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Supporting occupational health and wellbeing professionals

Hand-Arm Vibration Syndrome (HAVS) Special Interest Group

Delphi Study

Consensus statements on
Issues relating to the management of HAVS

With

Complete report of responses, comments and list of evidence considered

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Preface

This document has been produced by members of the Delphi Study Group of the Society of Occupational Medicine Hand-Arm Vibration Syndrome (HAVS) Special Interest Group (SIG) as a resource to assist those involved in the diagnosis and management of workers exposed to hand-transmitted vibration.

It does not necessarily represent the views of any individual member of the group, the study group, the SIG or the Society of Occupational Medicine (SOM). Rather, the nature of the study is that unless there has been 100% agreement regarding particular issues, some participants will not necessarily agree with the consensus statements. The issues addressed represent opinions rather than reflect definitive evidence but are offered in the hope that they will assist colleagues dealing with HAVS and these related issues in practice. The Special Interest Group welcomes any comments or suggestions regarding this publication.

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A summary of some of the results of this study was presented at the International Conference on Hand-Arm Vibration, held in Nancy, France in June 2023. Dr Roger Cooke and Dr Cornelius Grobler are pleased to acknowledge the support provided by the SOM Golden Jubilee Fund in assisting with their attendance.

The abstract of that presentation and others from the conference are available on an open-access basis at https://www.mdpi.com/books/book/7393-the-15th-international-conference-on-hand-arm-vibration.

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September 2023

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List of abbreviations

ALARP	As low as reasonably practicable
CTS	Carpal tunnel syndrome
DD	Dupuytren's disease
EAV	Exposure action value
ELV	Exposure limit value
F2F	Face to face
HAVS	Hand-arm vibration syndrome
HS	Health surveillance
HTV	Hand-transmitted vibration
LM	Line manager
OR	Odds ratio
PRCS	Primary Care Rheumatology Society (now the Primary Care Rheumatology and Musculoskeletal Society)
PRP	Primary Raynaud's phenomenon
QST	Quantitative sensory testing
RD	Raynaud's disease
SIG	Special Interest Group
SN	Sensorineural
SOM	Society of Occupational Medicine
SRP	Secondary Raynaud's phenomenon
SWM	Semmes–Weinstein monofilament
TPTT	Thermal perception threshold testing
VTT	Vibrotactile threshold testing
WEST	Weinstein enhanced sensory testing

1. Introduction

1.1 Aim

The aim of this Delphi Study was to review specific issues relating to hand-arm vibration syndrome (HAVS), for which there is no definitive evidence but where a consensus view would likely assist those undertaking HAVS surveillance and assessments.

This document includes a list of all statements agreed by consensus (i.e. with 75% or more agreement) as well as details of the Delphi Study including all comments made by participants at each stage.

1.2 Background

It is over 100 years since the relationship between vibration exposure and symptoms affecting the hands was first recognised. Since then, there have been developments in the approach to staging the severity of those symptoms, which is largely reliant on staging systems such as the Taylor-Pelmear and, latterly, the modified Stockholm scale. The UK introduced the Control of Vibration at Work Regulations in 2005, with associated guidance on the assessment of risk, the process of health surveillance and the management of affected employees. However, issues relating to management of such employees remain poorly defined.

The Society of Occupational Medicine (SOM) Special Interest Group (SIG) was established in 2017 to facilitate discussion relating to any aspect of vibration-related disease among members with particular interest and/or expertise. Since then, publications addressing a range of associated topics have been produced, but it has become increasingly apparent that there are markedly divergent opinions regarding several issues. It is believed that this divergence of opinion is representative of practitioners in the UK and elsewhere.

1.3 Method

Fifteen members of the SOM SIG participated - occupational physicians and an occupational health adviser, each with experience of hand arm vibration syndrome. It was agreed that eight specific topic areas would be subject to the Delphi process, undertaken by email, with one member of the group acting as moderator for each topic. The broad topics considered are in Table 1, with specific statements designed by the topic moderator in a format consistent with a Delphi exercise, to allow for agreement or disagreement and presentation of supportive evidence by each participant. The moderator formulated the statement(s) for each round, such that the responses are agree/disagree/undecided.

The first round of the Delphi exercise commenced in December 2022. Round one statements were accompanied by a summary of relevant literature, prepared by the moderator to assist participants. After rounds one and two, each participant responded agree/disagree/undecided and provided free text comments to support their opinion, along with additional relevant evidence including references to published literature. It was agreed by members of the Delphi Group that responses would be accepted as a consensus opinion if there was agreement by 75% of participants.

1. Introduction (cont)

SET	TOPIC	ISSUES TO BE ADDRESSED
1	**Primary Raynaud's phenomenon (RP)**	What criteria should be used to differentiate primary RP from vascular HAVS? What advice should be offered to those with primary RP wishing to work with exposure to hand transmitted vibration (HTV)? What criteria should lead to a referral for a further investigation of RP?
2	**Frequency of health surveillance**	How frequent should increased surveillance be performed for those with stage 2 HAVS and how long should the increased frequency of surveillance continue?
3	**Criteria for vascular staging of HAVS**	With vascular HAVS, should the extent of the blanching always override the frequency of the blanching when staging? If not, how do you balance the frequency and extent when grading?
4	**Use of monofilaments for sensory testing**	What cut-off of WEST/SW monofilaments should be used to assess normal sensory perception when assessing whether reduced sensory perception is present in those exposed to hand transmitted vibration? What other factors should be considered when interpreting the results of monofilament testing?
5	**The use of quantitative tests for routine health surveillance**	When should cases of HAVS be referred for a tier 5 assessment? Should reduced sensory perception in sensory HAVS be assessed by using more than one QST? If so, at what stage should ST be considered?
6	**Peripheral neuropathy and sensorineural HAVS**	What advice should be offered to those with peripheral neuropathy/ neurological symptoms similar to HAVS that are wishing to work with exposure to HTV? Is there an overlap of HAVS SN symptoms with diabetic neuropathy (DN) symptoms when performing HAV surveillance? What should the frequency of surveillance be? How to mitigate the legal risks for an employer with a missed diagnosis of HAVS masked by DN symptoms?
7	**Carpal tunnel Syndrome (CTS)**	Should cases of suspected CTS from history and examination be referred for nerve conduction studies before confirming a diagnosis? Should cases of suspected CTS be restricted from using hand vibrating tools until an investigation and treatment is completed? Should cases of a recurrence of CTS be permanently restricted from using vibrating tools?
8	**Dupuytren's disease**	Should cases of Dupuytren's contracture be restricted from using vibrating tools? If yes, to what severity?

Table 1 – Initially agreed topics for Delphi consideration

2. Summary of conclusions

The following summary lists the statements considered within this study.
For each topic, the statements are divided into three groups.

- **Statements prefixed A are those for which consensus agreement was achieved – i.e. 75% or more of the participants agreed the original statement was appropriate.**
- **Statements prefixed B are those for which there was consensus disagreement – i.e. 75% or more of the participants disagreed the original statement was appropriate.**
- **Statements prefixed C are those for which no consensus was achieved.**

With questions evolving and views changing as the rounds progressed, it may appear that some statements are in conflict. Therefore, it is recommended that when advising on the management of individual cases practitioners should consider the totality of consensus statements (A & B) in each topic group, as well as those for which consensus was not achieved.

Topic 1 – Primary Raynaud's phenomenon (PRP)

A. Consensus agreement was achieved that the following statements are appropriate:

A1 PRP generally presents with a symmetrical pattern of blanching in individuals under the age of 30. A positive family history of PRP and involvement of the feet also makes the diagnosis of PRP likely. (Considerations 1.1.1, 1.1.2 and 1.1.3)

A2 Vascular HAVS results from significant vibration exposure, and alternative diagnoses such as PRP should be considered in those with short-duration lifetime exposure, i.e. less than five years' exposure. (Consideration 1.1.4)

A3 Asymmetrical blanching affecting the trigger fingers of the dominant hand is more suggestive of HAVS than PRP. (Consideration 1.1.5)

A4 HTV-exposed individuals who are diagnosed with PRP at health surveillance should be advised that they can continue with limited exposure (below the EAV) with careful monitoring. (Consideration 1.2.3)

A5 HTV-exposed individuals with a history of blanching and possible carpal tunnel syndrome (CTS) should be referred for investigation/treatment of CTS prior to diagnosing RP or vascular HAVS. (Consideration 1.3.1)

A6 Those with blanching and a history of health issues known to be associated with RP (e.g. scleroderma, connective tissue disorders, rheumatoid arthritis, hypothyroidism) should be referred. (Consideration 1.3.2)

A7 For those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. (Consideration 1.4.2)

A8 For those with known PRP, enhanced surveillance should include annual review of photographic evidence to help monitor progression of symptoms. (Consideration 1.4.4)

A9 Symmetrical blanching affecting all fingers of both hands (+/- other extremities) warrants more in-depth enquiry to exclude other conditions (e.g. autoimmune disease, blood or vascular disorders, medication) when it presents in vibration-exposed individuals over the age of 30, with no family history of PRP. (Consideration 1.4.5)

B. Consensus agreement was achieved that the following statements are not appropriate:

B1 Individuals with a history of PRP embarking on a career involving HTV (e.g. mechanical apprentices) should be advised that exposure is not recommended and that they are effectively "not fit" to use vibrating tools. (Consideration 1.2.1)

B2 HTV-exposed individuals who are diagnosed with PRP at routine health surveillance should be advised that they cease exposure. (Consideration 1.2.2)

B3 It is impossible to provide effective HAVS surveillance in the presence of PRP and therefore anyone with this diagnosis should be advised not to use vibrating tools, regardless of their age or duration of employment. (Consideration 1.2.4)

C. There was no consensus regarding the following statements:

C1 Symmetrical blanching affecting all fingers of both hands (+/- other extremities) always warrants more in-depth enquiry into medical history, medication and potential referral, regardless of the age of the individual. (Consideration 1.3.3)

C2 Vibration-exposed individuals with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred back to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies, regardless of their age/age of symptom presentation. (Consideration 1.6.1)

C3 Vibration-exposed individuals with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred back to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies, only if their symptoms commenced when aged >30 since most cases of PRP present in those aged <30. (Consideration 1.6.2)

C4 Vibration-exposed individuals aged over 30 with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred back to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies. (Consideration 1.4.6)

C5 For those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. These individuals should be subject to enhanced health surveillance that should consist of an annual face to face assessment at Tier 3 (or Tier 4 if reported change), which would ideally also include a review of photographic evidence to help monitor any progression of symptoms. This level of surveillance would need to continue for the duration of vibrating tool use.
(Consideration 1.5.1)

C6 For those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. These individuals should be subject to enhanced health surveillance that should consist of an annual face to face assessment at Tier 3 or Tier 4 for the first five years after the onset of PRP, which would ideally also include a review of photographic evidence to help monitor any progression of symptoms. If there is no evidence of change or progression of symptoms in the first five years, surveillance should continue with at least annual Tier 2 questionnaires in the same manner as other vibration-exposed workers. (Consideration 1.5.2)

C7 For those with known PRP, exposure to hand-transmitted vibration should not exceed the "no harmful effect level" of 1 m/s2 or 16.6 points on the HSE scale. (Consideration 1.4.1)

C8 For those with known PRP, ongoing exposure should be subject to enhanced health surveillance with at least annual Tier 4 review. (Consideration 1.4.3)

Topic 2 – Frequency of health surveillance

A. Consensus agreement was achieved that the following statements are appropriate:

A10 Following a new diagnosis of Stage 2 HAVS, frequency of Tier 4 assessment should be increased to every six months until there is no progression in symptoms. Where there has been no symptom progression for two years, assessment can revert to a yearly Tier 3 or 4. (Consideration 2.2)

A11 If the individual has ceased exposure, Tier 4 assessment should be continued for two years and if there is no progression of symptoms, then there is no need for ongoing surveillance. (Consideration 2.4)

C. There was no consensus regarding the following statements:

C9 Those with Stage 2 HAVS should have a Tier 4 HAVS assessment every six months, and this should continue until they are removed from exposure to vibrating tools. (Consideration 2.1)

C10 For employees who have a diagnosis of Stage 2 HAVS and stable symptoms, and no progression for four years, surveillance could be stepped down to Tier 2, with a specific questionnaire written to look for changes or new symptoms. (Consideration 2.3)

Topic 3 – Criteria for vascular grading (staging) of HAVS

A. Consensus agreement was achieved that the following statements are appropriate:

A12 With vascular HAVS, the extent of blanching should override frequency. (Consideration 3.1)

A13 Photographic evidence should be used to confirm the diagnosis and extent of blanching and vascular staging. (Consideration 3.2)

B. Consensus was achieved that the following statements are not appropriate:

B4 Given adequate time to provide photographic evidence (say a full winter), the absence of photographic evidence should be used to discount or overturn a presumptive diagnosis of vascular HAVS where there is a history of sufficient exposure and anamnesis of cold-induced distal circumferential finger blanching. (Consideration 3.3)

Topic 4 – Use of monofilaments for sensory testing

A. Consensus agreement was achieved that the following statements are appropriate:

A14 Given the paucity of normative data for Semmes–Weinstein monofilament (SWM) perception in occupational groups, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results. (Consideration 4.4)

A15 Using WEST/SW monofilaments in vibration-exposed workers, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however, for workers unable to sense an applied force of 0.2 g-f, further testing (if available) with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments (long test kit) should be considered, especially for older workers with thickened skin/calloused hands. (Consideration 4.5)

A16 For clinicians with only access to WEST monofilaments, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results. If there remains doubt, then referral for quantitative sensory testing (QST) such as vibrotactile threshold testing (VTT) and thermal perception threshold testing (TPTT), which tests receptors other than touch pressure, should increase the potential for excluding an effect of skin thickening on sensibility. (Consideration 4.6)

A17 Where the long test monofilament kit is available, when the mean SWM bend force in two digits is ≥ 0.6 g-f, the history, clinical picture, progression and distribution of digital loss of sensory perception should be taken into account and Tier 5 testing considered if there remains doubt about the diagnosis. (Consideration 4.7)

B. Consensus agreement was achieved that the following statements are not appropriate:

B5 Age and occupational group should NOT be considered when interpreting results of monofilament testing. (Consideration 4.2)

C. There was no consensus regarding the following statements:

C11 Using WEST/SW monofilaments, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception in vibration-exposed workers. (Consideration 4.1)

C12 Using WEST/SW monofilaments in vibration-exposed workers, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however, for workers unable to sense an applied force of 0.2 g-f, further testing with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments should be undertaken. For those unable to sense
0.6 g-f or more, quantitative sensory perception testing should be considered. (Consideration 4.3)

Topic 5 – Use of quantitative tests for routine health surveillance

B. Consensus was achieved that the following statements are not appropriate:

B6 All cases of HAVS should be referred for Tier 5 assessment. (Consideration 5.1)

C. There was no consensus regarding the following statements:

C13 Reduced sensory perception in sensory HAVS can be staged by using only one QST (monofilament). (Considerations 5.2 and 5.4)

C14 QST may play a useful role in refining a sensorineural grading of 2SN into "early" and "late". (Consideration 5.3)

Topic 6 – Peripheral neuropathy and sensorineural HAVS

A. Consensus agreement was achieved that the following statements are appropriate:

A18 Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to hand-transmitted vibration (HTV) should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and should have a health surveillance assessment initially every six months for the first two years by a clinician trained in detecting and diagnosing HAVS. If there is no evidence of progressive neurological deficit in the first two years, annual health surveillance should be considered if working with HTV. (Consideration 6.1)

A19 Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to HTV should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and should have a health surveillance assessment annually by a clinician trained in detecting and diagnosing HAVS. (Consideration 6.3)

B. Consensus was achieved that the following statements are not appropriate:

B7 To mitigate legal risks for an employer associated with the diagnosis of a late stage of neurological hand-arm vibration syndrome (HAVS), employees with diabetes mellitus (DM) should be excluded from exposure to hand-transmitted vibration (HTV). (Consideration 6.5)

C. There was no consensus regarding the following statements:

C15 Those with diabetes mellitus (DM) are at higher risk of carpal tunnel syndrome (CTS). Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS for anyone exposed to HTV. Those with DM should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV. The QST should be monofilament testing at least. Any progression in neurological deficit detected from the history or from QST should be referred for vibrotactile perception threshold (VPT) testing, thermal aesthesiometry (TA) and multi-segmental nerve conduction studies (NCS). (Consideration 6.2)

C16 Those with diabetes mellitus are at higher risk of carpal tunnel syndrome (CTS). Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS for anyone exposed to HTV. Those with diabetes mellitus should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV. (Consideration 6.4)

Topic 7 – Carpal tunnel syndrome (CTS)

A. Consensus agreement was achieved that the following statements are appropriate:

A20 In cases that meet recognised clinical diagnostic criteria for carpal tunnel syndrome (CTS) (e.g. the Primary Care Rheumatology Society (now the Primary Care Rheumatology and Musculoskeletal Society), CTS-6, Boston) management of the case should be based on a diagnosis of CTS while awaiting nerve conduction studies. (Consideration 7.5)

A21 Cases of suspected CTS should be restricted to daily vibration exposure of less than a specified level until investigation and treatment is completed. (Consideration 7.6)

B. Consensus was achieved that the following statements are not appropriate:

B8 Cases (of CTS) who are entirely symptom-free three months after carpal tunnel decompression surgery should be restricted from further exposure to vibration. (Consideration 7.8).

C. There was no consensus regarding the following statements:

C17 Cases of suspected CTS from history and examination should be referred for nerve conduction studies before confirming diagnosis. (Considerations 7.1 and 7.4)

C18 Cases of suspected CTS should be restricted from using hand-vibrating tools until investigation and treatment are completed. (Consideration 7.2)

C19 Cases of a recurrence of CTS should be permanently restricted from using hand-vibrating tools. (Consideration 7.3)

C20 Nerve conduction studies should be requested at the same time as other standardised sensorineural testing such as vibrotactile threshold testing and thermal aesthesiometry. (Consideration 7.7)

Topic 8 – Dupuytren's disease (DD)

A. Consensus agreement was achieved that the following statements are appropriate:

A22 Cases of Dupuytren's disease (DD) should have enhanced health surveillance/periodic observations (e.g. every six to 12 months) to determine the onset of contracture and the need for referral. (Consideration 8.3)

A23 In respect of Dupytren's disease, restricting work with hand-vibrating tools should be considered when functional impairment is such that it affects ability to do work tasks or causes risk to others. (Consideration 8.4)

B. Consensus was achieved that the following statements are not appropriate:

B9 All cases of DD should be restricted on initial diagnosis, regardless of severity or associated functional impairment. (Consideration 8.2)

C. There was no consensus regarding the following statement:

C21 Cases of Dupuytren's contracture should be restricted from using hand-vibrating tools. (Consideration 8.1)

3. Details of Delphi process

Topic 1 – Primary Raynaud's phenomenon

Background

Primary Raynaud's phenomenon (PRP) is common, with studies reporting prevalence in 5% or more of the general population and women more commonly affected than men. In general, PRP tends to occur before the age of 30, whereas Raynaud's that develops over the age of 40 is more likely to be secondary Raynaud's phenomenon (SRP). The prevalence of PRP in men increases with age and is more likely to be due to occupational exposure (e.g. vibratory tool use) or peripheral vascular disease from atherosclerosis (Ashraful, Hughes 2020).

Garner et al conclude that PRP usually starts in teenage years and later development is characteristic of secondary RP. This later onset may be predominantly influenced by environmental exposures such as vascular microtrauma from manual usage and vibrating tools (Garner, Kumari et al 2015).

HSE Guidance L140 and the HSE publication Health Surveillance – Guidance for Occupational Health Professionals4 suggest that those with PRP should not be vibration exposed. However, it is very unclear how rigidly this advice is followed in practice.

Further investigation of PRP should be considered in individuals with a history suggestive of vasospastic conditions caused by possible connective tissue disorders or in those who may have vascular occlusive conditions (SOM, The Identification and Management of HAVS). It is recommended that those who report concurrent PRP and separate sensory symptoms suggestive or compatible with CTS should formally exclude CTS before attributing symptoms to HAVS (Cooke, Lawson, Gillibrand, Cooke 2022).

Although the vast majority of Raynaud's is primary (idiopathic, PRP), it can be secondary to connective tissue disease and it is the most common presenting feature of systemic sclerosis. The minimal set of investigations for a patient with PRP (dictated by the criteria for PRP) comprises a blood count and ESR, ANA and nailfold capillaroscopy (Herrick 2017).

Seventy-four patients with Raynaud's phenomenon and no associated illness were followed prospectively to determine whether a secondary disease would develop. At follow-up, outcome information was available on 58 persons (78.4%). A connective tissue disease developed in 11 people (19%): three had systemic sclerosis and eight, CREST syndrome (Fitzgerald, Hess, O'Connor, Spencer-Green 1988).

