected. If, however, blanching precedes a person's first exposure to hand-transmitted vibration, then HAVS is not the primary pathology.

Sensorineural effects

18.Transient tingling in the digits is common after use of vibratory tools. However, with sufficient exposure, nerve injury (digital neuropathy) can arise. Also, hand-transmitted vibration can cause the nerve entrapment disorder carpal tunnel syndrome (CTS).

Prescription of HAVS

19. The IIDB Scheme recognises VWF, the sensorineural effects of vibration, and vibration-induced CTS in the terms of PD A11 and PD A12(a). PD A11 recognises "intense blanching of the skin, with a sharp demarcation line between affected and non-affected skin, where the blanching is cold-induced, episodic, occurs throughout the year and affects the skin of the extremities of a sufficient number of digits" in occupations entailing the use of a range of vibratory tools well-established to cause HAVS (e.g. chain saws, riveting hammers, swagers, road breakers).

Challenges in diagnosis of the vascular component of HAVS

20. The challenge when assessing the vascular component of HAVS is that the symptoms are episodic and fugitive in nature. In consequence, they are rarely witnessed and cannot be readily reproduced for clinical verification. In practice therefore, the diagnosis relies fundamentally upon the patient's description of their symptoms and their recollection of the development and progression of those symptoms. In a national expert consensus workshop, a system of grading the symptoms by severity was agreed: the Stockholm Workshop Scale.

21. A number of previous Council reports have commented on the availability and practicability of objective testing of vascular function: Cmnd 9347 Raynaud's Phenomenon (1954), paragraph 18; Cmnd 4430 Vibration Syndrome (1970), paragraph 14; Cmnd 5965 Vibration Syndrome (1975), paragraph 26; Cmnd 8350 Vibration White Finger (1981), paragraph 14; Cm 2844 Hand Arm Vibration Syndrome (Vascular and Neurological Components Involving the Fingers and Thumb) (1995), paragraphs 20-25; Cm 6098 Hand-Arm Vibration Syndrome (2004), paragraphs 59-60. All previous Council reports determined that there were currently no tests that were widely enough available with sufficient validity and repeatability that they could be recommended in support of the diagnosis of HAVS.

22. New diagnostic tests are regularly developed during medical research in order to further our understanding of a disease or develop treatment for it. However, in order for a test to be accepted as a "diagnostic test" to be used in practice it must fulfil some key criteria, as described in a recent Council command paper, Cm 6098. High rates of "false positives" (making the diagnosis when the disease is not present) or

“false negatives” (ruling out the diagnosis when the disease is present) are unacceptable. Tests that reach the threshold for acceptability for diagnosis need to show high levels of sensitivity (high rates of detection of true disease) and specificity (low rates of detection of false positives).

Objective tests for vascular function

23. A number of different approaches have been taken to more objectively assess vascular function in the hands, many of which have been used mainly for research or have been developed for other groups of patients (e.g. people with rheumatic diseases) and there are, on the whole, limited data in HAVS cases.

Cold Water Provocation Testing and Plethysmography (CWPT & FSBP)

24. Assuming that finger blanching occurs because the blood vessels are over sensitive to the cold (hyper-responsive), then it should follow that the phenomenon could simply be reproduced by exposing the digits to the cold under controlled conditions. However, it has been found, for reasons which are not clear, that cooling does not always reproduce the blanching reliably even in established cases. Therefore, researchers have investigated other more sensitive means of assessment of blood flow through the fingers in response to cooling.

25. The two most commonly researched techniques for cooling under controlled conditions are known as the cold water immersion or provocation test (CWPT) and the finger systolic blood pressure test (FSBP) where cooling is achieved by small water perfused cuffs placed around the fingers. The cold challenge applied is normally at temperatures of 10 or 15^{o}C for a period of five minutes. In CWPT this is achieved by placing the hands in cold water and in FSBP by perfusing cooled water in cuffs around fingers. There are two main measures assessed in response to the cooling: FSBP which records the blood pressure in the finger arteries as a measure of vasoconstriction (the point of return of blood flow being measured by a ‘plethysmograph’ or pulse volume recorder) and Finger Skin Temperature (FST) which is used to measure rewarming times as a surrogate for vasodilatation or blood flow through the finger. These tests were introduced in the 1970s and were mentioned in the original prescription for HAVS (Cmnd 4430). However, they have mainly been used in research studies.[1] Although the tests are relatively simple, the equipment is expensive. Moreover, their validity and reliability for wide-scale use was called into question when they were employed in multi-party medico-legal compensation assessment claims in the 1990s and a large volume of test data were analysed.[2]

26. Normative data for these tests have been published by the Institute for Sound and Vibration Research. A reading of <60% of FSBP is considered abnormal and re-warming times of 3 minutes indicating possible damage and 6 minutes, probable damage. To harmonise differing laboratory procedures and measuring techniques, International Standards were developed in 2004: the measurement of finger rewarming times after cold provocation (ISO 14835-1:2016) and the measurement of finger systolic blood pressures during cold provocation (ISO 14835-2:2005).[3,4] Standardised testing protocols were also recommended in Health and Safety Executive (HSE) Contract Research reports in 1998.[5] The associated literature

review reported sensitivities ranging from 5.9 to100 % and specificities ranging from 35 to 100% for measurements of rewarming times and sensitivities ranging from 50 to 100% and specificities from 73.8 to 100% for FSBP. A systematic review of the literature by the Faculty of Occupational Medicine in 2004 (updated in 2009 by the Health and Safety Laboratory) also included sensitivities and specificities.[6] However, the HSE concluded that the test was not sufficiently robust to recommend its use when publishing guidance to the Control of Vibration at Work Regulations 2005.[7]

27. An Administrative Court Judgement was heard in 2003 at the High Court of Justice, Queens Bench Division between the National Association of Colliery Overmen Deputies and Shot Firers and the Secretary of State for Work and Pensions.[8] The guidance notes for assessing doctors was scrutinised and the role of uncontrolled cold water provocation testing (CWPT) was heavily criticised subsequently leading to a review of the guidelines and the discontinuation of the CWPT. Moreover, of note is paragraph 108 of the judgement which specifically concluded that a '...negative result should be treated as of no diagnostic value.' None of the cold water provocation tests assists with the assessment of disablement.

28. Since the Council's last review of these tests, further, more recent papers have been published, some of which appear to support the utility of FSBP testing when assessing staging or symptomatic vs non-symptomatic fingers.[9,10,11,12,13] Of the two cold challenge tests, FSBP seems to be suggested to perform better.

29. Of particular relevance is one recent study over 12 months including 216 workers exposed to hand transmitted vibration (HTV) and 133 controls not exposed to HTV. All underwent medical examination and finger systolic blood pressure (FSBP) after finger cooling from 30^{o}C to 10°C and a 12-month follow-up. Workers with HAVS showed a significantly increased cold reaction in the fingers when compared to both controls and those exposed to HTV without vascular symptoms. The authors concluded their results suggested that measurement of FSBP after local cooling was an objective test and could be a useful monitor of change in vibration-induced vascular symptoms.[11]

30. However, another study on plethysmography and thermometry involving 139 HAVS subjects reported a specificity of 98% but a sensitivity of only 23%. The authors of this report concluded that neither plethysmography or thermometry alone or combined demonstrated adequate sensitivity and specificity to be an objective correlate for the Stockholm Workshop Staging (SWS) vascular staging of HAVS.[12]

31. In one additional study, using both cold provocation tests, in 60 people with symptoms of HAVS, the authors found significant increases in finger rewarming times and reductions in FSBPs at both 15°C and 10°C in symptomatic fingers. The authors reported that FSBPs had sensitivities and specificities >90% and that the finger rewarming test had a sensitivity of 77% and a specificity of 79%.[13]

32. In summary, we have found a small number of new publications since the Council's last review of this topic but, unfortunately, they provide conflicting evidence about the utility of these tests, at least in the assessment of the diagnosis of HAVS. There are also practical considerations in that the equipment and associated software used for these tests is both expensive and requires operator experience to

master. Additionally, it is clear that the testing is dependent upon carefully controlled laboratory conditions including precise room testing requirements, which can be achieved in research studies but would be much less practicable for widespread use in diagnosis. For example, it can be very problematic if workers attend for testing with low finger skin temperature (e.g. FST <24°C). Taken together, there is still insufficient evidence for the Council to recommend these provocation tests in support of a diagnosis of HAVS.

Capillaroscopy

33 The capillary loops of the skin's micro-vasculature are usually too small and too deep to be visible but can be observed in the nailfold of a digit by using a microscope set at a high level of magnification. Differences in the shapes and dimensions of these loops have been studied in Raynaud's and other connective tissue diseases (e.g. systemic sclerosis). They have shown some utility in the assessment of primary versus secondary Raynaud's by rheumatologists. However, to date, there have been few studies using capillaroscopy in HAVS cases.