Responses to questions

Issue 1.1 What criteria should be used to differentiate primary Raynaud's phenomenon (PRP) from vascular HAVS?

Consideration 1.1.1

	Agree	Disagree	Undecided
Age of onset generally below 30 in PRP	11 (85%)		2 (15%)

85% of respondents agreed with this statement. Consensus achieved.

Comments from participants

As a generalisation, PRP tends to occur before the age of 30, whereas Raynaud's that develops over the age of 40 is more likely to be SRP.

I agree with "generally". However, there are reports of later onset secondary Raynaud's phenomenon. In Jameson's paper 'Cold Hypersensitivity in Raynaud's Phenomenon' in Circulation 1971; 1(44): 254–264, reference is made to a group with late-onset RP, although some of those might now be seen as having evidence of other underlying causes.

Planchon et al (Angiology 1994; 45(8)) concluded that "the existence of true cases of late-onset RD (PRP) patients over 40 years was confirmed" but with less link to a family history than early-onset cases.

Consideration 1.1.2

	Agree	Disagree	Undecided
Blanching caused by PRP is usually symmetrical	11 (85%)	0	2 (15%)

85% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Symmetrical blanching due to HAVS from using HTV tools that require two hands to stabilise without a distinct trigger finger (e.g. road breakers) cannot be excluded, especially if blanching started later in life, there is no family history and it is a male employee.

I am not sure if this is the case but have insufficient clinical experience of PRP patients to comment definitively.

Consideration 1.1.3			
Positive family history and involvement of feet and/ or other peripheries is indicative of PRP rather than HAVS.	Agree 13 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Pooled OR for PRP of 16.6 if family history of PRP.

PRP affects fingers only in 50% of cases. Additional caution as HTV can affect feet:

House R, Jiang D, Thompson A, Eger T, Krajnak K, Sauvé J, Schweigert M. Vasospasm in the feet in workers assessed for HAVS. Occupational Medicine March 2011; 61(2): 115–20. https://doi.org/10.1093/occmed/kqq191

Family history: With the exception of employees whose parent(s) were also subject to exposure to HTV and complained of VWF, which is often the case.

Caution required, especially where family members have been exposed to vibration.

Consideration 1.1.4			
Vascular HAVS generally results from significant vibration exposure. Alternative diagnoses including PRP should be considered in those with short-duration lifetime exposure (less than five years).	Agree 10 (77%)	Disagree 1 (8%)	Undecided 2 (15%)

77% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Factors other than latency from history and clinical examination are more likely to point to PRP. Working overtime hours, working with tools with significant HAV magnitudes and working in cold environments would shorten the period of latency of onset of HAVS symptoms.

But remember individual sensitivity occurs in HAVS and daily exposure to high-vibration magnitude HTV can lead to short latent periods, i.e. 6 months (ISO 5349).

I particularly feel that there may be a significant cohort of employees suffering from undiagnosed non-freezing cold injury, either through occupational or recreational exposure.

Agree the need to consider alternative diagnoses but have excluded those who will be rapid progressors – those who develop symptoms after short exposure.

Consideration 1.1.5			
Asymmetrical blanching primarily involving the trigger fingers and leading hand would be more suggestive of HAVS than PRP.	Agree 12 (92%)	Disagree 1 (8%)	Undecided

92% of respondents agreed with this statement. Consensus achieved.

Issue 1.2 What advice should be offered to those with primary RP wishing to work with exposure to HTV?

Consideration 1.2.1

	Agree	Disagree	Undecided
Individuals with a history of PRP embarking on a career involving HTV (e.g. mechanical apprentices) should be advised that exposure is not recommended and that they are effectively "not fit" to use vibrating tools.	1 (7.5%)	11 (85%)	1 (7.5%)

85% of respondents disagreed with this statement and felt that such individuals could use vibrating tools. Consensus achieved.

Comments from participants

Explain risks and gaps in knowledge to employee. If they want to work with HTV, do baseline health surveillance to map extent of blanching before exposed to HTV, then more frequent health surveillance in the first few years. If no progression, continue to do annual health surveillance and reconsider if any new or progressive blanching.

I would encourage alternative careers and to consider their options fully but wouldn't advise they are unfit, e.g. at pre-placement – I would suggest enhanced health surveillance and lower exposure.

The risks should be explained to such individuals and for them to make up their minds if such a job is acceptable or not. Moreso, I do think with careful and more frequent monitoring such persons can work with vibratory tools.

The advice on fitness to work in those with primary Raynaud's has changed since the L140 2005 edition. See quotes below. There is no evidence of any increased risk, although an explanation of potential theoretical risk should be given to the individual (see Fitness for Work 6th Edition). The HSE website has not updated their advice to occupational physicians! Those with late onset >40 yrs of age should be investigated further before deciding on fitness for work. L140 2005 para 329 states:

'It is recommended that individuals who suffer from certain relevant vascular or neurological disorders affecting the hand or arm, e.g. Raynaud's disease and carpal tunnel syndrome, are not exposed to vibration at work. Initial assessment by questionnaire and, if necessary, clinical assessment by the qualified person and the doctor will identify these individuals.'

Updated L140 2019 para 175: 'Individuals who suffer from certain disorders affecting the hand or arm, e.g. Raynaud's disease and CTS, should be identified during their initial assessment by questionnaire and, if necessary, clinical assessment. The health professional should advise you on the individual's fitness to work with vibration – and the employee of the possible increased risk of symptoms worsening from exposure to vibration. Some affected employees will need more frequent monitoring under the health surveillance programme.'

The above approach ignores the good of work that needs to be balanced against the "potential" but not guarantee of harm.

Advice should be tailored to their situation, including frequency and severity of attacks. It should be explained that having pre-existing finger blanching may pre-dispose to further damage from HTV and pose a risk of concealing the development of vibration-associated symptoms.

My approach would be to document this discussion and recommend increased frequency of surveillance, at least initially.

As a general rule, followed by most OHPs I work with, PRP has an onset at a young age >30.

The concept of those with primary RP being more susceptible to effects of vibration seems logical, but is without evidence. The big issue is if there is progression of blanching, it would not be possible to say whether the progression is due to the underlying condition or due to vibration. My approach is to apply a Griffin and Stockholm grade to those with primary RP and then offer advice in line with what we would offer if the primary RP was due to vibration.

Consideration 1.2.2

	Agree	Disagree	Undecided
HTV-exposed individuals who are diagnosed with PRP at routine health surveillance should be advised that they cease exposure.	1 (8%)	12 (92%)	

92% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

Explain the risks and gaps in knowledge to the employee. If they want to work with HTV, do baseline health surveillance to map the extent of blanching before exposed to HTV, then more frequent health surveillance in the first few years. If no progression, continue to do annual health surveillance and reconsider if any new or progressive blanching.

This has huge employment implications for the individuals concerned and is not practical for the employer/employee involved.

Rather than ceasing exposure, exposure should be kept ALARP, and they should be monitored more frequently depending on the extent of the blanching.

May need investigation if atypical or if co-morbid sensory symptoms are suggestive of CTS.

As above – enhanced surveillance, good education, reduction in exposure levels and LM engagement are all important in this situation.

I would probably recommend restricting exposure to the EAV, with subsequent increased frequency of surveillance to monitor for progression.

Fit with adjustments such as advice to employer on keeping exposures ALARP and more regular surveillance once employed, e.g. every six months with careful follow-up, advice and clear instruction to monitor symptoms/report worsening and low threshold to cease exposure.

The decision should reflect their ability to do the job, consider any effect on the safety of others, and risk of progression. As the latter is not known, it would be a matter for decision by the employee based on full knowledge/ information from OH, including approach, as in the previous response.

Consideration 1.2.3			
HTV exposed individuals who are diagnosed with PRP at routine health surveillance should be advised that they can continue with limited exposure	Agree 11 (85%)	Disagree 1 (7.5%)	Undecided 1 (7.5%)

85% of respondents agreed with this statement. Consensus achieved.

Comments from participants

There is no evidence for an HTV threshold for exacerbation of PRP. I do agree with careful monitoring and more frequent health surveillance in the first few years of exposure to HTV if have a PRP diagnosis.

How do you know if it's PRP or SRP? Unless onset >40 yrs age, then it may require investigation to exclude connective tissue disorder.

In my opinion, this would be dependent on the extent of the PRP. If it is mild and not extensive, then I would suggest that they continue with limited vibration exposure and careful monitoring.

This is my approach.

I would probably recommend restricting exposure to the EAV with subsequent increased frequency of surveillance to monitor for progression.

Basically agree, although would prefer exposure to as low as reasonably practicable to "below EAV".

Consideration 1.2.4			
It is impossible to provide effective HAVS surveillance in the presence of PRP and therefore anyone with this diagnosis should be advised not to use vibrating tools, regardless of their age or duration of employment.	Agree	Disagree 12 (92%)	Undecided 1 (8%)

92% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

Explain the risks and gaps in knowledge to the employee. If they want to work with HTV, do baseline health surveillance to map the extent of blanching before exposure to HTV, then more frequent health surveillance in the first few years. If no progression, continue to do annual health surveillance and reconsider if any new or progressive blanching.

I would agree that a diagnosis of PRP makes surveillance difficult, but in the case of mild disease I would suggest that they continue with limited exposure and careful monitoring.

The frequency is still possible to monitor, and health surveillance allows an ongoing conversation about alternative careers/job roles that do not use vibrating tools.

Surveillance includes checking if any changes have occurred, i.e. whether the condition remains the same or is worsening. Therefore, an effective surveillance can be done with PRP and vibration tool use.

No evidence of increased risk or synergistic effect with HTV.

Some particularly severe cases of PRP may fall into this category but in most, HS will be able to monitor for progression of their "usual" symptoms.

Fit with adjustments such as advice to employer on keeping exposures ALARP and more regular surveillance once employed, e.g. every six months with careful follow-up, advice and clear instruction to monitor symptoms/report worsening and low threshold to cease exposure.

Use of photographic evidence of blanching and more regular surveillance with monitoring of symptoms should be considered.

Recommend more frequent surveillance (every six months) over the first one to two years.

Issue 1.3 What criteria should lead to referral for further investigation of RP?

Consideration 1.3.1

HTV-exposed individuals with a history of blanching and possible carpal tunnel syndrome should be referred for investigation/treatment of CTS prior to diagnosing RP or vascular HAVS.	Agree 11 (85%)	Disagree 2 (15%)	Undecided

85% of respondents agreed with this statement. Consensus achieved.

Comments from participants

I would diagnose vascular HAVS but not a sensorineural component in the presence of possible CTS.

I would consider a diagnosis of vascular HAVS before further investigation for CTS.

Exclude CTS before diagnosis of RP or vascular HAVS by doing nerve conduction studies.

Agree exclude CTS, although a clinical diagnosis of CTS may be sufficient.

Consideration 1.3.2

Those with blanching and a history of health issues known to be associated with RP (e.g. scleroderma, connective tissue disorders, rheumatoid arthritis, hypothyroidism) should be referred.	Agree 10 (77%)	Disagree 2 (15%)	Undecided 1 (8%)

77% of respondents agreed with this statement. Consensus achieved.

Comments from participants

I do not necessarily feel this warrants a referral but would weigh up the presentation and background to both their health condition and vibration exposure before deciding whether further referral was necessary.

Not sure of referral benefit in this situation if associated diagnosis is clear. However, if suspect associated disease is unproven, then appropriate referral a good idea.

Fit with adjustments such as advice to employer on keeping exposures ALARP and more regular surveillance once employed, e.g. every six months with careful follow-up, advice and clear instruction to monitor symptoms/report worsening and low threshold to cease exposure via GP to rheumatologist if appropriate.

Referral indicated if no previous appropriate specialist assessment/input or if RP is a new manifestation of existing disease known to be associated with RP. Conflicting evidence re rheumatoid, which we discussed in the SIG some time ago. Epidemiology suggests RP is no more common among those with RP than the normal population.

Consideration 1.3.3

Symmetrical blanching affecting all fingers of both hands (+/- other extremities) always warrants more in-depth enquiry into medical history, medication and potential referral, regardless of the age of the individual.	Agree 9 (69%)	Disagree 4 (31%)	Undecided

69% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

Disagree with the "always".

Depends on years of exposure and temporality or lateness of presentation. All fingers on both hands from the start warrants further investigation. Often, initial presentations elicit vague histories regarding retrospective onset "which hand or which fingers" and present late with bilateral symptoms. Hand grips on many tools are frequently swapped if tools are heavy, so bilateral presentations are not uncommon.

Nothing ever "always" warrants something, but there will be a subset who will require this!

To rule out systemic diseases amenable to treatment/peripheral vascular disease.

Rationale is that many develop RP as first manifestation of connective tissue disease before other features. (Spencer-Green et al. Am J Med 1988; 84: 718–726.)

Issue 1.4 Can individuals known to have finger blanching due to PRP continue using vibrating tools providing the following measures are in place?

Consideration 1.4.1

	Agree	Disagree	Undecided
In those with known PRP, exposure to hand-transmitted vibration should not exceed the "no harmful effect level" of 1 m/s2 or 16.6 points on the HSE scale.	2 (15.5%)	9 (69%)	2 (15.5%)

69% of respondents disagreed with this statement. Consensus not achieved.

Comments from participants

This is impractical, does not allow meaningful use of tools and is unjustifiable. There is no reliable evidence of adverse effects of HTV in PRP.

There is no evidence that hand-transmitted vibration exacerbates or causes progression of PRP. It seems sensible to apply the precautionary principle and lower exposure, which means to work below 5 m/s2 A (8). One option is below 2.5 m/s2 A (8). Another is below 1 m/s2 and another is ALARP. I am hesitant to agree with below 1 m/s2 because it means mechanical apprentices or someone with a similar skilled trade will have to do another job when diagnosed with PRP and on balance, this seems very restrictive in the absence of any evidence that hand-transmitted vibration causes progression of PRP. PRP might mask vascular HAVS, but more regular health surveillance would ensure any change in Griffin score, or frequency of blanching episodes would trigger a Tier 4 health surveillance assessment and subsequent advice about reduction of exposure commensurate with the clinical picture and the adjustments that are reasonable within the skilled trade/role.

It is not clear if exposure ALARP below the EAV is likely to worsen blanching.

Exposure should be ALARP; this level of exposure may make many people unemployable, with no proven benefit in terms of reduction in harm. However, they should have enhanced surveillance.

I am guarded about this recommendation as it would be outside the regulations currently used in general practice and industry and may be an "unreasonable adjustment" for most of industry, and thereby inadvertently cause loss of employment.

I would restrict to ALARP below the EAV and recommend enhanced surveillance.

Consideration 1.4.2

	Agree	Disagree	Undecided
In those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale.	11 (85%)	1 (7.5%)	1 (7.5%)

85% agreed and so the consensual view was that those with known PRP should have exposure kept ALARP below the EAV.

Comments from participants

There is a potential risk, and this approach seems proportionate.

There is no evidence that hand-transmitted vibration exacerbates or causes progression of PRP. It seems sensible to apply the precautionary principle and lower exposure, which means to work below 5 m/s2 A (8). One option is below 2.5 m/s2 A (8). Another is below 1 m/s2 and another is ALARP. I am hesitant to agree with below 1 m/s2 because it means mechanical apprentices or someone with a similar skilled trade will have to do another job when diagnosed with PRP and on balance, this seems very restrictive in the absence of any evidence that hand-transmitted vibration causes progression of PRP. PRP might mask vascular HAVS, but more regular health surveillance would ensure any change in Griffin score, or frequency of blanching episodes would trigger a Tier 4 health surveillance assessment and subsequent advice about reduction of exposure commensurate with the clinical picture and the adjustments that are reasonable within the skilled trade/role.

I tend to grade these employees as though they have vascular HAVS and recommend restrictions appropriate to that stage.

Consideration 1.4.3

	Agree	Disagree	Undecided
In those with known PRP, ongoing exposure should be subject to enhanced health surveillance with at least annual Tier 4 review.	9 (69%)	3 (23%)	1 (8%)

69% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

Enhanced, yes, but not necessarily Tier 4 every year – it depends on the local arrangements of Tier 3 or their declared new symptoms.

Annual Tier 4 is overkill. If blanching is reported to have increased in frequency or extent, then that should result in escalation to Tier 4 assessment.

Attribution of any deterioration will be problematic and explained pre-emptively to the employee.

Review can be earlier if there is deterioration.

Enhanced surveillance is required. Possibly Tier 3 or maybe even just more frequent Tier 2 questionnaires.

But not for the long term, only for the initial couple of years and if no worsening/progression, the requirement for annual Tier 4 can be reviewed on a case-by-case basis.

Tier 2 review will result in automatic escalation due to positive responses to questions and so would not be a suitable means of surveillance in this situation. Annual Tier 3 rather than annual Tier 4 could be an option when there has been no change in extent or frequency of blanching in patients with consistent known levels of exposure to vibration, and stable symptoms. Some form of annual surveillance (T3 or T4) would be required, and ideally I would like to see photos each year for comparison.

Given that conditions such as scleroderma may initially present only with a picture that resembles PRP, I agree that an annual OHA/OHP review is appropriate for five years after onset of the RP. (Spencer-Green et al. Prospective study of the evolution of Raynaud's phenomenon. Am J Med 1988; 84: 718–726). I would not regard full annual Tier 4 assessment as essential thereafter if there is no reported change.

Consideration 1.4.4

	Agree	Disagree	Undecided
In those with known PRP, enhanced surveillance should include annual review of photographic evidence to help monitor progression of symptoms.	10 (77%)	1 (8%)	2 (15%)

77% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Having photos will always help.

This has some merit as an objective monitor of the employee's symptoms. It may, however, be difficult or resource-heavy to implement.

Would need to have several photos as don't usually get the same fingers affected in every attack. So, should be complementary to the history and deterioration should not be "fixed" by photography alone.

Photographic evidence would help with clinical decisions. From experience, not all people remember to take photographs during episodes of blanching, and some find it difficult to comply with the request to bring photographs to appointments!

I would suggest the word 'could' rather than 'should'.

It would be useful to have photographs of blanching but there are limitations – some individuals may not have an episode/remember to take a photo.

This would help confirm the patient's description.

It may be helpful to bring evidence to any further frequent F2F reviews to help inform the assessor.

In an ideal world, this would be preferable but in my experience very unlikely to be complied with by either the employee or the employer.

This will be helpful as we are always faced with recall issues asking employees to recall something that happened several months ago – in the winter months – and not every attack is similar, so relying on an individual's memory may not be the most accurate way of following up and monitoring for progression.

Review of photos is always helpful. Individuals subject to regular review should learn over time that they need to bring photos and whilst compliance may be low initially, hopefully the need to provide photographic evidence for HAVS health surveillance will become the accepted norm.

I agree that photography is likely to be useful if there is a reported change in the extent of blanching. Undecided as to whether it would help if there is no reported change – although could be useful if an employee has not noticed a slow change. No reason not to request them, but undecided whether they are essential if the employee reports no change.

Consideration 1.4.5

Symmetrical blanching affecting all fingers of both hands (+/- other extremities) warrants more in-depth enquiry to exclude other conditions (e.g. autoimmune disease, blood or vascular disorders, medication) when it presents in vibration-exposed individuals over the age of 30, with no family history of PRP.	Agree 12 (92%)	Disagree 1 (8%)	Undecided

92% of respondents agreed with this statement. Consensus achieved.

Comments from participants

As previously stated, it still depends on onset and progression. Yes, all fingers of both hands from the outset needs investigating. However, answers to questions such as 'which fingers did it start in?' are often poorly recalled by anamnesis, leaving 'all fingers both hands' reported as that is what is extant when asked the question. I note the quoted study on outcomes but have followed up large vibration-exposed cohorts of individuals for years with bilateral multiple fingers with distal circumferential blanching (DCB) and most tended to plateau with no other causes emerging. An additional point that does not appear in any article or textbook is the presentational "differences" in PRP and other secondary causes. I have witnessed these on numerous occasions since the advent of mobile phone usage: those with atypical histories very suggestive of PRP or other secondary causes often (but not always) present from the outset with a more erythrocyanotic or blotchy white patch appearance sometimes extending into the palms, rather than typical DCB. Their FSTs (finger skin temperatures) are usually lower than normal compared to the vibration-exposed groups, even after acclimatisation at room temperature. This, of course, is anecdotal but rarely incorrect in my extensive practice. Apart from a rheumatologist, I have not heard others report this phenomenon, so it is an outlier view, but I wanted to share this experience with the Delphi group.

I would agree this should be considered.

I think it should be for all vibration-exposed workers rather than over 30 years.

This is certainly something that should be considered and delved into in more detail. Such individuals should be referred to their GP for investigation.

Consideration 1.4.6

Vibration-exposed individuals aged over 30 with symmetrical blanching affecting all fingers of both hands (+/- other extremities), with no other obvious cause for the symptoms (e.g. medical history or medication), should generally be referred for further investigation such as nailfold capillaroscopy and antinuclear antibodies.	Agree 9 (69%)	Disagree 2 (15.5%)	Undecided 2 (15.5%)

69% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

This is not a decision for OH. Referral back to the GP (as in 2.2) may be appropriate.

As above. I tried ophthalmoscopic capillaroscopy some years ago using a drop of oil but found it technically challenging, but the technique now seems to have the potential for the future, where referral in such cases described in these questions may help differentiate between various causes of RP in vibration-exposed individuals.

(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

HAVS (including vascular HAVS) should only be diagnosed in the absence of an alternative explanation for the symptoms (Montracon v Whalley 2005 Court of Appeal).

This could still be PRP, but secondary causes apart from vibration should be explored.

I think it should be for all vibration-exposed workers rather than those over 30 years.

I agree that further investigation should be considered in these individuals, where HAVS seems to be an unlikely diagnosis based on the presentation.

It would be important to exclude other treatable conditions that may also be associated with RP, e.g. connective tissue diseases and CTS, before diagnosis of vascular HAVS is made.

Such individuals should be referred to their GP for investigation.

Certainly if other features of systemic disease are present. Referral for other cases is justified on the basis that RP may precede other manifestations of disease (as above – Spencer-Green et al). Eds note – ref Fitzgerald et al, 1988)

Topic 1 – Primary Raynaud's phenomenon (cont)

Round 3 Question
Due to the lack of consensus around the precise form of ongoing enhanced surveillance for vibration exposed in individuals with PRP and referral for further investigation, the round 3 questions were intended to clarify these areas.

Issue 1.5 In those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. These individuals should be subject to enhanced health surveillance that should:

Consideration 1.5.1			
Consist of an annual face to face assessment at Tier 3 (or Tier 4 if reported change), to ideally also include a review of photographic evidence to help monitor any progression of symptoms. This level of surveillance would need to continue for the duration of vibrating tool use.	Agree 7 (54%)	Disagree 3 (23%)	Undecided 3 (23%)

54% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

Not happy with Tier 3 or Tier 4. One or the other. With so few OHPs doing HAVS, referral is going to be difficult. Will the worker be suspended from vibrating tool use till they are seen?

This may depend on local arrangement whether an on-site team is easily available. A remote telephone consultation for stable symptoms may be appropriate for some cases, backed up by alternate year F2F (Tier 3 or 4) assessments.

Annual face to face assessments for an unlimited period seems overcautious in my view, especially if vibration levels are known, controlled and there is no progression evident after a pre-determined follow-up period.

Annual enhanced surveillance is certainly required. There may be scope for a remote assessment alongside a review of photographic evidence, with face to face assessments every two or three years if the condition appears stable.

I agree with face to face (F2F) and with annual assessments initially. I would opt for two or three years at Tier 3 or Tier 4 and then it is the clinician's decision as to whether to revert to Tier 2 or to persist with Tier 3 or 4 for longer, but F2F is not necessary for the duration of vibrating tool use.

Consideration 1.5.2			
Consist of an annual face to face assessment at Tier 3 or Tier 4 for the first five years after the onset of RP to ideally also include a review of photographic evidence to help monitor any progression of symptoms. If there is no evidence of change or progression of symptoms in the first five years, surveillance should continue with at least annual Tier 2 questionnaires in the same manner as other vibration-exposed workers.	Agree 5 (38%)	Disagree 5 (38%)	Undecided 3 (24%)

38% of respondents agreed with this statement and 38% disagreed. Consensus not achieved.

Comments from participants

Although the statement is a correct reflection, I am not sure where is the evidence behind the five-year period.

I am not sure if lifelong Tier 3 or 4 assessment is practical, noting the cost associated with it. The issue here is that the underlying PRP symptoms make diagnosis of additional HTV-related blanching difficult; a photo review may help with this.

It would be difficult to determine what is a progression of PRP from that influenced by HTV – the key being onset of asymmetry of symptoms in relation to the hand held in contact with the vibrating surface.

This may depend on local arrangement whether an on-site team is easily available. A remote telephone consultation for stable symptoms may be appropriate for some cases, backed up by alternate year F2F (Tier 3 or 4) assessments.

Tier 2 assessment would result in positive answers, which would then escalate to Tier 3 anyway.

I think progression can occur after five years. Therefore, to simplify the health surveillance, it would be more reasonable to have a uniform advice on the Tier.

Annual assessments for five years seems quite a long follow-up period in my view. And compliance/employer engagement must be considered as well. However, I do recognise that the reason for five-year follow-up relates to literature studies. That said, any recommended follow-up periods must be evidence-based.

Any Tier 2-type questionnaire would need to be modified to prevent automatic escalation and ideally be reviewed alongside photos. There may be scope for a remote rather than face to face assessment alongside a review of photographic evidence in such cases that appear stable.

I agree with F2F and with annual assessments initially. I would opt for two or three years at Tier 3 or Tier 4 and then it is the clinician's decision as to whether to revert to Tier 2, or to persist with Tier 3 or 4.

Topic 1 – Primary Raynaud's phenomenon (cont)

Whilst it was implied from previous responses that OH physicians may not be in a position to refer individuals for further investigation, they do need to consider whether the symptoms of blanching are likely to represent PRP, be due to vibration exposure, or be due to an emerging connective tissue disorder.

The following questions were therefore posed:

Issue 1.6: Vibration-exposed individuals with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies.

Consideration 1.6.1

	Agree	Disagree	Undecided
Regardless of their age/age of symptom presentation.	8 (61%)	4 (30%)	1 (9%)

61% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

This would be advisable as I feel their symptoms warrant further medical investigation.

Depends on onset and progression to this level and prior HTV. As previously stated, I would agree if all fingers affected from the outset, a history of onset in adolescence or at 20–30 years old and then progression after subsequent exposure to HTV, particularly if the progression is asymmetrical and relates to the hand in contact with vibrating surface, points to a co-morbid HAVS.

I would want the GP to be aware of the diagnosis and the uncertainty of the cause of the symptoms. I would state that, given the history, this seems to be PRP and would suggest it appropriate for further investigations to be done (e.g. ANA) to rule out other causes. I would state weather is concerned. HTV exposure could be a cause of the observed blanching and what exposure the individual has had over the years. Quite often it is clear cut, with the individual having very little tool use.

I think below the age of 30 and with a classic presentation of PRP, further investigation via the GP would not be necessary.

However, GPs may not refer due to the policies and criteria for referral. There will be a need to interface with GPs to get such referrals through.

It is important to exclude connective tissue disorders and ensure individuals are offered appropriate treatment in these cases.

I agree that the possibility of a connective tissue disorder needs consideration, but in those presenting at a young age with classic symptoms of PRP, and particularly with a family history, investigation may not be necessary.

I would only consider referral for further investigation for new onset symmetrical blanching of all digits (if the only symptoms) for those over the age of 40. I would also consider referral for those at any age with new onset symmetrical blanching of all digits and other symptoms suggestive of CREST syndrome.

I would not consider it necessary to refer those with longstanding PRP that had been present for five years or more with no symptoms of systemic disease during that time and/or if there was, for example, an FH of PRP.

Consideration 1.6.2

	Agree	Disagree	Undecided
(a) In general, only if their symptoms commence when aged >30 as most cases of PRP present in those aged <30.	3 (23%)	9 (69%)	1 (8%)

69% of respondents disagreed with this statement. Consensus not achieved.

Comments from participants

Will GPs accept these referrals? I can see a lot of workers being lost to follow up. We need to word a referral letter.

The decision on further investigation rests with the GP if HAVS has been ruled out as a cause.

Taking this blanket approach would misdiagnose and I still feel the symptoms warrant further medical investigation.

Onset and progression of symptoms to this level or from the outset again is important. Otherwise, the logical end point would have to be that all pre-employment medicals prior to any HTV exposure aged less than 30 years of age that report a history of Raynaud's phenomenon to this degree should have ANA screening and capillaroscopy. However, a later age onset to this degree should probably warrant referral.

I am cautious to say that individuals aged more than 30 years do not develop PRP.

It is true most cases present >30 but there are still some that present <30, so the use of ONLY makes me disagree.

It is for the GP to decide whether further testing for connective tissue disorder is appropriate, and it would be appropriate for the OH clinician to flag this condition and symptoms to the individual's primary care team.

The possibility of an underlying connective tissue disorder should always form part of the differential diagnosis and those presenting aged >30 are potentially more likely to have such underlying pathology. Flagging such a case to their GP would be reasonable. The decision whether to investigate further would then rest with the GP.

I agree with referral of new onset symmetrical blanching as symptoms only at an older age, probably >40. [1]

Moinzadeh et al. Older age onset of systemic sclerosis – accelerated disease progression in all disease subsets. Rheumatology November 2020; 59(11); 3380–3389. https://doi.org/10.1093/rheumatology/keaa127

I would not consider it necessary to refer those with longstanding PRP that had been present for five years or more with no symptoms of systemic disease during that time. PRP is described in middle-aged men – ref: Planchon et al (Angiology 1994; 45(8); 677–86). Late onset Raynaud's disease is a valid diagnosis – pathogenesis is less dependent on genetic sensitivity to cold than that of early onset cases. An old reference but one that anecdotally fits with my experience.

Moderator's summary of conclusions regarding Raynaud's phenomenon

Primary Raynaud's phenomenon (PRP)

The consensual view was that PRP generally presented with a symmetrical pattern of blanching in individuals under the age of 30. A positive family history of PRP and involvement of the feet also made the diagnosis likely.

The majority of respondents believed that vascular HAVS resulted from significant vibration exposure and that in those with <5 years exposure, alternative diagnoses such as PRP should be considered. They also agreed that asymmetrical blanching affecting the trigger fingers of the dominant hand would be more suggestive of HAVS than PRP.

Topic 1 – Primary Raynaud's phenomenon (cont)

Exposure to HTV with PRP

The consensual view was that it was not necessary to advise those embarking on a career involving HTV that exposure was not recommended. Nor should those attending HAVS health surveillance and diagnosed with PRP be advised to cease exposure.

However, the consensual view was that those exposed to HTV who are diagnosed with PRP at health surveillance should be limited to exposure below the exposure action value (EAV – 2.5 m/s2 daily A(8) or 100 points on the HSE scale) and be subject to careful monitoring.

It was felt that those with PRP could effectively be monitored with health surveillance and that there was no need to routinely advise against exposure to HTV, regardless of their age or duration of employment.

Investigation of Raynaud's phenomenon

The consensual view was that those with a history of blanching and possible CTS should be referred for investigation/treatment of CTS prior to diagnosing RP or vascular HAVS.

It was felt that those with blanching and other health issues known to be associated with RP should be referred. However, whilst the majority (69%) felt that symmetrical blanching affecting all fingers of both hands always warranted more in-depth enquiry – regardless of the age of the individual – consensus was not reached as the use of "always" was felt by some respondents to be inappropriate.

Whilst the consensual view was that those with known PRP should keep exposure to HTV as low as reasonably practicable and be subject to enhanced surveillance, it was not felt appropriate by many to keep exposure below the "no harmful effect level" of 1 m/s2 or 16.6 points on the HSE scale. Reducing to below this level could make some individuals unemployable, and there is lack of evidence about the effect of vibration exposure on progression of PRP. The consensual view was that ongoing exposure should be kept below the EAV.

Consensus was not reached regarding the nature of ongoing enhanced surveillance for those with PRP. Indefinite annual Tier 4 reviews with ongoing exposure was felt by many to be unnecessary, with the suggestion that this might be appropriate for up to five years, with a review of the frequency/type of surveillance at that stage if there had been no change. However, a review of photographic evidence annually was considered likely to be of use where possible.

The consensual view was that those vibration-exposed individuals over the age of 30 with no family history of PRP, presenting with symmetrical blanching affecting all fingers of both hands (+/- other extremities), warranted more in-depth enquiry to exclude other conditions.

Whilst the majority felt that vibration-exposed individuals aged over 30 with symmetrical blanching affecting all fingers of both hands and with no other obvious cause for the symptoms should generally be referred for further investigation, consensus was not reached regarding who should be responsible for referring (i.e. the GP or the OHP) and the need to consider alternative diagnoses in all cases, not just those aged >30.

With regards to the further investigation, the consensual view was that more in-depth enquiry to exclude other conditions was required in those with symmetrical blanching aged over 30 with no family history of PRP. However, there was no consensus about actual referral, with only 69% of respondents agreeing that this should generally occur and when this did happen, it should probably be the responsibility of the GP.

The question intended to clarify the nature of enhanced surveillance for those with PRP failed to reach a consensus. Whilst respondents agreed that annual surveillance was required, the need for face-to-face review for those with stable symptoms was questioned and the possibility of remote assessments alongside review of photographic evidence raised.

In response to the question about annual face-to-face review for five years and then reverting to Tier 2 questionnaires, opinions differed, and no consensus was reached. The possibility of remote consultations and review of photos was again suggested, and it was pointed out that any Tier 2 type questionnaire would need to be modified to avoid automatic escalation. Simplification of the recommendation for the type of follow-up was suggested so that there is a consistent approach – i.e. opt for a tier and stick to it. It may be that the existing tiered approach is inflexible and a hybrid Tier 4, such as a remote OHP consultation with review of photos for stable cases, could be a potential way forward.

Whilst it was clear from the comments received that all respondents felt it important to consider alternative diagnoses and exclude connective tissue disorders, it was also felt that the history and extent of the vibration exposure should provide pointers to the likelihood of alternative pathology and that further investigation into those with a classic history of PRP would not be necessary.

Evidence considered

1. Haque A and Hughes M. Raynaud's phenomenon. Clinical Medicine Nov 2020; 20(6): 580–587. doi: 10.7861/clinmed.2020-0754 https://www.rcpjournals.org/content/clinmedicine/20/6/580.full.pdf
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3. Details of Delphi process

Topic 2 – Frequency of health surveillance

Background

If an employee is diagnosed as having HAVS Stage 2 (sensorineural or vascular), the aim is to prevent HAVS Stage 3 developing because this is a more severe form of the disease, associated with significant loss of function and disability.
At the onset of symptoms of HAVS at Stage 2, there should be a reassessment of exposure conditions and close monitoring (HSE, Workplace Expert Health Committee).

Latest HSE guidance is that those who progress to Stage 2 should undergo health surveillance more frequently as determined by the OH professional. How long that should continue is a matter of clinical judgement, balancing any apparent progression with the knowledge that some employees' symptoms will plateau in spite of continuing exposure (IIAC Position Paper 43).

Working with high-vibration handheld tools during the previous two years was related to an aggravation, with more finger phalanges affected at the second examination.

It is concluded that vibration white finger (VWF) has a good prognosis in patients with mainly moderate to severe VWF after one to thirteen years of observation. Continued work with high-vibration handheld tools, smoking, other circulatory diseases and low age at the time of diagnosis had an unfavourable influence on the prognosis (Aarhus et al, 2019).

Information on prognosis is limited (WHEC report) and reports of stage "'plateauing" suggest that continuing more frequent surveillance, particularly Tier 4, indefinitely is not necessary: IIAC consulted international experts and reported that 'the majority of cases plateaued at stage 1V or 2V (SWS) despite ongoing vibration exposure' (IIAC Position Paper
43 2019).

In addition, Aarhus et al (2019), in a 22-year follow-up study of many with ongoing exposure to HTV, found no significant change in hand numbness or pain among those who had baseline sensorineural symptoms.

Consideration 2.1

Those with Stage 2 HAVS should have a Tier 4 HAVS assessment every six months and this should continue until they are removed from exposure to vibrating tools.	Agree 3 (33%)	Disagree 5 (56%)	Undecided 1 (11%)

33% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

Whilst I feel enhanced surveillance is required, the frequency for this and what other factors should be considered to determine frequency are unclear.

HSE recommends more frequent health surveillance at Stage 2 (more frequent would apply more frequently than annually, which is standard frequency). Tier 3 or Tier 4 would ensure subtle progression is detected. Tier 4 is preferable as indication of progression can be examined by an OH physician and would help avoid delays between Tier 3 and Tier 4 referral if there was progression.

Six-monthly medicals would not be advisable on a permanent basis for all cases. It would be appropriate to consider six-monthly assessments following diagnosis and use clinical judgement as to the ongoing frequency after an agreed period of review and if stability of symptoms plus appropriate workplace exposure controls were in place. For example, if no change in symptoms after a follow-up period of two to three years, consideration may be given to return to annual Tier 4 (face to face).

In my opinion this is a subjective issue that will vary from case to case. Hence, for employees who have long-standing symptoms with no progression but are diagnosed at Stage 2 at first assessment, the need for frequent review is much less than individuals who have been closely monitored since the start of exposure and have progressed to Stage 2 with shorter exposure. Six monthly for two years seems a good – though entirely arbitrary – starting point, but subject to adjustment by senior clinicians to reflect the individual circumstances. If, after two years, and especially if there was evidence of being at Stage 2 before the initial surveillance, this suggests the employee is in the group that plateaus at this level, and I would place them back on annual but emphasise the need to report any change.

I would advise more frequent than annual initial health surveillance but if stabilised, I would then reduce it to annual review. And so I only partially agree – more than annual initially but then reducing to annual and not always as a Tier 4. Could be a Tier 3 if very stable and if reviewed by an experienced Tier 3 clinician, who can escalate as required to a Tier 4. This is commercially far more practical.

Whilst increased surveillance is appropriate, it should be individually targeted and maintained until the condition stabilises – and certainly not until removal from exposure.

Topic 2 – Frequency of health surveillance (cont)

Consideration 2.2

Following a new diagnosis of Stage 2 HAVS, frequency of Tier 4 assessment should be increased to every six months, until there is no progression in symptoms. Where there has been a two-year period in which there has been no symptom progression, assessment can revert to an annual Tier 3 or 4.	Agree 8 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

I should have mentioned that although they should undergo HS more frequently, we could consider reducing the level over time, i.e. Tier 4 for one to two years and then Tier 3 or maybe 2 (with a specific questionnaire written to look for changes/new symptoms).

A period of more frequent surveillance for two years post diagnosis of Stage 2 seems sensible. The clinician might decide to revert to annual health surveillance if no progression in that period.

The caveat is if the individual with HAVS is working with HTV intermittently and at varying vibration magnitudes (for example site services or mechanical maintenance where exposure is reactive to events rather than a standardised process), the clinician should take into account the HTV exposure in the preceding two years. If lower than the typical average annual exposure, more frequent health surveillance might be necessary for longer than two years.

Information on prognosis is limited (WHEC report) and reports of stage plateauing suggest that continuing more frequent surveillance, particularly Tier 4, indefinitely is not necessary: IIAC consulted international experts and reported that 'the majority of cases plateaued at stage 1V or 2V (SWS) despite ongoing vibration exposure' (IIAC Position Paper 43 2019). In addition, Aarhus et al (2019), in a 22-year follow-up study of many with ongoing exposure to HTV, found no significant change in hand numbness or pain among those who had baseline sensorineural symptoms.

I think this would be a reasonable approach, where the individual remains vibration exposed even at below the EAV. If the individual has ceased exposure annual Tier 4 for two years after, ceasing exposure might be sufficient.

Consideration 2.3

For employees who have a diagnosis of Stage 2 HAVS and have stable symptoms, with no progression over a period of four years, surveillance could be stepped down to Tier 2, with a specific questionnaire written to look for changes or new symptoms.	Agree 1 (12.5%)	Disagree 4 (50%)	Undecided 3 (37.5%)

50% of respondents disagreed with this statement. Consensus not achieved.

Comments from participants

The symptom progression might be subtle from a Stage 2 early to Stage 2 late. A conversation with someone trained in HAVS assessment (such as Tier 3 or Tier 4) would help to identify early progression and prevent from progressing to late stage. (At late Stage 2, exposure to HTV is usually not recommended and termination of contract or redeployment should follow.)

Employees are increasingly changing roles and altering their exposures to HTV. A regular HAVS Tier 3 or 4 review picks this up, reinforcing the exposure restrictions required and particularly when there is a lack of knowledge at employer level. This statement implies the exposures remain stable too and so there is no need for a review.

The concern with questionnaires is that individuals do not always answer honestly or fully disclose, particularly if they are concerned about their job. Questions about blanching would ideally be accompanied by photographic evidence and monitoring vascular symptoms in this way might be reasonable, given the lack of objective tests for blanching. Sensorineural symptoms are subtle and hard to define. QST (monofilament testing) would in my opinion be advisable at annual intervals in those with ongoing exposure and a diagnosis of Stage 2SN. I don't think a questionnaire would be a substitute for a Tier 4 HAVS in such cases.

It really depends on their level of exposure to HTV. For minimal exposure, this might be acceptable with an F2F assessment (Tier 3 or 4) every two to three years, but for those with continuing high exposure levels of HTV, ongoing F2F assessments are required.

I feel that continuing Tier 4 assessments for four years in the absence of any evidence of progression is unnecessary. Six-monthly Tier 4s following a new diagnosis for 18 to 24 months seems sufficient, thereafter reverting to annual Tier 2, as long as it is clear in the questionnaire that any new symptoms be reported.