34. We identified one study amongst male gold miners (n=113) which reported significant differences in morphological characteristics of the nailfold capillaries between groups with vascular HAVS (n=35), vibration exposed groups (n=39) and non-vibration exposed groups (n=39). Nailfold video-capillaroscopy characteristics of the 2nd, 3rd and 4th digits of both hands carried out under blinded conditions included: number and dimension of capillaries, avascular areas, haemorrhages and enlarged capillaries. A higher percentage of those with HAVS were reported to have haemorrhages (65.7%) compared with the other two groups (VEC: 7.7% and NVEC: 7.5%). Moreover, the dimensional and morphological characteristics of the capillaries revealed significant association with HAVS.[14]

35. With only one study, there is currently insufficient evidence to recommend this test will be useful in HAVS patients but the Council will continue to keep this under review.

Doppler Ultrasound

36. Doppler ultrasound is a non-invasive test which can be used to estimate the blood flow through blood vessels. High-frequency sound waves (ultrasound) are emitted from the Doppler probe and these bounce back off the red blood cells giving an estimate of flow rates. Doppler ultrasound is widely used in clinical practice for detection of e.g., deep venous thrombosis. For assessment of hand arterial blood flow, a Doppler ultrasound fitted with an 8MHz probe can be used. This has been shown to be a technique suitable for determining a normal arterial supply to the hand and palmar vasculature. The superficial palmar arch is easily identified and lies about 5-6 cm from the distal wrist crease with the deep arch about 4-5 cm. However, there are widespread normal anatomical variations in the vascular supply to the hand.

37. As long ago as 1929, Edgar Van Nuys Allen described a physical examination sign for the purposes of detection of physiological variants in the blood supply to the hand (known as Allen's test). Normally, the hand receives arterial blood supply from

both the radial and ulnar arteries. However, it is vital that the ulnar artery supply is verified before e.g., instrumentation of the radial artery. In one important clinical setting, namely pre-operative assessment to confirm the effectiveness of ulnar artery collateral circulation prior to radial artery harvesting in coronary bypass grafting, Doppler ultrasonography has been shown to be more reliable in assessing hand circulation than Allen's test.[15]

38. A delayed Allen's test can occur in a condition called hypothenar hammer syndrome (HHS). This can result from repeated trauma to the hand particularly if used like a 'hammer'. The latter needs to be differentiated from HAVS as a cause of digital blanching. Doubt over normative values in delay times and high false positives of the Allen's test has led some to recommend the Doppler as a more reliable alternative to this test.[16]

39. Doppler ultrasound may have a role in differentiating atypical cases of finger blanching and among patients with a history of hand trauma. However, anatomic variations may lead to misleading results. Magnetic Resonance Angiography (MRA) has also been reported as a confirmatory test in a small case series. To date, there is insufficient evidence in HAVS to recommend its widespread use in diagnosis of HAVS.

Summary of the review of vascular tests

40. The above review of the recent evidence of objective tests for the vascular component of the diagnosis of HAVS found a lack of robust evidence which, along with practical reasons, mean that none of the available methods should be required for diagnosis.

Digital Photography

41. Digital photography has become very accessible with more widespread use of good quality photographic equipment on mobile phones. Photographs can be used to document evidence of distal finger vasospasm (colour change /blanching) sufficient to be verified independently by a clinician. Use of photographs follows on naturally from the previous practice of using colour charts to help with the diagnosis and staging of Raynaud's phenomenon.[17] A small scale study evaluating digital photographs for this purpose has been reported in the literature.[18,19] A recent international consensus was reached by a Delphi exercise that use of photography to support the staging of HAVS could be recommended.[20]

42. In order for the photographs to be suitable as supporting evidence for assessment, they are best taken in the 'hold-up' pose with an individual's face clearly identifiable. It is possible for amateur photographers to obtain sufficient quality images, particularly if excess backlighting is avoided. A number of photographs from different occasions may be helpful and there is also the possibility of using video. Provision of photographs also reduces the chances of a claimant being disadvantaged by not fully understanding the complex terminology used in this field. Overall, the Council therefore feels that claimants can be encouraged to provide digital photographs in support of their claim for HAVS when the photographs clearly confirm that their fingers have blanched or changed colour due to vasospasm.

However, photographs will be suitable only to supplement the patient's description of their symptoms and relationship with work and exposures, but will not be sufficient on their own to replace this evidence.