Topic 2 – Frequency of health surveillance (cont)

Consideration 2.4			
If the individual has ceased exposure, Tier 4 assessment should be continued for two years and if there is no progression of symptoms, then there is no need for ongoing surveillance.	Agree 6 (75%)	Disagree 1 (12.5%)	Undecided 1 (12.5%)

75% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Employees often restart exposure at a later date and due to the demands of their employment, managers change and historic advice is forgotten. I would advocate ongoing review or at least an annual statement that they are still not exposed.

Generally, the view is to continue surveillance for 12 months following ceasing exposure; this allows exposure to all seasons to determine if cold-induced symptoms (blanching) are worsened.

I am not aware of individuals whose symptoms have continued to progress two years after cessation of vibration exposure and so currently recommend ongoing HAVS surveillance is not required beyond that.

It is normally accepted that new symptoms do not develop after having no HTV exposure for one year, hence continuing surveillance for two years after cessation of HTV exposure is a sensible option.

Moderator's summary of conclusions regarding frequency of health surveillance

The consensus opinion concludes that following a diagnosis of Stage 2 HAVS, the frequency of Tier 4 assessment should be increased to every six months, until there is no progression in symptoms. Where there has been a two-year period in which there has been no symptom progression, assessment can revert to annual Tier 3 or 4. In addition, consideration should be given to those working intermittently and at varying vibration magnitudes. If their exposure is lower than typically average annual exposure, then more frequent health surveillance might be necessary for longer than two years.

If the individual has ceased exposure, Tier 4 assessment should be continued for two years and if there is no progression of symptoms, then there is no need for ongoing surveillance. Although 75% consensus was achieved for this statement, it was suggested that a statement be made by the individual or manager that they continue not to be exposed to vibration, on an annual basis. This would ensure appropriate follow-up is put in place if they return to vibration exposure.

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3. Details of Delphi process

Topic 3 – Criteria for vascular staging

Background

The consistency of application by practitioners of the modified Stockholm Workshop Scale (SWS) in the United Kingdom has previously been called into question, in particular whether frequency of attacks of vasospasm and extent of finger blanching are applied to staging as originally intended (Lawson 2016).

Frequency of attacks of blanching depends on time spent outdoors in a cold, wet environment and whether warm clothing or gloves are worn. Severity based on attack frequency is dependent 'on climate, latitude, and cultural habit' and 'in comparisons of international research findings, extent of disease can be considered a more stable and perhaps a more desirable index of severity' (Palmer et al 1997). Poole et al noted that the 'SWS assumes that there is a positive relationship between the frequency of attacks and extent of blanching. Our data question the validity of this assumption (Poole K et al 2006). A separate Delphi exercise similarly found that the correlation between frequency and extent of blanching was not high (Poole CJM et al, 2019).

Poole CJM et al (2019) stated: 'Although the correlation between frequency and extent of blanching was not high, it is recommended that a blanching score, as described by Griffin (1990), is used to stage vascular HAVS. This is an objective measure of the extent of vasospasm and should be taken from photographs of the hands in ventral and dorsal views during an attack of blanching with the arms elevated alongside the face. A colleague or friend of the worker would need to take the photographs. If the most severe attack has not been captured, then the scoring could be provisional pending additional photographs … [and that if] … photographs are not available for review, the diagnosis could be qualified as "probable".'

The Industrial Injuries Advisory Council Position Paper 43 stated: '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 … 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.'

Consideration 3.1

	Agree	Disagree	Undecided
With vascular HAVS, the extent of blanching should override frequency.	13 (100%)		

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

I would agree that determining the extent of the blanching is the primary consideration, but ideally this would also be backed up by photographic evidence. The history is often vague, and I would be reluctant to confirm vascular staging in a new case these days without seeing a photo. My view is that the staging should be provisional and that it may be reasonable to delay reporting new vascular cases under RIDDOR, providing appropriate restrictions are in place, pending confirmatory evidence whenever possible. It would be interesting to know what the consensus is about photographic evidence.

Do feel that sometimes we find a mismatch between the extent of involvement (i.e. blanching scores) and blanching frequency, which could well be due to the reasons above. Do think this merits further discussion and consideration/ evaluation. My own feeling is the scores should be given greater weighting and the frequency should at least be correlated with the scores before giving a staging, but the extent of distribution should be given greater primacy.

Caveat is when working in a cold environment where frequent attacks are impacting work. Reference Lawson 2016: 'An exception to this rule would be a right-handed worker using a pencil grinder in a tripod grip in a cold environment who has frequent attacks of blanching at work affecting the whole of his right index finger. This is correctly staged at late Stage 2 despite the blanching score being only 6 because of the frequent index finger involvement at work having a functional impact.'

In other conditions associated with secondary Raynaud's phenomenon (SRP), such as systemic sclerosis, the frequency of episodes of blanching does not correlate with fingertip ulceration. Frequency of episodes of blanching in SRP associated with systemic sclerosis increased in the winter months when colder while severity of episodes generally did not alter due to environmental factors or patient behaviour. (Pauling 2019)

Agreed frequency of attacks is influenced by external factors such as PPE/outdoor working time and therefore, for vascular staging, the extent of blanching attacks should override the frequency.

I recall early work quoted by Pelmear which showed that when arteriography was done during an attack of blanching, there was an unexpectedly poor correlation between the site of vasospasm and the extent of blanching. There is no doubt that altering cold exposure changes the frequency of episodes of blanching – hence the seasonal variation. Also, evidence of different results of CPT in the same individual in summer and winter. On balance, and in spite of the arteriographic evidence, the extent of blanching therefore seems more likely to represent the degree of pathological damage and should, in my opinion, override the frequency of attacks. A question arises as to what extent of whiteness is considered for staging ¬– typically, it is the worst, but should it be the "usual" or should it be the extent seen in photographic evidence or from direct observation?

Topic 3 – Criteria for vascular staging (cont)

Consideration 3.2

Photographic evidence should be used to confirm the diagnosis and extent of blanching and vascular staging.	Agree 8 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

One caveat with photography is that several may be required on different occasions as not all fingers affected necessarily blanch during every attack, either between or within fingers, to the same degree.

I agree that photographic evidence should be used but should not always be determinative, and photographs should be considered one part of the totality of evidence – the other main part being the account by the individual. Although clearly preferable to have supportive (photographic) evidence, where there is a good history I would be content to make a diagnosis and offer a staging without photographic evidence.

I would worry about not making such a diagnosis where there is a good account of blanching, particularly if workplace/exposure advice reflects the absence of confirmed diagnosis. Similarly, if the reported extent is greater than the photographic evidence suggests, there is a potential risk in using the latter as the basis for workplace advice. I would advocate a cautious approach to both diagnosis and grading for the purposes of workplace management.

I would always expect photographic evidence before making a firm diagnosis of vascular HAVS but would not necessarily rely on it for the extent of blanching, which can vary between episodes. In my experience, the problem practically is that an employee passes from clinic to clinic, not providing photos often over a few years and therefore RIDDOR doesn't occur or is delayed.

My view is that in individuals reporting finger(s) blanching, clinicians should ask for photographic evidence – especially, in new cases, photographic evidence would be preferred to confirm that what the individual is describing/experiencing is true blanching attacks and not white fingers/exposure to cold/poor circulation effects etc. In terms of staging of vascular HAVS and progression of vascular HAVS, we know that in many cases the history is often vague and as the attacks happen in winter/are seasonal and rely on a person's recall, photographic evidence would be important and indeed preferable in my view. Further to this, Tier 5 testing for vascular HAVS is usually not required, therefore clinicians have to rely on clinical history and photographic evidence.

There are no other reliable quantitative tests for vascular HAVS that help with diagnosis or staging (and some of these are not ethical as they elicit symptoms/discomfort in an attempt to confirm a diagnosis). Photographs provide objective visual information for diagnosing HAVS and for staging HAVS. In addition to photographs, magnetic resonance angiography (MRA) can be considered if the clinical history is consistent with the hammer syndromes. Ref: Poole CJM and Cleveland TJ. Vascular hand–arm vibration syndrome—magnetic resonance angiography. Occupational Medicine 2016; 66(1): 75–78. https://doi.org/10.1093/occmed/kqv151

Consideration 3.3

Given the adequate time to provide photographic evidence (say a full winter), the absence of photographic evidence should be used to discount or overturn a presumptive diagnosis of vascular HAVS where there is a history of sufficient exposure and anamnesis of cold-induced distal circumferential finger blanching.	Agree 1 (11%)	Disagree 7 (78%)	Undecided 1 (11%)

78% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

The aim of a Tier 4/5 assessment is to diagnose or rule out HAVS and then appropriately protect an employee and inform further risk assessments (considering the other employees). In this situation, we should believe what we are told, and the absence of a photo should not delay taking appropriate protective action.

Thirty years ago, we were expected to take a comprehensive, detailed history. The absence of photography does not equal the absence of disease. A night worker who experiences symptoms at 2am on a cold, wet night isn't going to think about whipping their camera out and taking pictures of their fingers. They probably don't want to take their gloves off, and the facilities cabin may be some distance from where they are working.

Individuals who experience blanching may endeavour to maintain their core body temperature and keep their hands warm to prevent it occurring or may avoid activities that they know will induce blanching. Reducing or ceasing vibration exposure might also result in minor improvement in vascular symptoms. Recent winters have not had extended periods of very cold weather.

Therefore, if a previous presumptive diagnosis has been made in someone with a history of sufficient vibration exposure who can adequately describe circumferential finger blanching and identify which parts of which fingers were affected, I would not overturn it.

Using photos of blanching to show to the individual and confirm that is what they were previously experiencing might be useful if there is any doubt about the history.

As vibration dose is cumulative, overturning a previous diagnosis and relaxing any restrictions on vibration exposure risks the return and progression of previously experienced symptoms of blanching.

The above assumes that the individual did not also have CTS and that the improvement in blanching was not subsequent to CTS surgery.

Yes, delay diagnosis until photographic evidence is available, especially for new cases of vascular HAVS diagnosis. My view is that we cannot just rely on individuals saying they have blanching attacks without providing evidence, given that we are unable to refer to Tier 5 for confirmation of diagnosis and our only objective way of confirming diagnosis would be with photographic evidence.

From experience, it can be difficult to obtain photographs of blanching. I make recommendations for those based on my presumptive diagnosis, including advice to reduce or to refrain from using HTV. I prefer to see photographs before I confirm my presumptive diagnosis. Once diagnosis is confirmed, the employer has a legal duty to report under RIDDOR regs, and usually a civil litigation claim follows. I remain hesitant to take this step without objective evidence to support their anamnesis of the extent/frequency of cold-induced, digital vascular vasospasm.

Topic 3 – Criteria for vascular staging (cont)

Consideration 3.3

Comments from participants (cont)

Not everyone has the motivation or capacity to provide photographic evidence and overturning/discounting the possibility would be detrimental to the individual concerned if they indeed did have HAVS and also to the employer if the diagnosis was missed. There are often a multitude of reasons why photos aren't produced. It would be better to encourage managerial intervention to help provide the photos rather than Occupational Health taking this approach.

In this case, I would make a diagnosis based on the history (without photos) but encourage the individual to take/bring photographs to future review appointments.

Continue to encourage obtaining photographs in the context of health surveillance and advise management based on presumptive diagnosis. In the context of a medico-legal claim, the absence of a reasonable quality photograph will increasingly become a source of claim rebuttal, as will those showing vasoconstriction, either physiological or from hyperextended fingers.

Moderator's summary of conclusions regarding criteria for vascular staging

There was unanimous agreement with this statement (100% from 13 respondents) that environmental factors are the main determinant of frequency of attacks and in only rare circumstances should frequency ever override the extent of blanching when staging vascular HAVS. Some respondents referred to the potential role of photography in confirming the extent of blanching in typical attacks.

There was unanimous agreement that photography should be used to confirm a diagnosis and the extent of vascular staging (100% from eight respondents). Comments ranged from an expectation of photography prior to confirming diagnosis, especially new cases to photography being part of an assessment but anamnesis being of overall importance. There was acknowledgement of a lack of reliable objective tests and that several photographs may be required as different fingers are affected in different attacks.

There was concern that protective actions should not be postponed in the absence of photography; technical issues may preclude good quality photography; absence should not override a good quality history; hesitancy to a RIDDOR report without photography; delay confirmation of diagnosis until photography presented; concern that photography in the absence of objective measures of vasospasm is only objective confirmation; and likely contentiousness in medico-legal practice when photographs are not provided.

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3. Details of Delphi process

Topic 4 – Use of monofilaments for sensory testing

Background

The HSE recommends using monofilaments to test perception of light touch and deep pressure as part of the neurosensory assessment of suspected HAVS (HSE Guidance for Occupational Health Professionals). The Weinstein Enhanced Sensory Test (WEST) monofilament classification states being unable to detect an applied force of 0.2 g-f or 2 g-f is deemed diminished light touch and diminished protective sensation, respectively (Lawson 2018). Birke et al reported a threshold of sensory perception between normal and abnormal as 1.4 g-f; Birke also reported sensory threshold increased with increasing age and manual work (Birke 2000). A 1998 study by Schulz et al to determine normal age and sex matched sensory thresholds (defined as the values for 80% of the population of each category) proposed normal values as 0.035 g-f for men and women <55 years and 0.385 g-f for men >55 years (Schulz 1998). A 2009 review from the Health and Safety Laboratory suggested 'in defining neurosensory deficit in vibration exposed subjects… defining abnormality as not being able to detect an applied force of 0.2 g-f or lower has the best, but limited diagnostic power' (Poole, Mason 2009).

Given evidence of increased sensory perception thresholds with increasing age and heavy manual work, the use of a single sensory perception threshold to define abnormality has been questioned and the suggestion made that normal threshold should be defined for different occupational groups and possibly age ranges (Lawson 2018, Birke 2000, Cavazzana 2018, Poole 2020). Poole et al, in their 2019 Delphi exercise, re-analysed previously published data on normal limit values for sensory perception using Semmes–Weinstein monofilaments (SWMs) in non-vibration-exposed maintenance workers as median and 95th percentile values; normal values ranged from 0.07 to 2.04 g-f with variations due to age noted (Poole 2019). In 2020, Poole et al published data on sensory perception in office workers and heavy manual workers not exposed to HTV evaluated with SWM (Poole 2020). He suggested that rather than using 0.2 g-f as the cut-off from normal, for manual workers who may be affected with thick or hard skin, the cut-off from normal (95th percentile) for male heavy manual workers should be 1.0 g-f (≥50 years 1.4 g-f).

Poole et al found a mean 'threshold of ≥ 1.0 g-f had a 79% sensitivity and 64% specificity for detecting abnormalities of thermal and vibration perception in the ipsilateral index and little fingers of workers with HAVS', advocating the use of 'hand-sets of SWM that include filaments with bend forces in the range 0.2–2.0 g-f and not a standard WEST handset in the range 0.07–200 g-f' and recommend that workers exposed to HTV have their digits screened with SWM and are referred for QST when the mean SWM bend force in two digits is ≥ 0.6 g-f'. Using this cut-off had a 90% sensitivity and 54% specificity for detecting abnormalities of thermal and vibration perception in the ipsilateral index and little fingers of workers with HAVS. He also noted: 'The sensory perception thresholds, as measured by SWM, in the digits of heavy manual workers not exposed to HTV, were found to be significantly higher than that of office workers. This is probably because of thickening or hardness of the skin, but sensory neuropathy from trauma to the hands cannot be excluded. The median threshold for heavy manual workers was 0.16 g-f and there was no threshold > 2.00 g-f. The 95th percentile was 1.00 g-f (95% CI 0.60–1.00), which was significantly greater than for office workers 0.16 g-f (95% CI 0.16–0.16).'

Although there may be a more noticeable change in sensory perception to SWM after the age of 50–55 (Schulz 1998, Poole 2020), the evidence for predictable changes in sensory perception of the fingertips across the working ages is not clear and further research on this would be required prior to adjusting normative values for SWM perception according to age. Changes in finger sensory perception in heavy manual workers have been shown to be significantly higher in the digits compared with office workers, but this may be due to glabrous skin thickening or neuropathy from trauma to the hands.

Consideration 4.1

	Agree	Disagree	Undecided
Using WEST/SW monofilaments, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception when assessing whether reduced sensory perception is present in vibration-exposed workers.	8 (67%)	4 (33%)	

67% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

I agree that 0.2 g-f or under is likely to be normal. There is a difficulty with a finding of between 0.2 and 2.0 g-f, given the suggestions in the literature you have summarised. The manufacturers cite 0.07 g-f as normal, but it seems that many accept 0.2 g-f.

Tekavec et al (Tekavec E, Löfqvist L, Larsson A et al. Adverse health manifestations in the hands of vibration exposed carpenters – a cross sectional study. J Occup Med Toxicol. 2021; 16(1): 16. https://doi.org/10.1186/s12995-021-00305-3) used a 0.271 g-f, so there is undoubtedly a range of opinion.

I feel that the age and occupation group should be taken into account when interpreting abnormal results and establishing a diagnosis.

In the standard WEST monofilament testing kit, the blue filament is 0.2 g-f and the next one up is purple (2 g-f). Sets of 20 or more filaments are available with smaller g-f intervals, but more costly and take longer to test.

As a screening test for large-volume HAVS health surveillance, detecting the blue 0.2 g-f means someone still has 2 point-discrimination and light touch perception. Once someone cannot detect the purple monofilament, manual dexterity and protective sensation might already be affected. [1]

[1] Lawson I. Monofilaments. Occupational Medicine 2018; 68(8): 559–561. https://doi.org/10.1093/occmed/kqy116

Testing should be carried out in a warm environment and the individual must have had time to warm up properly and have warm warm hands before tests are performed.

In my practice and experience, manual workers often present with skin changes/hardened skin and therefore it may be appropriate to consider changing this cut-off value for diminished light touch testing.

Agree but only as a screening test at Tier 3 health surveillance, therefore failing to safety so to speak (see further comments below*). Worth pointing out that there have been other studies citing monofilaments in vibration-exposed populations and normative data: Kent et al used a 0.2 g-f (n = 40); Cederlund et al used a 0.2 g-f (n = 111), sensitivity 64% and specificity 73%; Poole K et al 2009 [5] used a 0.2 g-f, sensitivity 78% and specificity 74%.The current practice in HAVS surveillance has been to use the 0.2 g-f monofilament as a cut-off to determine when sensory perception is reduced. Peripheral neuropathy in HAVS affects the digits, and the review by Birke et al [3] suggests the fifth digit normative levels were reported as lower and nearer to those reported by Schulz et al [4]. Schulz did note the potential problem with callosities but, in my experience, these rarely occur on the glabrous skin between the tip and the whorl. It is also worth noting the quoted Poole et al 2019 Delphi exercise did not actually reach a consensus on a cut-off value.

***In my opinion, for diagnosis and staging of sensory HAVS, there should be more than one QST performed (i.e. vibrotactile threshold testing (VTT) or thermal aesthesiometry (TA), Poole et al 2019). This would create a practical issue in the UK due to the paucity of Tier 5 QST facilities. Poole et al (2020) found a mean 'threshold of ≥ 1.0 g-f had a 79% sensitivity and 64% specificity for detecting abnormalities of thermal and vibration perception in the ipsilateral index and little fingers of workers with HAVS'… advocating the use of … 'hand-sets of SWM that include filaments with bend forces in the range 0.2–2.0 g-f and not a standard WEST handset in the range 0.07–200 g-f' … recommend that workers exposed to HTV have their digits screened with SWM and are referred for QST when the mean SWM bend force in two digits is ≥ 0.6 g-f .**

Consideration 4.1

Comments from participants (cont)

Therefore, this is a possible case for using a different cut-off as a surrogate for Tier 5 testing by VTT to TA. This would require consensus and agreement by manufacturers to develop new sets of WEST monofilaments with these ranges of force – or full packs of SWM.

Kent DC, Allen R, Bureau P, Cherniack M, Hans J, Robinson M. Clinical evaluation of hand-arm-vibration syndrome in shipyard workers: sensitivity and specificity as compared to Stockholm classification and vibrometry testing. Conn Med 1998; 62(2): 75–83.

Cederlund R, Iwarsson S, Lundborg G. Hand function tests and questions on hand symptoms as related to the Stockholm Workshop Scales for diagnosis of hand-arm vibration syndrome. J Hand Surg Br. 2003; 28(2): 165–171.

The evidence cited above is consistent with my clinical experience. When considering the outcome of a clinical assessment, I would give limited weight to apparent mildly reduced sensation if the history of neurological symptoms were not convincing and suggestive of HAVS and if the employee clearly had calloused hands.

Consideration 4.2

	Agree	Disagree	Undecided
Age and occupational group should NOT be considered when interpreting results of monofilament testing.		11 (92%)	1 (8%)

92% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

The issue of skin elasticity and therefore skin thickening has been addressed in numerous papers in respect of sensory testing of the feet – for example Castellano et al (Castellano VK, Jackson RL, Zabala ME. Contact Mechanics Modeling of the Semmes–Weinstein Monofilament on the Plantar Surface of the Foot. Int J Foot Ankle 2021; 5(2):055. doi. org/10.23937/2643-3885/1710055), who also noted significant changes in monofilament buckling force after repeated applications, as well as in different storage conditions for the fibres. There are numerous studies describing an effect of skin thickness on the results of monofilament testing in the feet.

If one accepts that age/occupation affects skin elasticity, as well as potentially being independent factors influencing the outcome of monofilament testing, it may be difficult to argue against considering these factors relevant.

Age and type of work done are necessary considerations in interpreting results of monofilament testing, as the literature suggests. Anecdotally, in my practice, I have noticed that those who are heavy manual workers do have thick or hard skin, which affects the outcome of monofilament testing, even for those that don't have HAVS.

The history (including the occupational group and age), clinical picture, progression and distribution of digital loss of sensory perception should be taken into account and Tier 5 testing considered when someone cannot detect 0.2 g-f (especially if there is an asymmetrical perception deficit).

It is usually very evident when patients have thickened skin and calloused hands and clearly this will impact on their ability to detect light touch.

Additional factors such as age and occupational groups should be considered.

Undecided as there needs to be more evidence of different occupational group normative data such as semi-skilled workers before departing from a 0.2 g-f cut-off, and it is unclear whether glabrous skin thickening occurs in other occupations. Additional research on age and monofilament normative data as there is evidence that other QST such as VTT are not affected significantly by age (Lindsell 2003, Seah 2008).

Hard skin and age very relevant.

One has to use judgement, as described above, when using an inexact classification system.

Topic 4 – Use of monofilaments for sensory testing (cont)

Consideration 4.3

Using WEST/SW monofilaments in vibration-exposed workers, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however, for workers unable to sense an applied force of 0.2 g-f, further testing with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments should be undertaken. For those unable to sense 0.6 g-f or more, quantitative sensory perception testing should be considered.	Agree 5 (56%)	Disagree 2 (22%)	Undecided 2 (22%)

56% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

In my view, at a Tier 4 assessment, the diagnosis of 1SN and 2SN early can be made without referring to Tier 5. Therefore, if someone has a history and symptoms consistent with sensorineural HAVS and CTS has been excluded, and due consideration has been given to those with thickened skin/calloused hands, the diagnosis can be made if monofilaments indicate abnormal sensory perception using a 0.2 g-f cut-off.

In my opinion, if a person cannot sense an applied force of 0.2 g -f, their age/general condition of their skin/HAVS exposure should be considered to weigh up if this would be considered an abnormal result in that demographic. For younger employees without thickened skin, this may be enough information to make a diagnosis of reduced sensory perception. For other workers, who are able to sense an applied force of 2 g -f, consideration could be given to conducting further testing with an additional range of monofilaments or further quantitative sensory testing, to establish whether they have reduced sensory perception or not.

Not all clinicians use the multi-filament sets (20 filaments) but if so, this approach would increase sensitivity of screening for SN HAVS.

For those using the set with only 0.2 and 2.0 g-f and no thresholds in between, the history, clinical picture, progression and distribution of digital loss of sensory perception should be taken into account and Tier 5 testing considered when someone cannot detect 0.2 g-f (especially if there is an asymmetrical perception deficit).

Yes, agree it should be considered.

Agree that quantitative sensory perception testing should be considered on a case-by-case basis in those unable to sense 0.6 g-f or more. As with all HAVS assessments, there is likely to be a degree of subjectivity if the individual is in the older age range and clearly has thickened skin/calloused hands or some other potential cause for the findings, such as diabetic neuropathy.

QST could be considered in this case but should not be mandated as it may provide little additional benefit over clinical assessment, serial examination and consideration of the employee's wider occupational and medical picture to discern whether the observed changes are likely, on balance of probability, to be related to vibration exposure.

Consideration 4.4

Given the paucity of normative data for SWM perception in occupational groups, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results.	Agree 8 (80%)	Disagree 1 (10%)	Undecided 1 (10%)

80% of respondents agreed with this statement. Consensus achieved.

Comments from participants

It is usually evident by examination of the hands to identify those with thickened skin/calloused hands.

This will impact on their ability to detect light touch and as a result the OHP has to use judgement, when using an imperfect classification system.

The problem is that without a defined "normal" cut-off, interpretation of test results does then become so subjective.

The lack of normative data and the inexact nature of the classification scheme requires this kind of practical approach. Weight should also be given to serial measurements and any observed changes over time.

If available, and a question of a monofilament result being influenced by skin thickening arises, I would proceed to other QST such as VTT and TA. The former tests Pacinian corpuscles; the latter, smaller thermal nerve fibre endings. Testing receptors other than touch pressure (Merkel disc) should increase the potential for excluding an effect of skin thickening on sensibility.

Consideration 4.5

Qu 1: Using WEST/SW monofilaments in vibration-exposed workers, ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however for workers unable to sense an applied force of 0.2 g-f, further testing (if available) with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments (long test kit) should be considered, especially if an older worker with thickened skin/calloused hands.	Agree 9 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

This appears to be a sensible and pragmatic approach should the additional monofilaments be available. As ever, diagnosis takes into account many factors and should not solely be based on one result (e.g. just the monofilament). I have previously tried to obtain the additional monofilaments in the UK without success and have emailed the distributor in the US, who was not prepared to mail them to the UK.

Certainly something to consider alongside clinical judgement on a case-by-case basis.

Topic 4 – Use of monofilaments for sensory testing (cont)

Consideration 4.6			
For clinicians with only access to WEST monofilaments, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results. However, if there remains doubt, then referral for QST such as VTT and TPTT, which tests receptors other than touch pressure, should increase the potential for excluding an effect of skin thickening on sensibility.	Agree 9 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

This seems a sensible and pragmatic way forward given the limitations. The diagnosis should be based on history and examination, etc. and not rely solely on one test.

Agree that this is something to consider when in doubt but not necessarily a rule.

Consideration 4.7			
Where the long test monofilament kit is available, when the mean SWM bend force in two digits is ≥ 0.6 g-f, the history, clinical picture, progression and distribution of digital loss of sensory perception should be taken into account – and Tier 5 testing considered if there remains doubt about the diagnosis.	Agree 9 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

In cases where there remains doubt about the diagnosis, Tier 5 testing is an option to consider.

Moderator's summary of conclusions regarding criteria for use of monofilaments for sensorineural staging

Most respondents agreed that a cut-off of 0.2 g-f implied normal sensation; however, those who disagreed with this statement did so based on their views that skin changes in the hands might require an increase to the cut-off for diminished light touch. However, one respondent pointed out that, in their extensive experience, thickening to the glabrous skin between the tip and the whorl of the digits was a rare occurrence. It was noted that Poole et al (2020) advocated that workers exposed to HTV should have their digits screened with SWM and be referred for QST when the mean SWM bend force in two digits is ≥ 0.6 g-f; however, it was pointed out that standard widely used WEST monofilaments do not have monofilaments for applied force between 0.2 and 2 g-f.

Age and occupational group consideration when interpreting monofilament testing

The consensus view was that age and occupational group should be considered when interpreting the results of monofilament testing. Whilst some respondents felt that age affects skin elasticity and therefore would reduce sensory perception, it was noted that respondents reported anecdotal experience of visibly thickened skin affecting monofilament results, but that individual judgement needed to be applied, taking account of other factors such as progression and pattern of loss. It was noted that other QST such as VTT are not affected significantly by age (Lindsell at al, Seah at al), there was a paucity of evidence of normative data for monofilament testing for different occupational groups and there was no data regarding whether glabrous skin thickening occurred in other non-manual worker occupations. The consensus from round one was that age and occupational group should be considered when interpreting results of monofilament testing.

Requirement for QST if unable to sense 0.6 g-f or more

Those who agreed with the statement noted not all clinicians use the multi-filament sets (20 filaments), but this approach might increase sensitivity of screening for SN HAVS; it was also felt that age, thickened skin and other comorbidity such as diabetic neuropathy should be considered before referral for Tier 5 testing. Those who disagreed felt that a diagnosis of 1SN or early 2SN could be made without referral for Tier 5 testing and that QST should be considered on a case-by-case basis.

Use of 0.2 g-f cut-off of normality for monofilament testing

There was consensus that the use of a 0.2 g-f cut-off of normality for monofilament testing should be standard, but it was not clear to what extent visible skin thickening or calloused hands should affect interpretation of monofilament testing. One respondent opined that if there was uncertainty about whether skin thickening was affecting the sensory perception, then QST would address this as VTT (Pacinian corpuscles) and TA (smaller thermal nerve fibre endings) not being affected by skin thickening. The consensus from round two was that we should use a 0.2 g-f cut-off of normality for monofilament testing.

For round three there was universal agreement for each of the three statements. One comment that was repeated was that any diagnosis of SN HAVS should not rely on a single test but should be based on history and examination as well. Therefore, these statements should not be interpreted in isolation of other findings.

Topic 4 – Use of monofilaments for sensory testing (cont)

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3. Details of Delphi process

Topic 5 – Use of quantitative tests for routine health surveillance

Background

The HSE Guidance L140 does not require quantitative sensory (Tier 5) testing (QST) for the diagnosis of HAVS, depending instead on the clinical judgement of the doctor and taking account of the reported symptoms. It states that QST is considered potentially useful for studying the progression of the disease (HSE – Health surveillance – Guidance for Occupational Health Professionals). Testing for vascular HAVS is usually not required, with diagnosis and grading relying on clinical history and photographic evidence. For sensorineural HAVS, monofilaments alone may be suitable for the diagnosis of mild to moderate sensorineural HAVS, although others have recommended that two or more validated methods, such as monofilaments, thermal aesthesiometry and vibrotactile thresholds, are used routinely to determine sensory perception loss as part of the staging of HAVS (Cooke R 2020). The use of additional testing may depend on availability, the speed of onset of symptoms, the severity and reproducibility of symptoms, and exclusion of other conditions such as carpal tunnel syndrome, as well as cases where there is concern about continuing exposure to hand-transmitted vibration and potential medicolegal issues. In particular, QST may play a useful role in refining a sensorineural grading of 2SN into "early" and "late", and thereby contribute to the management of the affected worker and a decision to remove them from using vibrating tools and resultant impact on their employability (Poole 2019).

Consideration 5.1

	Agree	Disagree	Undecided
All cases of HAVS should be referred for Tier 5 assessment.		12 (100%)	

100% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

There is absence of evidence that QST is more effective than clinical tests in grading severity. It is possible that it reflects pathological change more accurately, but it remains subjective. The practical constraints make this approach impossible at present in the UK.

This is clearly unnecessary and practically unachievable.

I do not feel this is necessary with a straightforward HAVS diagnosis, and access to Tier 5 is also limited.

Tier 5 testing and QST do not add much for vascular HAVS as there are no validated and ethical QSTs to confirm diagnosis or help with staging.

All suspected new sensorineural cases in view of the variation in the sensory perception. Tier 5 is usually not required to make a diagnosis of vascular HAVS.

Rapidly progressing symptoms or disability. This would include increased frequency and extent of blanching over the course of three to six months or from Stage 0 to Stage 2 (vascular or sensorineural) at annual review.

All suspected late Stage 2 cases (vascular or sensorineural).

All Stage 3 cases (vascular or sensorineural).

1. If there is doubt about the diagnosis of HAVS.

2. Suspected Stage 2SN (early or late) or Stage 3SN cases as such a staging can lead to redeployment or job loss. For this reason, it should be done as accurately as possible.

3. Rapidly progressing symptoms, signs or disability associated with HAVS.

4. Challenging cases such as those with CTS and suspected co-morbid sensorineural HAVS, or those with vascular HAVS and an abnormal Allen's test.

Whilst not recommended for routine health surveillance by the HSE, an expectation on occupational health providers for more accurate staging to inform employment decisions is, in my opinion, likely to increase over the coming decade. Most European countries provide more widespread and multiple QSTs.

This would not be practical. As the diagnosis of 1SN HAVS is based on history without any requirement for there to be reduced sensory perception, testing would not add any value. Whether a Tier 5 is needed to differentiate early from late 2SN is a different issue.

Consideration 5.2

	Agree	Disagree	Undecided
Reduced sensory perception in sensory HAVS can be staged by using only one QST (monofilament).	7 (60%)	5 (40%)	

60% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

QST by definition is a battery of tests. So, it is not likely to be appropriate to use only one test.

Taking into consideration a clear history too.

Employment implications of 2V (early) and 2V (late) are vastly different. Smaller organisations may not be able to redeploy, with termination of employment contract the only option for 2V (late). It is possible to stage as 1V or 2V using the 2g or 4g (for older manual workers), but monofilaments do not assist with differentiation with Stage 2V or with 3V. A combination of QST gives a more rounded clinical picture if combined with clinical history. Even if there is additional cost to an employer for Tier 5 QST, the cost will be less than replacing (or not being able to replace) a highly skilled employee. People may overestimate or underestimate the intermittent/persistent nature of numbness/tingling without keeping a symptom diary. A combination of monofilaments and other QST helps with staging when retention of skills/experience is paramount to the success of a commercial enterprise.

For sensorineural HAVS, monofilaments alone may be suitable for the diagnosis of 1SN to 2SN early HAVS. It would be equally important to rule out CTS before a diagnosis of SN HAVS is made.

I think that sensory perception in sensory HAVS can be staged using only monofilaments, given that early and late Stage 2 can be differentiated by intermittent/persistent tingling/numbness. Where there is uncertainty over a person's sensory perception, given the variation found with age and type of work, then in my opinion, using a second QST would be advisable.

I believe many cases with reduced sensory perception can be staged using one QST.

Consideration 5.3

	Agree	Disagree	Undecided
QST may play a useful role in refining a sensorineural grading of 2_{SN} into "early" and "late".	7 (58%)		5 (42%)

58% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

Agree. Although not specific to, or diagnostic of, HAVS, VTT and TA have been shown to have clinical utility in staging both severity and supporting anamnesis of symptomatic against asymptomatic fingers (McGeoch 2004, Ye et al 2018, Poole et al 2019). In addition, Ye et al concluded there is evidence to suggest that cold thresholds have greater sensitivity and specificity than warm thresholds for detecting mild and early sensory damage. A dose response relationship with QST has been documented in several studies (Sauni et al 2009, Virokannes 1995, Bovenzi 2011, Clemm 2020).

The distinction between early and late Stage 2 should be made clinically. Practically, this also involves consideration of rate of change of symptoms, employee age, employment and availability of work adjustments. A negative QST should not overturn a clinical decision to grade late.

Would it distinguish between intermittent or persistent symptoms between early and late? These are based on a good history, so it may help but it isn't the only way of distinguishing between Stage 2 early or late. History is just as important.

On a case-by-case basis, there remains a role for QST to support OHPs with those cases where 2SN late may be present in order to support decision-making on continued exposure to hand-arm vibration.

As above, I don't necessarily think this is required for defining disease into 2SN early and late, as this is decided on the persistence of the tingling and numbness, alongside reduced sensory perception. So, once the reduced sensory perception has been identified, the grading into early and late is decided on the frequency of the symptoms.

I agree that this may be helpful in refining grading in some cases.

Consideration 5.4

	Agree	Disagree	Undecided
Reduced sensory perception in sensory HAVS can be staged by using only one QST (monofilament).	6 (60%)	4 (40%)	1

60% of respondents agreed with this statement. Consensus not achieved.

Moderator's note – Responses given mirrored the responses to the same question in Round 1.

Moderator's summary of conclusions regarding criteria for use of quantitative tests for routine health surveillance

There was unanimous disagreement with this statement (100% from 12 respondents) that Tier 5 testing was required for all cases of HAVS. Many cited that Tier 5 testing for vascular HAVS would be unlikely to add anything to the diagnosis and staging, and Tier 5 testing was not widely available in the UK. Tier 5 testing should be reserved for sensorineural and more complicated, higher stage cases.

There was no overall consensus on the use of QST in separating Stage 2SN into early and late cases although no one was in disagreement in their use (agreement 7, undecided 5). Many felt Tier 5 testing may be useful in difficult or unclear cases, particularly if there were legal or employment implications. However, on repeating this question, there was an overall consensus of agreement in this statement (agreement 9, disagreement 2). As before, many felt that Tier 5 testing would be useful in difficult cases where individuals could be removed from using vibrating tools.

Many felt that for straightforward sensorineural HAVS cases, a single QST (monofilaments) was sufficient to detect reduced sensation and the HSE did not require Tier 5 testing. Cost of Tier 5 testing was also cited. Others felt more than one QST test was needed as they test different nerve fibres and mechanoreceptors, and some cases may go undetected.

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3. Details of Delphi process

Topic 6 – Peripheral neuropathy and sensorineural HAVS

Background

Health surveillance must be provided for vibration-exposed employees who are 'at particular risk even if exposure in the current job is below the EAV' (HSE Guidance L140, 2019).

Health surveillance for sensory hand-arm vibration includes monofilament testing (pressure threshold) and two-point discrimination. Tier 5 health surveillance includes vibrotactile perception threshold testing (VPT). Many type 2 diabetics without neurological hand or finger symptoms have abnormal pressure thresholds (monofilament testing), two-point discrimination and reduced vibration sensation (VPT testing). Additional reduction in sensibility due to early stages of hand-arm vibration syndrome (HAVS) would be undetectable in some employees with type 2 diabetes as health surveillance for hand-arm vibration syndrome relies on monofilament testing, two-point discrimination and vibrotactile perception threshold assessment. All the sensations were found to be decreased in a diabetic group, as compared to a non-diabetic group. Though no symptoms were reported by these patients, the clinical evaluation of the sensations revealed the changes. Severity of the [diabetic] neuropathy increases as the duration of type 2 DM increases (Sarkar 2011).

Tier 5 health surveillance includes VPT. Many with type 2 diabetes mellitus (DM), without neurological hand or finger symptoms, have abnormal pressure thresholds (monofilament testing), two-point discrimination and reduced vibration sensation (VPT testing) (Sarkar 2011). Additional reduction in sensibility due to co-existing CTS would be undetectable in employees with type 2 DM if health surveillance for hand-arm vibration syndrome relied on VPT.

Participants were asked to consider the high prevalence of CTS and diabetic peripheral neuropathy (DPN) in patients with type 2 DM (Naha 2023, Zimmerman 2022). The most sensitive test for CTS diagnosis in the clinical setting was the Semmes–Weinstein monofilament test (3.22 monofilament size equivalent to the blue 0.2 g-f of the WEST monofilament kit as normal threshold) in any radial finger and potentially useful as a screening tool and examination. This is likely to be particularly relevant where examination of sensation in the little finger reveals no reduction of sensitivity (Dabbagh 2021).

Diabetic neuropathy might mask the symptoms of neurological HAVS or make it difficult to determine the contributions of hand-transmitted vibration to the neuropathy. Watson et al (2015) noted that 'diabetic neuropathy can take many forms. A chronic, length-dependent, sensorimotor peripheral neuropathy is the most common form. It is a late complication of poorly controlled diabetes. It usually occurs with other late microvascular complications of diabetes mellitus, namely retinopathy and nephropathy. This association is so strong that if there is no clinical evidence of retinopathy or nephropathy in a patient with suspected diabetic distal symmetric neuropathy, alternative nondiabetic aetiologies should be considered in up to 10% of diabetic patients, and neurologic deficits can be attributed to an alternative cause'. Diabetes can cause other patterns of neuropathy including mononeuropathies, thoracic radiculopathy, length-independent polyradiculoneuropathy, and diabetic lumbosacral radiculoplexus neuropathy (also known as diabetic amyotrophy).

It is unclear whether a common law claim for SN HAVS would succeed if there was evidence of an alternative condition such as diabetic neuropathy to account for symptoms (Montracon v Whalley 2005).

Consideration 6.1			
Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to hand-transmitted vibration (HTV) should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and have a health surveillance assessment initially every six months for the first two years by a clinician trained in detecting and diagnosing HAVS. If there is no evidence of progressive neurological deficit in the first two years, annual health surveillance should be considered if working with HTV.	Agree 11 (92%)	Disagree 1 (8%)	Undecided

92% of respondents agreed with this statement. Consensus achieved.

Comments from participants

The difficulty I see is identifying those who are at particular risk, given the lack of epidemiological data. Hence, while I have put "agreed", that really reflects my view that those with conditions which could present similarly to HAVS/CTS be subject to health surveillance, even if below EAV.

I would agree that more frequent health surveillance initially seems like a sensible approach.

This seems a pragmatic sensible way forward to give additional surveillance of those at higher risk of neuropathy (i.e. diabetics) exposed to HTV without going as far as needing Tier 5 testing that is not widely available in the UK and does not have the capacity to deal with the number of those possibly needing Tier 5 testing if it was needed for all diabetics.