Variation in the description of the time course of symptoms of claimants for PDA11

43. Currently, the diagnosis of HAVS relies almost completely on the assessment of the claimant's description of the development of their symptoms, their nature of onset and their time course in relation to relevant exposures. Assessors therefore have a complex task to elicit all of the relevant information particularly in cases where the history has been prolonged or has been complicated by multiple changes of occupation or employer. Therefore, the Council reviewed the guidance for assessors as published in the Industrial Injuries Benefit Handbook 2 (pages 53-54) for Healthcare Professionals (HCP), the Prescribed Diseases covers aspects in the history to take into account when assessing claimants for PDA11.[21] This guidance is supplemented with additional information about history-taking in VWF, HAVS and PDA11 of Handbook 2 (pages 156-160)[21].

44. The findings from the audit (paragraph 2) suggested areas which were particularly difficult, and perhaps open to different interpretation, for assessors were: (a) when symptoms developed very rapidly or became very severe over the course of only a few months;
(b) when symptoms seemed to plateau despite ongoing vibration exposure; (c) where symptoms progressed only minimally despite long-term exposure; (d) where symptoms continued to worsen after cessation of the exposure and (e) where symptoms developed de novo after exposure had ceased.
With this in mind, the Council consulted independent international experts in the field of HAVS about their opinion on these five points.

45. **Rapidity of development of symptoms**: an international expert who has followed hundreds of cases over many years commented that very high vibration magnitudes can lead HAVS to present early (i.e. after only 6 months of exposure) and that a rapidity of onset was recognised implicitly in the international standard on exposure assessment ISO 5349. In his expert opinion, rapidity of onset should not be used as a factor to exclude a diagnosis of HAVS. Indeed, in the Council's report, in paragraph 46 of Cm 6098 (2004), it was stated that "it may take as little as 6 months' exposure… for the onset of attributable finger blanching."

46. **Plateau of symptoms despite ongoing exposure**: two experts reported that plateau was highly consistent with their extensive personal experience of the condition. One expert had seen some cases in young vibration exposed workers and reported that the majority of cases plateaued and did not worsen despite continued exposure. Another commented that whilst some cases will progress through the stages to reach stage 3V (of the Stockholm Workshop Scale) over time, in his view, the majority remained 'stable' at either stages 1V or 2V for many years. Indeed, he highlighted that he rarely made recommendations for HAVS affected workers to be redeployed in order to prevent progression to more severe stages of the disease because "slow progression" was not the typical natural history found in practice.

47. **Minimal progression of symptoms despite long-term exposure:** whilst the literature reports higher prevalence of more severe VWF with greater duration/magnitudes of vibration exposure, the relationship between years of exposure and stage progression is not a simple linear one. Case progression is often dependent on a number of factors and not just vibration exposure and in practice is sometimes seen with business cycles when there is a move to a role with higher vibration magnitude or there are longer exposure durations with increased workload.

48. **Symptoms continued to worsen after cessation of the exposure**: the effect of reducing vibration can halt progression in individual cases but more often cases plateau even without changes to job or hand-transmitted vibration. Indeed, a third expert commented that they have seen VWF develop in workers with relatively light exposure to HTV, again reinforcing that dose alone is not the only determining factor.

49. **Symptoms starting after cessation of exposure to HTV**: this was previously alluded to by the Council in paragraph 46 of Cm 6098 (2004) when they noted that "attacks of blanching … can occur up to one year after the cessation of exposure". They did however go on to note that other schemes were known to "compensate people whose first attacks begin more than two years from their last exposure to HTV." It seems that it is possible for symptoms to commence after cessation of the exposure under some circumstances, e.g., if vibration exposure stopped during a period of mild spring weather and the first cold challenge did not occur until the following winter, and that therefore it would be acceptable to allow that the vibration exposure was still relevant. However, it was the Council's intention that symptoms starting more than 12 months after cessation of HTV were not to be compensated.

50. Therefore, this review by the Council, supplemented by expert opinion, has clarified some of the accepted variation in the presentation and progression of VWF which will enable the Council to make clearer the guidance for medical assessors. The Council accepts that these issues can be compounded by a recall bias from claimants when providing histories of symptom onset and progression some years after their initial onset.

Conclusions and recommendations

51. This review, following an audit of cases, recognises the difficulties for assessors in substantiating a diagnosis of vascular HAVS in the absence of any gold standard objective testing. The Council re-examined the evidence for recommending objective testing methods to assess vascular function for the diagnosis of HAVS, but found that there are practical considerations, as well as insufficient evidence, which preclude any of the available testing methods to be required in substantiation of the diagnosis. However, the Council advises that digital photographs/videos, taken in such a way that the face of the applicant is visible, would be a useful adjunctive way of providing evidence of finger blanching at the assessment. That said, the Council is not mandating that photographs should be an absolute requirement for diagnosis.