Agreed this seems to be a sensible approach for those who may be at higher risk of HTV health effects and therefore increased health surveillance is likely to diagnose progression early and implement additional control measures or restrictions as indicated clinically.

Whilst this approach might seem reasonable for individuals with existing peripheral neuropathy/neurological symptoms starting work with HTV for the first time, the decision about frequency should be made on a case-by-case basis. Keeping exposure ALARP and considering aspects of the medical history of relevance in the context of the pre-existing symptoms will all form part of the decision-making process. Enhanced surveillance definitely, but six-monthly face-to-face reviews for everyone for the first two years may be excessive. There may be a role for the enhanced use of Tier 2 type questionnaires in some of these cases between face-to-face reviews.

Not sure about the six-month surveillance schedule – an alternative would be a Tier 3 for two years and to replace just a Tier 1 and then 2 as better practice.

Consideration 6.2

Those with diabetes mellitus (DM) are at higher risk of carpal tunnel syndrome (CTS). Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS. Those with DM should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV. The QST should be monofilament testing at least. Any progression in neurological deficit detected from the history or from the QST should be referred for vibrotactile perception threshold (VPT) testing, thermal aesthesiometry (TA) and multi-segmental nerve conduction studies (NCS).	Agree 6 (50%)	Disagree 3 (25%)	Undecided 3 (25%)

50% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

I wonder if in these cases the use of the long monofilament set might be more appropriate to detect more subtle changes.

To be pedantic, it is work with vibratory tools and not vibration exposure per se that increases risk of CTS, although in practice the same group of people will require surveillance.

I agree that sensory testing with monofilaments is appropriate for those with DM, and that there is a good argument for doing that annually, since some sensory loss may develop without the individual being aware.

The difficulty with VTT and TA is then that of interpretation – is the identified deficit due to DM or S/N HAVS? So my approach would be to ask for NCS initially if a deficit is found in someone with DM, and then review against background fo those results. Very difficult

I agree with the fact that those working with HTV who have DM should have a minimum or monofilament testing at baseline and then at regular intervals. I remain undecided as to whether VPT, TA and NCS would be required in all with a progressing neurological deficit, and I would probably want to assess this on a case-by-case basis.

I agree that diabetics should have one QST (monofilament) testing. If they have symptoms suggestive of CTS, then NCS should be arranged. Other testing such as VPT and TA (as part of a Tier 5 assessment) may be indicated in some cases where symptoms are not clinically most likely CTS, but these tests are not widely available.

A baseline with Tier 4 including monofilament testing as a minimum to support future reviews/follow-up and comparison in subsequent assessments would be appropriate, in order to refer for more specialised assessment as necessary.

I suggest that there be consideration of some clinician discretion as to which tests/investigations may be appropriate in the event of progression in neurological deficit.

The decision to refer for further investigation will need to be taken on a case-by-case basis. If there is evidence of progression of neurological deficit detected from either the history or the QST (monofilament testing) at Tier 4, the OH advice with regards to ongoing exposure to HTV in someone with a known underlying vulnerability is likely to involve reducing or ceasing exposure. The aim of HAVS health surveillance is to prevent symptoms progressing to the level at which they affect hand function/dexterity and so where there is evidence of progression most OHPs will adopt a cautious approach, regardless of actual causation. In some ways, therefore, referring all such cases for further investigation is unlikely to affect their management occupationally and might only be of value if likely to result in treatment such as CTS surgery or other similar intervention.

Monofilament testing is not that sensitive. A good history of CTS symptoms is a better approach, and a history would necessitate onwards referral. Access to Tier 5 testing is very limited within a high prevalence of CTS in DM.

Consideration 6.3

Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to HTV should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and have a health surveillance assessment annually by a clinician trained in detecting and diagnosing HAVS.	Agree 9 (75%)	Disagree	Undecided 3 (25%)

75% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Whilst I have no doubt that these workers require some form of enhanced surveillance, I wonder if they might also require some exposure limitation. Thereafter, I am not clear if the surveillance should be by questionnaire or by physical review or a combination of these.

It is plausible that the risk of developing neurological injury from HTV and having DM is multiplicative. To my knowledge, this has not been confirmed epidemiologically, and the risk is likely to vary considerably from person to person. Therefore, there is a potentially significant but undefined risk in such people. We know that the EAV does not represent zero risk of developing HAVS/CTS, and I am mindful of the points made by xxx at a recent meeting, arguing for HS provision to those exposed below the EAV. It seems sensible to me to provide HS to people who are potentially at higher risk from HTV, even if the exposure estimated by the employer is below the EAV. However, I am not convinced that this needs to be face to face. A Tier 2 questionnaire may suffice.

Also, it is important to fully document that the employee is advised of the risk, but that it cannot be quantified in terms of likelihood or of likely time before any changes occur.

Annual health surveillance would be advisable in a person with newly diagnosed neuropathy to monitor for progression etc. Arguably, if the neuropathy is mild, has been present for an established period and is not progressive, health surveillance frequency in terms of examination may be reconsidered on a case-by-case basis. In addition, it may be appropriate to include advice to the employer on keeping the exposure below the EAV. Would be good to know if this is something other OHPs would advise in cases like this.

Whilst I agree it would seem appropriate, because of a theoretical and/or potential synergistic risk, I suggest that surveillance should be six monthly for the first two years.

Consideration could be given to more frequent than annual, particularly for the first two years, for example, to ensure no significant deterioration.

Exposure below the EAV does not mean that symptoms cannot progress and those at particular risk should have enhanced surveillance. Whilst it might be hard to know if progression of symptoms is related to low-level vibration exposure, it will be important to consider removing those with evidence of progression from exposure if symptoms have potential to impact on hand function/dexterity.

Consideration 6.4

Those with diabetes mellitus are at higher risk of CTS. Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS. Those with diabetes mellitus should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV.	Agree 3 (25%)	Disagree 4 (33%)	Undecided 5 (42%)

25% of respondents agreed and **33%** disagreed with this statement. Consensus not achieved.

Comments from participants

The prevalence of DM is high. Sarkar's study looked at a hospital clinic population and, from the abstract, I am unclear whether the DM group was homogenous, i.e. a variety of severity and duration of DM or those with longer standing DM. Is a newly diagnosed diabetic treated with diet at significantly less risk of developing CTS than a longer standing diabetic requiring insulin? I suppose it depends on the duration and degree of hyperglycaemia and subsequent degree of oxidative stress. There is evidence that Type 1 is a higher risk than Type 2, and sex also plays a part (Ref 1). Therefore, a blanket requirement for Tier 5 assessment for all workers might not be required, but we could suggest that all new workers undergo a Tier 4 assessment and if any abnormalities are found in monofilament testing, they undergo Tier 5 assessment.

Ref 1. Zimmerman M et al. Carpal Tunnel Syndrome and Diabetes–A Comprehensive Review. J Clin Med. 2022; 11(6): 1674. https://doi.org/10.3390/jcm11061674

I think it would be sensible to conduct baseline QST for these employees, but I cannot see the benefit of repeating QST unless normal HS indicates reported symptoms. If symptoms are reported, then further QST can occur. Even then, it will form part of the clinical picture rather than deciding the outcome.

I agree entirely with the logic of this statement. From a practical perspective, I would support regular neurological assessment – monofilaments, 2PD – as routine, with referral for NCS or QST based on PHP judgement. I am not aware of any evidence to suggest what interval should be used for repeat QST if these were to be done routinely in these circumstances. Also, managing asymptomatic employees with abnormal test results is likely to be challenging unless there is evidence of functional incapacity affecting ability to work, or evidence of rate of deterioration – which is not available for HAVS, and I am not aware of such for diabetic peripheral neuropathy.

I do think an additional nerve conduction study may be needed since diabetes, HAVS and CTS all give similar sensory symptoms.

I would agree with baseline monofilaments and then annual monofilament assessment. On the other hand, VTT and TA as baseline health surveillance would be difficult to achieve due to limited expertise and Tier 5 centres in the UK.

Sensory tests undertaken in the OH clinic are subjective and should not be seen as a definitive indicator of normal/abnormal sensation. The prevalence of diabetes in the UK is such that undertaking this type of enhanced baseline screening for all diabetics prior to HTV tool work would be disproportionate to the risk, especially taking into account sub-optimal OH clinic sensory testing methods/outcomes.

The QST deployed should be a minimum of monofilaments but, if available, VTT and TA. Any emerging sensory history should be investigated by the latter, plus NCS, to determine whether the site of putative damage is at receptor level (peripheral neuropathy) or nerve trunk (compression such as CTS). Abnormalities in QST are not specific to HAVS, so attribution of any emerging peripheral neuropathy would still be problematic. Dabbagh et al 2021 also indicated a role for monofilaments in CTS diagnosis.

Consideration 6.4

Comments from participants (cont)

Quote from the SOM publication on DD: 'The review found the most sensitive test for CTS diagnosis in the clinical setting was the Semmes Weinstein monofilament test (3.22 monofilament size equivalent to the blue 0.2 g-f of the WEST monofilament kit as normal threshold), in any radial finger (SN values 49% to 96%), and potentially useful as a screening tool and examination. This is likely to be particularly relevant where examination of sensation in the little finger reveals no reduction of sensitivity.'

Reference: Dabbagh A, MacDermid JC, Yong J. et al. Diagnostic accuracy of sensory and motor tests for the diagnosis of carpal tunnel syndrome: a systematic review. BMC Musculoskelet Disord. 2021; 22(1): 337. https://doi.org/10.1186/s12891-021-04202-y

I do not feel that would be appropriate in every case. Enhanced surveillance for those at risk of developing peripheral neuropathy may be appropriate and QST should be considered on a case-by-case basis.

This would not be practically or commercially possible and because of the high prevalence of diabetes within those exposed and the lack of access to QST.

Consideration 6.5

To mitigate legal risks for an employer associated with the diagnosis of late-stage neurological hand-arm vibration syndrome (HAVS), employees with diabetes mellitus should be excluded from exposure to hand-transmitted vibration (HTV).	Agree	Disagree 11 (92%)	Undecided 1 (8%)

92% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

The argument to exclude workers with diabetes from HTV exposure is that additional reduction in sensibility due to early stages of hand-arm vibration syndrome would be undetectable in some employees with type 2 diabetes. However, sensory tests undertaken in the OH clinic are subjective and semi-quantitative and should not be seen as a definitive indicator of normality, but instead be interpreted taking consideration of the overall presentation (including symptom and occupational history). I am therefore not convinced that it is reasonable to exclude all diabetics from HTV work.

Diabetes clearly affects a large number of people of working age and is increasing in prevalence. Excluding everyone with diabetes from work with HTV would be a disproportionate response to the risk. Practical mitigation could include limiting exposure of workers with DM to the EAV.

It is well recognised that diabetic neuropathy may affect the fingers and that neuropathy of the fingers may be the first presentation of diabetes, and that clinical differentiation may be difficult when using clinical measures such as monofilaments or two-point discrimination. I am not aware of epidemiological evidence that other forms of peripheral neuropathy predispose to SN HAVS, but logic dictates that a combined effect of two neuropathies is likely to be more severe than one alone.

Consideration 6.5

Comments from participants (cont)

Diabetic neuropathy is a late complication of poorly managed diabetes. Those adequately managed may not present with it. I think it is not reasonable to exclude employees with diabetes that is well managed in exposure to HTV. Also, reduction in sensibility is common to both HAVS and diabetes and can occur in persons who carry out heavy manual duties. It is therefore in my opinion not a good discriminator to exclude employees.

There are 3.9 million people in the UK with diabetes. To exclude all of those of working age from exposure to hand-transmitted vibration would be detrimental to the industry and the employee's autonomy to do work of their choice. Systematic health surveillance, and at baseline, while exposed, would identify the proportion of diabetics who do have peripheral neuropathy of hands/fingers. Where there is progression of symptoms, diabetic control can be taken into account, and if a diabetic employee has poor insight or does not manage their diabetes, a recommendation about future exposure can be made to the employer.

Preventing individuals with diabetes to work with HTV would be considered direct discrimination.

Not all diabetics progress to developing peripheral neuropathy, so a blanket ban approach would be unwise.

Additionally, the emphasis of health surveillance and working with vibrating tools would be for employers to control exposure and prevent the development of HAVS in the first instance. (a) A case-by-case risk assessment approach would be more sensible, in my view, e.g. optimal diabetes control to be encouraged and health promotion of the individual in this regard. More regular health surveillance in certain cases where risks are identified, such as suboptimal diabetic control and already established end organ damage, e.g. retinopathy/nephropathy.

(b) What advice should be offered to those with peripheral neuropathy/neurological symptoms similar to HAVS and wishing to work with exposure to HTV?

A risk-based case-by-case approach to consider the following:

In the first instance, establish the correct diagnosis in any diabetic with neurological symptoms working with HTV tools – i.e. by obtaining further medical evidence from the GP/endocrinologist to confirm whether from their perspective the individual has a diagnosis of diabetes-related peripheral neuropathy.

Could this be CTS as it is a common phenomenon in diabetics?

Advice to the employer in terms of keeping exposure ALARP/below 100 points a week.

More regular or enhanced annual F2F health surveillance to monitor symptoms.

Can nerve conduction studies be used to assist diagnosis? What other tests could the OHP consider to assist with clinical assessment, if not monofilaments/VPT etc. for diabetic employees? Tbc, I have looked at additional research evidence and papers but found nothing else to support this review. Perhaps a common consensus approach with other senior OHPs would be the best approach here.

I have disagreed because the evidence is that someone with diabetes does not necessarily develop a peripheral neuropathy or, even if they did, it would manifest in lower limbs first and therefore prompt an opportunity to discuss further then. Yet, it would be good practice to advise individuals with diabetes that there may be a theoretical additional risk to sensory loss, offer the opportunity for more frequent surveillance, and encourage them to inform the OHA if any upper or lower limb symptoms develop or peripheral neuropathy is diagnosed.

The Watson paper goes on to say: 'The most common pattern of clinical involvement is that of a length-dependent peripheral neuropathy. This form of neuropathy is symmetric, and symptoms begin in the longest nerves at their terminals (i.e. distal foot). Negative (lack of feeling) or positive (prickling, tingling, burning) sensory symptoms usually precede motor weakness. The symptoms ascend insidiously up the leg, with hand symptoms often becoming evident around the time leg symptoms approach the knee. Upper limb involvement may never occur.' It would therefore seem to be unfairly restrictive to have a blanket restriction on all those with a history of diabetes mellitus.

Consideration 6.5

Comments from participants (cont)

I have disagreed because the evidence is that someone with diabetes does not necessarily develop a peripheral neuropathy or, even if they did, it would manifest in lower limbs first and therefore prompt an opportunity to discuss further then. Yet, it would be good practice to advise individuals with diabetes that there may be a theoretical additional risk to sensory loss, offer the opportunity for more frequent surveillance, and encourage them to inform the OHA if any upper or lower limb symptoms develop or peripheral neuropathy is diagnosed.

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Employers accept a risk of 10% of a group developing HAVS at the EAV. Is the individual risk any greater for diabetics?

The Sarkar paper referred to >5 yrs type 2 diabetes in a study pop 40–82 age group, so my comments are also particularly relevant to a younger age group who should not be discriminated against because of a history of type 1 diabetes. Also, QST such as vibrotactile thresholds can be elevated in vibration exposed with no symptoms. Sensory HAVS is diagnosed on symptoms and QST assists with staging severity. So, some diabetics exposed to vibration may be asymptomatic but show abnormalities in QST. Decisions on diagnosis should only be based on symptoms; changes in QST are not sensitive enough on their own.

In summary, the employee should be informed of the potential risks and difficulties with attribution should sensory symptoms arise so they can make an informed decision and determine whether to avoid working with handheld vibrating tools or not (and with consent, the employer should be informed that the individual is fit for work but has been informed that there may be a potential increased risk from working with HTV). In addition, the individual should be informed that both working with vibrating tools and type 2 diabetes is a risk factor for the development of CTS. Should they decide to work with HTV, then baseline QST should be carried out, despite the caveats above and repeated at six months or earlier should any relevant symptoms arise and then annually thereafter. Irrespective of the risk (with no evidence of any synergy of vibration and diabetes), if sensory symptoms develop (with or without worsening of QST), then attribution should be based on clinical probability, i.e. sensory symptoms in the hands – in the absence of peripheral neuropathy in the feet – is more likely to be sensory HAVS. Then a further discussion of risk etc. can take place.

I think there would certainly be an argument for enhanced surveillance with routine annual Tier 3 or potentially Tier 4 assessments rather than Tier 2 to ensure that a clinical examination was being performed. Whilst monofilament testing and two-point discrimination might not be useful, dexterity using the pegboard can be assessed and scores from previous assessments compared. A history can be taken and evidence of any functional effects of neuropathy will hopefully be picked up early. What we are aiming to avoid is impairment of function, i.e. impaired dexterity, and so (at the moment) I would recommend enhanced face-to-face surveillance, even though the neurological tests may not be that helpful.

Statement to restrict HTV to everyone with diabetes mellitus is too broad. According to Diabetes UK, prevalence of DM is around 7%, or 1:16 people, which has huge workforce and employment implications. Suggesting restricting use could apply to at-risk individuals with an obvious neuropathy or take into consideration the length of diagnosis or associated complications.

A thorough history should be considered within health surveillance, too, rather than relying on just the clinical examination.

Topic 6 – Peripheral neuropathy and sensorineural HAVS (cont)

Evidence considered

1. Dabbagh A, MacDermid JC, Yong J et al. Diagnostic accuracy of sensory and motor tests for the diagnosis of carpal tunnel syndrome: a systematic review. BMC Musculoskelet Disord. 2021; 22: 337. https://doi.org/10.1186/s12891-021- 04202-y
2. HSE Hand-arm Vibration: The Control of Vibration at Work Regulations 2005 (L140) p44.
3. Montracon vs Whalley Case No: B3/2005/0017 Neutral Citation Number: [2005] EWCA Civ 1383.
4. Naha U, Miller A, Patetta MJ et al. The Interaction of Diabetic Peripheral Neuropathy and Carpal Tunnel Syndrome. Hand 2023; 18(1_suppl): 43S–47S. https://doi.org/10.1177/15589447211014607
5. Pandey A, Usman K, Reddy H, Gutch M, Jain N and Qidwai S. Prevalence of hand disorders in type 2 diabetes mellitus and its correlation with microvascular complications. Ann Med Health Sci Res. 2013; 3(3): 349–54.
doi: 10.4103/2141-9248.117942. PMID: 24116312; PMCID: PMC3793438.
6. Sarkar S, Eapen C and Adhikari P. Sensory changes in the upper limb in type 2 diabetic patients - A case control study. Journal of Clinical and Diagnostic Research 2011; 5(1):96–100.
7. Watson JC, Dyck PJ. Peripheral Neuropathy: A Practical Approach to Diagnosis and Symptom Management. Mayo Clin Proc. 2015; 90(7): 940–951. doi: 10.1016/j.mayocp.2015.05.004
8. Zimmerman M et al. Carpal Tunnel Syndrome and Diabetes–A Comprehensive Review. J Clin Med. 2022; 11(6): 1674. https://doi.org/10.3390/jcm11061674

3. Details of Delphi process

Topic 7 – Carpal tunnel syndrome

Background

The association between use of vibratory tools and CTS is generally acknowledged. Gillibrand and others found no evidence of a dose response relationship for exposures below the ELV (Gillibrand 2016).

Some regard nerve conduction as the gold standard for diagnosis of CTS, and there are a number of clinical approaches to diagnosis without nerve conduction studies:

- Primary Care Rheumatology (now the Primary Care Rheumatology and Musculoskeletal Society) – Burton C, Chesterton LS, Davenport G. Diagnosing and managing carpal tunnel syndrome in primary care. Brit J Gen Pract. 2014; 64(622): 262–3. doi: 10.3399/bjgp14X679903
- CTS-6 – Graham B. The Value Added by Electrodiagnostic Testing in the Diagnosis of Carpal Tunnel Syndrome. Bone Joint Surg Am. 2008; 90(12): 2587–93. doi: 10.2106/JBJS.G.01362
- Boston Carpal Tunnel Questionnaire and CTS-6 – Multanen J et al. Structural validity of the Boston Carpal Tunnel Questionnaire and its short version, the 6-Item CTS symptoms scale: a Rasch analysis one year after surgery. BMC Musculoskeletal Disorders 2020; 21(609).

There is a range of sensitivity and specificity reported for nerve conduction studies (NCS), relating in part to the diagnosis used for comparison – i.e. surgical findings, relief of symptoms or clinical diagnosis – making it difficult to compare different studies and data. When using a selection of parameters (i.e. not just nerve conduction velocity), the sensitivity of nerve conduction studies has been reported as 75% (Lew 2005). Studies considering clinical diagnosis with symptom relief after surgery as the diagnostic standard found NCS sensitivities of 74% and 78% (Atroshi 2003). These studies suggest that NCS are expected to positively identify, or confirm, only about 75% of those with CTS, although specificity (ability to detect those without CTS) of NCS is significantly higher.

The Industrial Injuries Benefits Handbook 2 notes that 'nerve conduction studies are not essential if the diagnosis (of CTS) can be made on the basis of history and clinical findings'. The National Institute for Health and Care Excellence (NICE) notes that 'guidelines for healthcare commissioning from the British Society for Surgery of the Hand, the British Orthopaedic Association and the Royal College of Surgeons of England state that nerve conduction studies are not indicated in primary care'. In other words, a clinical diagnosis can be made of CTS. NICE also notes that NCS should be reserved for situation where there is diagnostic doubt, complex cases, or if symptoms recur after initial surgery (Middleton 2014).

Consideration 7.1

	Agree	Disagree	Undecided
Cases of suspected CTS from history and examination should be referred for nerve conduction studies (NCS) before confirming diagnosis.	3 (30%)	7 (70%)	

70% of respondents disagreed with this statement. Consensus not achieved.

Comments from participants

Many cases are clear cut with classic symptoms, and a clinical diagnosis can be confidently made particularly if using the PCRS guidelines. If blanching is also present or the clinical findings/history are equivocal, the case for referral for NCS becomes stronger and I would refer.

For those exposed to vibration, since the sensorineural symptoms of HAVS may be similar to CTS, NCS should be done before diagnosis as the specificity is very high. If not exposed to vibration, NCS is not necessary.

Particularly with atypical presentations or differential diagnosis of either other upper limb entrapments or to determine the level of damage, i.e. HAVS (Lawson 2016). Also to confirm degree of compression (Szarbo 1992, Sonoo 2018), which may affect advice on treatment options and initial restrictions.

Clinical diagnosis should be relied upon for most cases, but some might require NCS; I am unsure what criteria should be used for this, though.

There is an overlap of symptoms between various upper limb conditions, e.g. CTS, HAVS or other nerve entrapments higher up in the arm/shoulder/neck, or Guyon's/ulnar nerve entrapment. Therefore, relying on clinical history and examination alone is not sufficient in an occupational health setting. Additionally, as the condition is RIDDOR reportable and there is some degree of certainty of the diagnosis, it would be prudent before recommending to an employer in relation to RIDDOR.

If there is significant diagnostic certainty from history and examination alone, then I would suggest that nerve conduction studies are not required. However, if there is any doubt about the diagnosis, then, in my opinion, nerve conduction studies should be done.

From a practicable point of view, NCS are not always easily available, with GPs often reluctant to refer for occupational cases and, similarly, employers reluctant to fund as they are not mandated by the HSE for diagnosis. Where the symptoms are mild and the vibration exposure is low, bearing in mind that there is no recognised "safe" exposure related to CTS and that often ergonomic factors are the main issue rather than vibration exposure, I would be happy for the individual to continue to use vibrating tools subject to periodic review and their symptoms not worsening.

Noted the sensitivity of NCS for CTS is circa 75% (Lew H et al). In my opinion, NCS is useful due to its specificity for CTS. Employers might be visited by the HSE for an inspection when reporting a case of CTS under RIDDOR and it's the employer who has to carry the costs of an inspection. Legal claims often arise from a diagnosis of CTS if the OH physician gives the view it is likely to be a case of v-CTS attributed to work. NCS has a high specificity for CTS, and suspected cases of CTS with a negative NCS despite the symptoms and history being consistent with CTS do need to be assessed carefully for a differential diagnosis before clinically confirming CTS and attributing to HTV (if NCS negative).

Ahmed et al [2] recommend NCS as part of a HAVS assessment due to high prevalence of compressive neuropathy in people with neurological symptoms in their hands/fingers. In my opinion, it would be excessive to include NCS in health surveillance programmes routinely due to the high cost for the employer and the availability of neurophysiology resources in England. However, cases with symptoms consistent with CTS should be referred for NCS, even if negative results would not necessarily exclude the possibility of CTS (for reasons stated above).

Consideration 7.2

	Agree	Disagree	Undecided
Cases of suspected CTS should be restricted from using hand-vibrating tools until investigation and treatment is completed.	6 (60%)	4 (40%)	

60% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

I would look at each case on its merits, and the advice would depend on the severity of symptoms and the nature of work.
I would certainly advise keeping exposure ALARP below the EAV and as close to the "no harmful effect level" as possible.
I would generally restrict those with very severe or recurring symptoms (e.g. following surgery).

Since there is no evidence of a dose response relationship for exposure below the ELV , such employees may continue using vibratory tools, on the advice that they keep exposure below the ELV .

Mostly yes but grading into mild, moderate or severe by use of NCS (particularly where POCT-NCS is available, Lawson 2019) may assist in determining whether temporary workplace restrictions are necessary whilst awaiting treatment, i.e. allowing employees to continue exposure in mild cases in conjunction with nocturnal splinting.

If an injury is suspected and clinically likely, then appropriate mitigations/treatment should be offered before considering unrestricted HTV exposure.

One of the important objectives of health surveillance is to detect work-related ill health early and prevent worsening of the condition.

If the carpal tunnel syndrome appears to be triggered by ergonomic factors rather than vibration, I would suggest that the ergonomic factors be addressed, and in this case, it would not necessarily be essential to restrict the person from using
hand-vibrating tools.

If the symptoms are attributable to vibration, but are mild, then restriction to 100 points could be considered initially.

I would only restrict them to the EAV initially unless their symptoms were severe and there were safety concerns such as very poor grip strength, making holding tools unsafe. As said, the cause of CTS is often multifactorial – often an ergonomic issue as well as a vibration issue, weight, etc.

Gillibrand et al found no evidence for dose response relationship between CTS and HTV, and therefore reduction in exposure while waiting for definitive investigation/treatment would not necessarily reduce the risk of progression. Delayed investigation or administrative errors in health surveillance recall may result in more advanced CTS when conclusions are reached. In my opinion, advice should be to avoid HTV until fully assessed.

Consideration 7.3

	Agree	Disagree	Undecided
Cases of a recurrence of CTS should be permanently restricted from using vibrating tools.	6 (60%)		4 (40%)

60% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

I do generally restrict those with recurrent CTS symptoms, but I also advise looking at the work tasks to see if repetitive forceful extension/flexion activities involving the wrist and forceful gripping tasks can be minimised. Cases do need to be looked at individually, along with the severity of recurrent symptoms, the age of the individual, and the wish to continue working despite symptoms. Keeping exposure ALARP and close to 16 points (i.e. well below the EAV) may be an option as opposed to total restriction.

This should be advisory, though, and left to the employee and management to take the decision. It is likely to be guided by employee choice, skills and availability of job options.

If CTS is adequately treated, advise on potential risks to allow an informed choice with regard to returning to work with vibrating tools. If there is then a recurrence of symptoms, exposure would lead to a recommendation to cease exposure permanently.

For most cases, possibly; however, it depends on what treatment they had to help resolve it initially. If splints were used but now decompression is indicated (and works), then they should be allowed to return (as long as other workplace risk factors such as ergonomics have been addressed).

A case-by-case approach is prudent. If the recurrence is after surgical correction and no further treatment can be offered, yes, consideration may need to be given to prevent further exposure, or at least restrict from tool use for a period of time, undertake local risk assessment to avoid other possible causative factors (e.g. ergonomic/forceful extension and flexion of the wrist; night splints) and review after to assess response.

In regards to the causation of CTS – to consider if the HAV tool use is linked to ergonomic risks (e.g. repetitive flexion and extension of the wrist), all these considerations would be prudent for the OHS clinician to assess on a case-by-case basis.

Yes – where the CTS has likely been caused by the vibration exposure.

Very much depends on the individual circumstances, the amount of tool use, the degree of symptoms, and the individual's and the employer's acceptance etc.

Potentially yes due to the risk of LT symptoms/impairment, but would need to be considered on a case-by-case basis with risk assessment, including the amount of vibrating tool use.

"Recurrent" implies that the employee with CTS may have been monitored by increased frequency of health surveillance and CTS recurred nonetheless. In my opinion, if recurrent despite monitoring and risk reduction (hierarchy of control), advice should be to not work with HTV again. The hierarchy of control should take into account other occupational risk factors for recurrence or progression of CTS, such as high force and high repetition, when someone has CTS attributed to work – see Hassan et al [1].

Consideration 7.4

	Agree	Disagree	Undecided
Cases of suspected CTS from history and examination should be referred for nerve conduction studies before confirming diagnosis.	7 (70%)	2 (20%)	1 (10%)

70% of respondents agreed with this statement. Consensus not achieved.

Comments from participants

I would generally not advise RIDDOR without a specialist opinion, surgery or NCS results.

For "classic" cases, clinical diagnosis may be relied upon using the PCRS criteria. However, more complex (criteria as yet undefined) cases may require NCS referral.

I have changed my opinion on this one, as although I don't think NCS are always required for making a diagnosis of NCS, I can see how having the diagnosis confirmed by NCS may be helpful for the employer and the employee. If the CTS is negative, this obviously would not exclude that as a diagnosis.

CTS symptoms are not always "classic" in their presentation. Using the Primary Care Rheumatological Society (now the Primary Care Rheumatology and Musculoskeletal Society) diagnostic criteria is a good approach to diagnosis, and in my experience many cases in practice do not spare the fourth and fifth finger in terms of tingling etc. Additionally, the diagnosis is RIDDOR reportable and there are implications to consider for the reporting employer/subsequent HSE investigations. Therefore, my practice would be to have a high degree of certainty before diagnosing CTS and advising re RIDDOR.

Yes, whilst the diagnosis can be made clinically, and restrictions made, whenever possible, NCS should be arranged. In many cases, this requires the GP to be involved and, in my experience, there has been reluctance to refer for investigations.

Cases of "suspected" CTS that do not meet the threshold for confident clinical diagnosis using diagnostic criteria such as PCRS should be referred for nerve conduction studies before confirming the diagnosis. I would not consider referral necessary if history and clinical findings were sufficient to make a confident diagnosis using accepted diagnostic criteria.

NCS has a high specificity for CTS (approx. 75%). Suspected cases of CTS with negative NCS (despite the symptoms and history being consistent with CTS) do need to be assessed carefully for a differential diagnosis before clinically confirming CTS and attributing CTS to HTV. However, cases with history and symptoms consistent with CTS, but with negative NCS, should be diagnosed on clinical grounds once differentials have been excluded. Ergonomic contributing factors should be noted in the clinical records.

I would adhere to the PCRS algorithm, and if those criteria were met, I would make a diagnosis of CTS without NCS. However, if the algorithm indicated further investigation, then NCS would be appropriate.

Topic 7 – Carpal tunnel syndrome (cont)

Consideration 7.5

In cases that meet recognised clinical diagnostic criteria for CTS (e.g. the Primary Care Rheumatology Society (now the Primary Care Rheumatology and Musculoskeletal Society), CTS-6, Boston), management of the case should be based on a diagnosis of CTS while awaiting nerve conduction studies.	Agree 10 (100%)	Disagree	Undecided

100% of respondents agreed with this statement. Consensus achieved.

Comments from participants

I would manage with a restriction in place for classic CTS symptoms – usually below the EAV.

In cases of suspected CTS, management advice on avoidance of further exposure/local risk assessment would be sensible to prevent further deterioration/worsening of symptoms in cases of CTS, whilst awaiting the outcome of NCS.

Adjustments/restrictions should be put in place on a presumptive diagnosis and then subsequently reviewed, hopefully following the completion of CTS.

In such circumstances, I would manage the case based on the clinical diagnosis of CTS. Unless there was doubt about the diagnosis, the possibility of mixed pathology, or co-existent new blanching, I would not necessarily consider recommending nerve conduction studies.

I would assign a provisional diagnosis of CTS to the case and advise accordingly. The provisional diagnosis would then be revisited with the NCS results or, if the NCS results were unobtainable, would diagnose as likely CTS for definitive management.

Consideration 7.6

Cases of suspected CTS should be restricted to daily vibration exposure of less than a specified level until investigation and treatment is completed. (If agree, please state in comments whether EAV, ELV, other specified or case-by-case basis.)	Agree 8 (80%)	Disagree 2 (20%)	Undecided

80% of respondents agreed with this statement. Consensus achieved.

Comments from participants

Depends on the severity of symptoms, and on a case-by-case basis, alongside ergonomic advice. Could be EAV, ELV, or even full restriction depending on the severity of symptoms and ergonomic factors.

This will require a global assessment/mitigation looking at ergonomics, frequency of use and vibration exposures. For milder cases, an EAV limitation may be appropriate; for more significant symptoms, total HTV restriction may be appropriate.

I would limit at least to the EAV. If symptoms are impacting on the safety of their work, e.g. due to poor grip, then I may advise removal from vibration exposure until they have been treated.

CTS is often multifactorial (medical conditions, hobbies etc.). There is no evidence for dose response relationship between CTS and HTV (Gillibrand 2016). Restriction of all cases may have implications for an employee's job role and employment. Therefore, in those with mild symptoms, advice to the employer would include local risk assessment to control ergonomic factors, reduce exposure to below 100 points, nocturnal splinting and follow-up Tier 4 health surveillance, say every six to 12 months, to monitor and assess for progression. Also, give the individual advice on reporting worsening and early OHS review if concerns. Those with severe symptoms should be restricted from exposure.

I normally recommend no more than the EAV (2.5 m/s2, 100 HSE points) and ALARP, although many are already restricted due to company policy lower than this anyhow.

Every case needs to be considered individually, but symptomatic individuals should have a review of their work activities to include forceful gripping and flexion/extension activities involving the wrist. I would generally recommend that vibration exposure be kept ALARP below the EAV of 100 points. Those with severe symptoms or symptoms that appear to be progressing rapidly might warrant total restriction (below 16 points) pending investigation/treatment.

Case-by-case basis.

Unlike HAVS, where evidence suggests 1 m/s2 A(8) as threshold, there is no evidence for a threshold for CTS. Recommend no exposure to HTV until investigation/treatment is completed.

Needs to be assessed on an individual basis, taking account of other CTS risk factors.

Consideration 7.7

	Agree	Disagree	Undecided
Nerve conduction studies should be requested at the same time as other standardised sensorineural testing such as vibrotactile threshold testing and thermal aesthesiometry.	3 (30%)	5 (50%)	2 (20%)

30% of respondents agreed with this statement and **50%** disagreed. Consensus not achieved.

Comments from participants

Whilst differential diagnosis can sometimes be clear from the history and use of diagnostic aids for diagnosis by anamnesis, it will also depend on the experience of the practitioner to consider the potential for co-morbidity of receptor level damage (HAVS) and other more proximal upper limb entrapments (CTS, CuTS) (Cooke 2021).

Whilst the results of the QST/NCS might not override a clinician's pre-test opinion, they may lead to a reflection on aspects of history taking and examination that influence their conclusion and modify their subsequent history taking and practice.

At Tier 5 – other standardised sensorineural testing is unlikely to be accessible via the NHS.

HAVS is a diagnosis of exclusion. If CTS is suspected, then it should be investigated, and treatment considered before considering other symptoms (vascular/neurological).

I don't think additional sensorineural testing is necessarily required when considering a diagnosis of CTS, but could be useful if the diagnosis remains uncertain/if NCS is negative.

CTS is a treatable condition and would need to be excluded and treated in the first instance before a diagnosis of SN HAVS can be considered.

Having NCS conducted at the same time as Tier 5 testing would be beneficial but is not always available. Given that any cases of SN HAVS are often found to have an element of CTS, this would be helpful.

Not routinely. Every case needs to be considered individually. If the symptoms findings are highly suggestive of CTS but insufficient for a definitive clinical diagnosis to be made, recommending nerve conduction studies may be appropriate in the first instance. Where the symptoms are vaguer, referral for other standardised tests would be a consideration.

The practitioner conducting Tier 5 health surveillance to decide on a case-by-case basis whether NCS is required. In many cases, NCS would help to differentiate between CTS and SN HAVS, but not in all cases.

Consideration 7.8

	Agree	Disagree	Undecided
Cases who are entirely symptom free three months after carpal tunnel decompression surgery should be restricted from further exposure to vibration.		10 (100%)	

100% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

Keep under review every three to six months initially and advise on a theoretical potential for recurrence and recommend they report any return of symptoms.

I would use a graduated approach to reintroduce further exposure up to the EAV.

With appropriate counselling, workers may be returned to HTV exposure.

At this stage I would gradually reintroduce vibration up to the EAV initially and then allow further exposure if they remain asymptomatic after a period of exposure. I would suggest that exposure be kept as low as is reasonably practical and an ergonomic risk assessment be required. I would also conduct six-monthly health surveillance initially so that early recurrence could be identified.

Successfully treated cases can resume normal work with HTV and remain under regular annual health surveillance as per the regs.

I would cautiously allow them to start using vibrating tools, with use ALARP and below the EAV, and review regularly. If any sign of recurrence of symptoms, I would consider permanent restriction from all vibrating tool use.

Explain the risks to the employee, and if the employee wants to continue to work with HTV, monitor closely with health surveillance and advise the employer/manager to reduce exposure to HTV to as low as reasonably practicable (which implies below 2.5 m/s2 A(8) to reduce risk of HAVS) whilst allowing the employee to apply their skills/trade. If any recurrent symptoms, even if mild, recommend redeployment.

Moderator's summary of conclusions regarding carpal tunnel syndrome

In round one of the Delphi study, 70% of participants disagreed that cases of suspected CTS from history and examination should be referred for nerve conduction studies before confirming the diagnosis, although in round two 70% agreed. Neither of those data meet the criterion for consensus regarding the need for nerve conduction studies (NCS). However, there was consensus (80%) that cases of suspected CTS be restricted in respect of daily vibration exposure until investigation and treatment is completed, and 100% agreement that cases meeting recognised clinical diagnostic criteria for CTS (e.g. the Primary Care Rheumatology Society (now the Primary Care Rheumatology and Musculoskeletal Society), CTS-6, Boston) should be managed on the basis of a diagnosis of CTS while awaiting nerve conduction studies. There was lack of consensus about whether nerve conduction studies should be requested at the same time as other standardised sensorineural testing such as vibrotactile threshold testing and thermal aesthesiometry.

There was 100% disagreement that cases who are entirely symptom free three months after carpal tunnel decompression surgery be restricted from further exposure to vibration.

In Delphi stream 6 above, opinion failed to reach consensus regarding those with diabetes mellitus, who are at higher risk of CTS, and whether they should have quantitative sensory testing at baseline (before exposure to HTV) and then at regular intervals if working with HTV.

Topic 7 – Carpal tunnel syndrome (cont)

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3. Details of Delphi process

Topic 8 – Dupuytren's disease

Summary

Dupuytren's disease (DD) is a common fibroproliferative connective tissue disorder of the palmo-digital fascia (aponeurosis) of the hand resulting in the formation of nodules and cords, which in turn can result in irreversible flexion contracture of the digits. DD is more common in men, with prevalence rising with age. Studies published found a consistent association between Dupuytren's disease and diabetes, liver disease and epilepsy. There is also a strong genetic component leading to DD at a younger age. Heavy alcohol drinking, cigarette smoking and manual work exposure have also been associated with the development of DD (SOM 2022, Alser 2020, Descatha 2014).

Recently published studies suggested that vibration is an independent risk factor for the development of DD and significant association between DD and hand-transmitted vibration and heavy manual work, with an increased risk after 15 years of exposure (Mathieu 2020).

Occupational exposure, including both vibration exposure and heavy manual work without significant vibration exposure, was associated with Dupuytren's disease (Murinova 2021).

Dupuytren's contracture was added to the list of prescribed industrial diseases due to exposure to HAV tools associated with more than doubling of relative risk (IIAC, Cm8860, 2014).

Not all cases of Dupuytren's disease (DD) progress to contracture, nor is it clear whether traditional risk factors, now including vibration exposure, affect this progression once initiated (Broekstra 2022). There is conflicting evidence in the literature regarding the issue of progression. Diep et al (Diep 2015) suggest that the majority of cases do not progress to contracture, developing nodules only. Whilst in another study population (Van der Berge 2021), it was reported that 'overall, 20/93 (21.5%) previously affected participants had disease progression, while 6/93 (6.5%) patients showed disease regression. Disease progression occurred more often in patients who initially had advanced disease'. However, Stirling et al (Stirling 2021) suggested that DD is progressive, with respect to disease extent and contracture severity, mostly on the little finger side of the hand.

There are scales for assessing severity (mostly used for surgical considerations). A goniometer is an objective means of monitoring degrees of flexion contracture (12). General points on occupational health case management may include periodic observation of the employee (every six to 12 months) to determine the onset of contracture and the need for referral, as well as advice to consider alternative work only if there are functional or safety issues with work tasks (1).

Topic 8 – Dupuytren's disease (cont)

Consideration 8.1

Cases of Dupuytren's contracture should be restricted from using vibrating tools. If yes, at what severity?	Agree 2 (18%)	Disagree 4 (36%)	Undecided 5 (46%)

36% of respondents disagreed with this statement and **46%** undecided. Consensus not achieved.