52. Accepting that the patient's description of their symptoms is therefore pivotal to the decision making, the Council has taken additional expert views on some of the more difficult aspects of the patient's history in relation to symptom onset and duration. It is the Council's view that the present guidance on interpreting the history

of reported symptoms may be too restrictive and not reflect the natural history of HAVS found in practice. Therefore, the Council recommends that the guidance notes for HCP should be re-written to clarify the following:

- In some individual cases, symptoms of HAVS may develop very rapidly after exposure to HTV
- Symptoms of HAVS may plateau despite ongoing exposure to HTV with minimal progression of stages even with long term exposure.
- Symptoms of HAVS may occur for the first time up to 12 months after cessation of exposure to HTV

References

1. Taylor W, Pelmear PL. Vibration White Finger in Industry. London: Academic Press; 1975: 78.
2. Proud G, Burke F, Lawson I J, McGeoch K L, Miles JNV. Cold provocation testing and hand-arm vibration syndrome – an audit of the results of the Department of Trade and Industry scheme for the evaluation of miners. British Journal of Surgery 2003; 90:1076-1079.
3. International Organization for Standardization. Mechanical vibration and shock—cold provocation tests for the assessment of peripheral vascular function—Part 1: Measurement and evaluation of finger skin temperature. Geneva: International Standard, ISO 14835-1, 2005.
4. International Organization for Standardization. Mechanical vibration and shock—Cold provocation tests for the assessment of peripheral vascular function—Part 2: Measurement and evaluation of finger systolic blood pressure. ISO/DIS 14835-2 (2004).
5. Lindsell C J, Griffin M J. Standardised diagnostic methods for assessing components of the hand arm vibration syndrome. HSE Contract Research Reports 197/1998. London HMSO.
6. Poole K. A review of the literature published since 2004 with potential relevance in the diagnosis of HAVS RR711 Published by the Health and Safety Executive 05/09 Sudbury, UK,HSE Books 2009.
7. Hand-Arm Vibration. The Control of Vibration at Work Regulations 2005. Guidance on Regulations. L140:2005; 104.
8. Administrative Court Judgement, R -v- Secretary of State for Work and Pensions [2003]. EWHC 607 (Admin). Case No:CO/2154/2002.
9. Mason H, Poole K, Saxton JM. A critique of a UK standardised test of finger rewarming after cold provocation in the diagnosis and staging of hand–arm vibration. Occup Med, 2003;53:325–330
10. Poole, K., J. Elms, and H.J. Mason, The diagnostic value of finger systolic blood pressure and cold-provocation testing for the vascular component of hand-arm vibration syndrome in health surveillance. Occup Med, 2004. 54(8): p. 520-7.
11. Bovenzi M, D'Agostin F, Rui F and Negro C. A longitudinal study of finger systolic blood pressure and exposure to hand-transmitted vibration. In Arch Occup Environ Health, 2008; 81: 613-623.
12. Thompson A, House R, Manno M. The sensitivity and specificity of thermometry and plethysmography in the assessment of hand–arm vibration syndrome. Occup Med (Lond) 2008;58:181–6.
13. Ye Y, Griffin MJ. Assessment of two alternative standardised tests for the vascular component of the hand–arm vibration syndrome (HAVS). Occup Environ Med, 2016; 73: 701-708.
14. Chen QS, Chen GP, Xiao B, et al. Nailfold capillary morphological characteristics of hand-arm vibration syndrome: a cross- sectional study. BMJ Open 2016;6:e012983. doi:10.1136/bmjopen-2016- 012983
15. Jarvis MA, Jarvis CL, Jones PM, Spyt TJ. Reliability of Allen's test in selection of patients for radial artery harvest. Ann Thorac Surg 2000; 70: 1362–1365.
16. Cooke R, Lawson I. Use of Doppler in the diagnosis of hypothenar hammer syndrome. Occup Med 2009; 59: 185–190.
17. Maricq HR, Weinrich MC. Diagnosis of Raynaud's phenomenon assisted by color charts. J Rheumatol 1988;15:454–459.

18. Youakim S. The validity of Raynaud's phenomenon symptoms in HAVS cases. Occup Med (Lond) 2008;58:431–435.
19. Lawson I. Use of photography in HAVS. Occupational Medicine. 2009; 59: 67.
20. Poole CJM, Bovenzi M, Nilsson T, Lawson IJL, House R, Thompson A, Youakim S. International consensus criteria for diagnosing and staging hand–arm vibration syndrome. International Archives of Occupational and Environmental Health. September 2018.
21. Industrial Injuries Benefit Handbook 2 for Healthcare Professionals. The Prescribed Diseases. MED-IIBHB~002. Issued 7th November 2016.

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