Comments from participants

I believe it should not be all cases but severe cases. Also, employees should be allowed to make a choice about continuing further exposure as some may have no other job than the one where they use tools and restriction could lead to loss of employment.

I don't think they should be restricted on initial diagnosis unless there is concurrent HAVS or CTS or the degree of associated functional impairment is severe. There is an argument for increasing the frequency of Tier 4 face-to-face review in cases of newly identified DD. Advice to the employer should include mention of the other factors demonstrated to have a causative role – lifestyle, heavy manual work, etc.

If we are considering restricting exposure to vibration solely as a result of DD, then I'd think this would be appropriate at the point where it is obviously progressing, it is causing a significant degree of functional impairment or when it has been judged to be suitable for surgery.

There should be risk assessment and discussion for those with Dupuytren's contracture –consideration of removal/close HS on a case-by-case basis, depending on severity and evidence progression.

Not for early cases without significant handgrip strength impairment. It is unclear whether traditional risk factors for Dupuytren's (including vibration exposure) affect progression to contracture.

If you answered yes/in agreement with the above, at what severity should cases of Dupuytren's contracture be restricted from using vibrating tools? If impaired grip strength or impaired manual dexterity due to fixed flexure contractures of fingers and being unable to hold heavy tools with significant HAV magnitudes might put an employee or their colleagues at risk of injury. In those instances, the OH clinician should consider whether still fit to use HAV tools.

I do not think this is a binary answer; there may be some cases where further HTV exposure should cease. However, this is likely to be related to function levels, time left working, etc.

The reason for this response is because (should there be a consensus of agreement to restrict cases) it may unintentionally become a default position with practitioners who may not fully appreciate current doubts over progression and severity.

First, there is conflicting evidence in the literature regarding the issue of progression of Dupuytren's; highlighted in the HAVS SIG document with one study (Diep et al 2015) suggesting that 'the majority of cases do not progress to contracture, developing nodules only' whilst another 'found a greater degree of progression in those with a higher initial stage of disease' (21.5%, van den Berge et al 2021), and a third five-year prospective study (Stirling et al) suggested that 'DD is progressive, with respect to disease extent and contracture severity mostly on the little finger side of the hand'.

Second is the problem concerning studies of progression in vibration exposed where there is inconsistency with regard to the use of Dupuytren's disease (DD) and Dupuytren's contracture (DC) (Descatha 2011 and 2014). Third is the paucity of prospective epidemiology.

Therefore, those with just nodules or cords and minimal contracture should not be restricted from work with vibrating tools: there is no indication that ongoing exposure leads to deterioration.

Consideration 8.1

Comments from participants (cont)

Severity is relevant to the OH practitioner in terms of functional restriction and safety consideration. Whilst there are scales for assessing severity (i.e. Hueston and Tubiana) which may align broadly with function, these are primarily used as indicators for surgery. In terms of function, cases should be treated individually. For example, a flexed little finger may not appear disabling as a flexed middle or index finger, yet the normal range of quadriga phenomenon, where the flexor tendon excursion is limited in the adjacent unaffected fingers by the interconnectedness of the flexor digitorum profundus tendons, can impact function significantly between individuals of similar severity.

So, cases should be managed individually and based on functional and safety consideration, not on theoretical prevention of progression or an arbitrary severity scale cut-off.

The lack of a dose response relationship and evidence of a significant genetic predisposition are such that (in my opinion) it is not possible to predict what exposure will either cause or lead to deterioration of Dupuytren's. On that basis, it is my opinion that individuals with Dupuytren's should be restricted only to reflect impairment of functional ability that affects ability to do their work or causes risk to others. Other cases will be addressed by discussion with the individual. Short-term restriction may be necessary following treatment.

The severity of disease along with age (and duration of vibration exposure) and concomitant risk factors should be considered in deciding about occupational management of such cases, including decision on restriction of vibration exposure rather than blanket restriction.

The literature seems to suggest that there is no evidence that ongoing use of vibrating equipment has any impact on the progression of the disease once contracture has started. Therefore, I feel that consideration would need to be given on a case-by-case basis, as to whether the employee should be restricted from using vibration tools. If the disease is having a functional impact on the person's ability to operate the tools, or if the disease appears to be progressing rapidly, then in my opinion, restriction would need to be considered.

As it is now a prescribed disease, I have recently taken the approach to restrict below the EAV and advise ergonomic modifications, too.

If you answered yes/in agreement with the above, at what severity should cases of Dupuytren's contracture be restricted from using vibrating tools? Requiring specialist input, surgery and a formal diagnosis or significant flexion noted – maybe when it meets the prescribed disease statement.

Consideration 8.2

	Agree	Disagree	Undecided
All cases of DD should be restricted on initial diagnosis, regardless of severity or associated functional impairment.		11 (100%)	

100% of respondents disagreed with this statement. Consensus achieved.

Comments from participants

Restriction to be considered if severe, or if functional impairment causes concern that the person with HTV cannot operate tools safely.

Not all cases progress, and particularly where there is no impairment of function there would be no justification to restrict every case.

In my opinion, restriction should only be considered where there is significant functional impairment.

Not all cases of Dupuytren's disease (DD) progress to contracture, and disease progression is noticed more in advanced cases.

Case by case should be reviewed and it depends on the severity of the DD.

This would seem disproportionate to the risk of progression.

Consideration 8.3

	Agree	Disagree	Undecided
Cases of DD should have enhanced health surveillance/periodic observations (e.g. every six to 12 months) to determine the onset of contracture and the need for referral.	9 (82%)	2 (18%)	

82% of respondents agreed with this statement. Consensus achieved.

Comments from participants

For any disease process thought related to work exposure, I would suggest it prudent to limit that exposure ALARP and provide enhanced surveillance to pick up disability and progression sooner.

Initially to be observed more frequently if to continue using tools with HTV. If stable after a period of two to three years, for example, and no progression or significant contracture, revert to annual health surveillance.

There would be an argument for enhanced surveillance, the periodicity of which would need to be determined on a case-by-case basis.

I would agree they should have enhanced surveillance beyond an annual Tier 2 but this could be a Tier 3, with clear guidance to escalate as necessary.

The annual usual surveillance should be appropriate.

Agree – is the contracture unchanged or deteriorating? – with the proviso that the worker is referred earlier if indicated.

Because the pathology takes years to develop, a six-monthly review is unlikely to make an impact. 'Recently published studies suggested that vibration is an independent risk factor for the development of DD and significant association between DD and hand transmitted vibration and heavy manual, with an increased risk after 15 years of exposure.' (Mathieu et al 2020, Murinova et al 2021).

Face-to-face review every 12 months, but not sooner might be appropriate. Action could be delayed until serial reviews have demonstrated progressing contracture.

Most DD is fairly slow to progress but annually seems suitable. Suggest face-to-face and goniometer measurements rather than virtual reviews once contracture commences. More frequent reviews may be justified in those with a history suggestive of Dupuytren's diathesis who possibly have a theoretical increased or synergistic risk; work-related attribution may be challenging in such cases.

Consideration 8.4			
Restricting work with vibrating tools should be considered when functional impairment is such that it affects ability to do work tasks or causes risk to others.	Agree 10 (91%)	Disagree 1 (9%)	Undecided

91% of respondents agreed with this statement. Consensus achieved.

Comments from participants

If impaired grip strength or impaired manual dexterity due to fixed flexure contractures of fingers might put an employee or their colleagues at risk of injury, or if they are unable to hold heavy tools with significant HAV magnitudes, the OH clinician should consider whether they are still fit to use HAV tools.

If safe operation of vibrating tools is likely to be compromised, restriction would be advised on safety grounds.

Yes, if there are safety risks, but perhaps through a health and safety risk assessment/rather than a Tier 4 statement of complete restriction, which has employment implications. It would be up to the employer to determine the acceptable risk,
with guidance that a risk assessment should occur.

By the time functional impairment is such that ability to do work tasks is affected, it must have reached an advanced stage.
At such an advanced stage, further progression is likely to be accelerated by exposure to vibration.

Agree, as this reduces the worker's ability to grip a potentially dangerous power tool.

Yes. However, this would be in the minority of cases, if not rare.

Restriction of vibration exposure seems most appropriate when there is evidence that the contracture is progressing quickly, function is becoming impaired or surgery has been deemed necessary. It will often be appropriate to recommend reduction in forceful manual tasks as well as restricting the amount of vibration exposure.

This may only be necessary on a temporary basis while awaiting the outcome of treatment, but permanent if the latter is unsatisfactory or not undertaken. Raises the issue of what to advise if DC is recurrent following treatment.

Moderator's summary of conclusions regarding Dupuytren's disease

In respect of Dupuytren's disease, there was 100% agreement that employees with DD should not necessarily be restricted from vibration exposure at time of initial diagnosis, regardless of severity or functional impairment. There was consensus (82%) that cases of DD should have enhanced health surveillance/periodic observations (e.g. every six to 12 months) to determine the onset of contracture and the need for referral and (91%) that restricting work with vibrating tools should be considered when functional impairment is such that it affects ability to do work tasks or causes risk to others.

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Appendix A –

List of all statements for which consensus agreement was achieved

A1 PRP generally presents with a symmetrical pattern of blanching in individuals under the age of 30. A positive family history of PRP and involvement of the feet also makes the diagnosis of PRP likely. (Considerations 1.1.1, 1.1.2 and 1.1.3)

A2 Vascular HAVS results from significant vibration exposure, and alternative diagnoses such as PRP should be considered in those with short-duration lifetime exposure, i.e. less than five years. (Consideration 1.1.4)

A3 Asymmetrical blanching affecting the trigger fingers of the dominant hand is more suggestive of HAVS than PRP. (Consideration 1.1.5)

A4 HTV-exposed individuals who are diagnosed with PRP at health surveillance should be advised that they can continue with limited exposure (below the EAV) with careful monitoring. (Consideration 1.2.3)

A5 HTV-exposed individuals with a history of blanching and possible carpal tunnel syndrome should be referred for investigation/treatment of CTS prior to diagnosing RP or vascular HAVS. (Consideration 1.3.1)

A6 Those with blanching and a history of health issues known to be associated with RP (e.g. scleroderma, connective tissue disorders, rheumatoid arthritis, hypothyroidism) should be referred. (Consideration 1.3.2)

A7 In those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s^2 or 100 points on the HSE scale. (Consideration 1.4.2).

A8 In those with known PRP, enhanced surveillance should include annual review of photographic evidence to help monitor progression of symptoms. (Consideration 1.4.4)

A9 Symmetrical blanching affecting all fingers of both hands (+/- other extremities) warrants more in-depth enquiry to exclude other conditions (e.g. autoimmune disease, blood or vascular disorders, medication) when it presents in vibration-exposed individuals over the age of 30, with no family history of PRP. (Consideration 1.4.5)

A10 Following a new diagnosis of Stage 2 HAVS, frequency of Tier 4 assessment should be increased to every six months, until there is no progression in symptoms. Where there has been a two-year period in which there has been no symptom progression, assessment can revert to an annual Tier 3 or 4 assessment. (Consideration 2.2)

A11 If the individual has ceased exposure, Tier 4 assessment should be continued for two years and if there is no progression of symptoms, then there is no need for ongoing surveillance.

A12 With vascular HAVS, the extent of blanching should override frequency. (Consideration 3.1)

A13 Photographic evidence should be used to confirm the diagnosis and extent of blanching and vascular staging. (Consideration 3.2)

A14 Given the paucity of normative data for SWM perception in occupational groups, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results. (Consideration 4.4)

A15 Using WEST/SW monofilaments in vibration-exposed workers, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however, for workers unable to sense an applied force of 0.2 g-f, further testing (if available) with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments (long test kit) should be considered, especially if an older worker with thickened skin/calloused hands. (Consideration 4.5)

A16 For clinicians with only access to WEST monofilaments, the 0.2 g-f cut-off of normality should not automatically be increased for manual workers; however, where fingertips are clearly thickened and the distribution of loss of sensory perception is symmetrical, this could be reflected in the interpretation of the SWM results. However, if there remains doubt, then referral for QST such as VTT and TPTT, which tests receptors other than touch pressure, should increase the potential for excluding an effect of skin thickening on sensibility.
(Consideration 4.6)

A17 Where the long test monofilament kit is available, when the mean SWM bend force in two digits is ≥ 0.6 g-f, the history, clinical picture, progression and distribution of digital loss of sensory perception should be taken into account and Tier 5 testing considered if there remains doubt about the diagnosis. (Consideration 4.6)

A18 Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to hand-transmitted vibration (HTV) should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and have a health surveillance assessment initially every six months for the first two years by a clinician trained in detecting and diagnosing HAVS. If no evidence of progressive neurological deficit in the first two years, annual health surveillance should be considered if working with HTV. (Consideration 6.1)

A19 Those with peripheral neuropathy/neurological symptoms similar to neurological HAVS and wishing to work where exposed to HTV should be advised of the possible risks of further neurological loss in hands and fingers due to HTV and should have a health surveillance assessment annually by a clinician trained in detecting and diagnosing HAVS. (Consideration 6.3)

A20 In cases that meet recognised clinical diagnostic criteria for CTS (e.g. the Primary Care Rheumatology Society (now the Primary Care Rheumatology and Musculoskeletal Society), CTS-6, Boston) management of the case should be based on a diagnosis of CTS while awaiting nerve conduction studies. (Consideration 7.5)

A21 Cases of suspected CTS should be restricted to daily vibration exposure of less than a specified level until investigation and treatment is completed. (Consideration 7.6)

A22 Cases of DD should have enhanced health surveillance/periodic observations (e.g. every six to 12 months) to determine the onset of contracture and the need for referral. (Consideration 8.3)

A23 Restricting work with vibrating tools should be considered when functional impairment is such that it affects ability to do work tasks or causes risk to others. (Consideration 8.4)

Appendix B –

List of all statements for which there was consensus that the statement is not appropriate

B1 Individuals with a history of PRP embarking on a career involving HTV (e.g. mechanical apprentices) should be advised that exposure is not recommended and that they are effectively “not fit” to use vibrating tools. (Consideration 1.2.1)

B2 HTV-exposed individuals who are diagnosed with PRP at routine health surveillance should be advised that they cease exposure. (Consideration 1.2.2)

B3 It is impossible to provide effective HAVS surveillance in the presence of PRP and therefore anyone with this diagnosis should be advised not to use vibrating tools, regardless of their age or duration of employment. (Consideration 1.2.4)

B4 Given the adequate time to provide photographic evidence (say a full winter), the absence of photographic evidence should be used to discount or overturn a presumptive diagnosis of vascular HAVS where there is a history of sufficient exposure and anamnesis of cold-induced distal circumferential finger blanching. (Consideration 3.3)

B5 Age and occupational group should NOT be considered when interpreting results of monofilament testing.

B6 All cases of HAVS should be referred for Tier 5 assessment. (Consideration 5.1)

B7 To mitigate legal risks for an employer associated with the diagnosis of a late stage of neurological hand-arm vibration syndrome (HAVS), employees with diabetes mellitus should be excluded from exposure to hand-transmitted vibration (HTV). (Consideration 6.5)

B8 Cases (of CTS) who are entirely symptom free three months after carpal tunnel decompression surgery should be restricted from further exposure to vibration. (Consideration 7.8)

B9 All cases of DD should be restricted on initial diagnosis, regardless of severity or associated functional impairment. (Consideration 8.2)

Appendix C –

List of all statements for which no consensus agreement or disagreement was achieved

C1 Symmetrical blanching affecting all fingers of both hands (+/- other extremities) always warrants more in-depth enquiry into medical history, medication and potential referral, regardless of the age of the individual. (Consideration 1.3.3)

C2 Vibration-exposed individuals with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred back to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies, regardless of their age/age of symptom presentation. (Consideration 1.6.1)

C3 Vibration-exposed individuals with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred back to their GP for consideration of further investigation such as nailfold capillaroscopy and antinuclear antibodies in general, only if their symptoms commence when aged >30 as most cases of PRP are present in those aged <30. (Consideration 1.6.2)

C4 Vibration-exposed individuals aged over 30 with symmetrical blanching affecting all fingers of both hands (+/- other extremities) with no other obvious cause for the symptoms (e.g. medical history or medication) should generally be referred for further investigation such as nailfold capillaroscopy and antinuclear antibodies. (Consideration 1.4.6)

C5 In those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. These individuals should be subject to enhanced health surveillance that consists of an annual face-to-face assessment at Tier 3 (or Tier 4 if reported change), to ideally also include a review of photographic evidence to help monitor any progression of symptoms. This level of surveillance would need to continue for the duration of vibrating tool use. (Consideration 1.5.1)

C6 In those with known PRP, exposure to hand-transmitted vibration should be kept as low as practicable below the EAV of 2.5 m/s2 or 100 points on the HSE scale. These individuals should be subject to enhanced health surveillance that consists of an annual face-to-face assessment at Tier 3 or Tier 4 for the first five years after the onset of RP, to ideally also include a review of photographic evidence to help monitor any progression of symptoms. If there is no evidence of change or progression of symptoms in the first five years, surveillance should continue with at least annual Tier 2 questionnaires in the same manner as other vibration-exposed workers. (Consideration 1.5.2)

C7 In those with known PRP, exposure to hand-transmitted vibration should not exceed the “no harmful effect level” of 1 m/s2 or 16.6 points on the HSE scale. (Consideration 1.4.1)

C8 In those with known PRP, ongoing exposure should be subject to enhanced health surveillance with at least annual Tier 4 review. (Consideration 1.4.3)

C9 Those with Stage 2 HAVS should have a Tier 4 HAVS assessment every six months and this should continue until they are removed from exposure to vibrating tools. (Consideration 2.1)

C10 For employees who have a diagnosis of Stage 2 HAVS and have stable symptoms, with no progression over a period of four years, surveillance could be stepped down to Tier 2, with a specific questionnaire written to look for changes or new symptoms. (Consideration 2.3)

C11 Using WEST/SW monofilaments, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception when assessing whether reduced sensory perception is present in vibration-exposed workers. (Consideration 4.1)

Appendix C –

List of all statements for which no consensus agreement or disagreement was achieved (cont)

C12 Using WEST/SW monofilaments in vibration-exposed workers, the ability to sense an applied force of 0.2 g-f or less indicates normal sensory perception; however, for workers unable to sense an applied force of 0.2 g-f, further testing with 0.4 g-f, 0.6 g-f and 1 g-f monofilaments should be undertaken. For those unable to sense 0.6 g-f or more, quantitative sensory perception testing should be considered. (Consideraion 4.3)

C13 Reduced sensory perception in sensory HAVS can be staged by using only one QST (monofilament). (Considerations 5.2 and 5.4)

C14 QST may play a useful role in refining a sensorineural grading of 2SN into “early” and “late”. (Consideration 5.3)

C15 Those with diabetes mellitus (DM) are at higher risk of carpal tunnel syndrome (CTS). Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS for anyone exposed to HTV. Those with DM should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV. The QST should be monofilament testing at least. Any progression in neurological deficit detected from the history or from QST should be referred for vibrotactile perception threshold (VPT) testing, thermal aesthesiometry (TA) and multi-segmental nerve conduction studies (NCS). (Consideration 6.2)

C16 Those with diabetes mellitus are at higher risk of CTS. Exposure to hand-transmitted vibration (HTV) at work increases the risk of CTS for anyone exposed to HTV. Those with diabetes mellitus should have quantitative sensory testing (QST) at baseline (before exposure to HTV) and then at regular intervals if working with HTV. (Consideration 6.4)

C17 Cases of suspected CTS from history and examination should be referred for nerve conduction studies before confirming diagnosis. (Considerations 7.1 and 7.4)

C18 Cases of suspected CTS should be restricted from using hand-vibrating tools until investigation and treatment is completed. (Consideration 7.2)

C19 Cases of a recurrence of CTS should be permanently restricted from using vibrating tools. (Consideration 7.3)

C20 Nerve conduction studies should be requested at the same time as other standardised sensorineural testing such as vibrotactile perception threshold and thermal aesthesiometry. (Consideration 7.7)

C21 Cases of Dupuytren’s contracture should be restricted from using vibrating tools. (Consideration 8.1)

Appendix D –

Statements regarding research undertaken

Author Contributions:
Conceptualisation, RC; methodology, RC, DA, HF, CG, RH-S, DH, EK and IL; validation RC, DA, HF, CG, RH-S, DH , EK and IL; investigation, RC, DA, HF, CG, RH-S, DH, EK and IL; writing – original draft preparation, review and editing – RC, DA, HF, CG, RH-S, DH, EK and IL. Overall editing, RC. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest:
The authors declare no conflicts of interest. All authors are members of the SOM HAVS SIG. The conclusions do not necessarily represent the views of the Society of Occupational Medicine or individual members thereof. IL is a member of the Industrial Injuries Advisory Board (IIAB). The conclusions do not necessarily represent the views of the IIAB or individual members thereof.

Notes

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