

Osteoarticular diseases of the hands and wrists caused by mechanical vibration (505.01)

Angioneurotic diseases caused by mechanical vibration (505.02)

Definition of causal agent

Mechanical vibration is an oscillating motion about a central fixed position. Vibration frequency, expressed in Hertz (Hz), describes the cyclic nature of vibration. Vibration is separated into two subcategories: hand-arm vibration (HAV) and whole-body vibration (WBV).

This section deals only with HAV. For HAV the relevant nominal frequency range is from 5 to 1500 Hz but frequencies usually occur between 125 till 300 Hz. According to the ISO standard (ISO 5349:1986, revised), the exposure is expressed as an exposure period in combination with an exposure intensity measured in m/s^2 , a frequency weighted and an 8 hour time averaged acceleration total value $a_{hv}(eq,8h)$ or just $A(8)$. Acceleration is now measured in 3 directions.

Main occupational uses and sources of exposure:

Occupational vibration reaches the worker through different paths or transmission routes. HAV arises when e.g. grinding, spinning, fettling, using a grinding wheel, chainsaw, high pressure water hose, hammer drill, rammer, chisel, chipping hammer or other pneumatic tool, that is, when either pressing the work-piece to a rotating tool, or pressing the tool to the work-piece.

Adverse effects

The majority of *hand-arm vibration syndrome (HAVS)* subjects have a combination of vascular and sensorineural effects. In severe cases there may be osteoarticular diseases. Clinical picture and diagnostic criteria are described for angioneurotic diseases first as the most common disease.

Clinical picture and diagnostic criteria

□ Angioneurotic diseases

Vibration-induced white fingers (Raynaud's phenomenon of occupational origin):

The disease is characterized by attacks of vasoconstriction of the digital arteries. Attacks can last for minutes to hours and are more likely to occur with exposure to the cold.

The Stockholm Workshop (1986) HAVS classification system for cold-induced peripheral vascular symptoms is an internationally recognized grading system:

Stage 1 (mild): Occasional attacks affecting only the tips of one or more fingers precipitated by exposure to a cold environment, touching cold objects or immersion in cold water

Stage 2 (moderate): Occasional attacks affecting distal and middle (rarely also proximal) of one or more fingers

Stage 3 (severe): Frequent attacks affecting all phalanges of most fingers

Stage 4 (very severe): Frequent attacks affecting all phalanges of most fingers with trophic changes in the fingertips.

The diagnostic procedure involves a detailed recollection of symptoms and medical history and may involve additional tests, e.g. a test of cold provocation with measurement of finger blood pressure before and after cooling.

Differential diagnosis: Idiopathic Mb. Raynaud or Mb. Raynaud as part of other medical disease (e.g. scleroderma or other connective tissue diseases, other vascular disease, polycytemia, medication).

Peripheral sensorineural polyneuropathy:

Symptoms include tingling and numbness in finger and hands. In later stages reduced sensation of touch, temperature and vibration and an impairment of manual dexterity.

In the Stockholm Workshop grading system 3 stages are recognized:

Stage 1 (mild): Intermittent numbness with or without tingling.

Stage 2 (moderate): Intermittent or persistent numbness, reduced sensory perception

Stage 3 (severe): Intermittent or persistent numbness, reduced tactile discrimination and/or manipulative dexterity.

The diagnostic procedure involves a detailed analysis of symptoms and medical history and a clinical neurological examination. Quantitative neurosensory tests may contribute to the diagnosis.

Differential diagnosis: Polyneuropathia and carpal tunnel syndrome of other origin.

See Annex I entry nr. 506.45 on *Carpal tunnel syndrome*.

Osteoarticular diseases

- Osteoarthritis of the elbow and wrist;
- Carpal bone diseases
 - Osteonecrosis of the semilunate bone (Kienböck's disease)
 - Pseudoarthrosis of the scaphoid bone

Osteoarticular disease is confirmed by radiography.

Other diseases

There is moderate evidence that contracture of the palmar aponeurosis (Dupuytren's disease) may occur as an effect of HAV.

The prevalence of musculo-skeletal diseases of the upper limb, shoulder or neck is increased in HAV-exposed but it has not been possible to separate the effect of HAV from the effect of other physical factors, i.e. force, repetition and posture.

It is not clear if HAV induces bone injuries such as vacuoles and cysts.

Exposure criteria:

Minimum intensity of exposure: Individual exposure history with confirmation of exposure to occupational HAV. Information about hand-arm vibration levels for specific tools used may be obtained from existing databases.

An inverse relationship between acceleration level and duration exists. If exposed to a frequency weighted and time averaged acceleration $\geq 3 \text{ m/s}^2$ (A(8)) for 10 years 10 % of the exposed will develop vibration induced white fingers. Same exposure level for sensorineural polyneuropathy. The exposure-response relationship for osteoarticular diseases may be different. Thus, HAV with a frequency range below 100 Hz and of high magnitude appears to be associated with joint and bone pathology (pneumatic percussive tools).

According to the EU directive 2002/44/EC the daily exposure limit value (A(8)) shall be 5 m/s^2 and the action value 2.5 m/s^2 .

Minimum duration of exposure: Depending on acceleration level.

$3\text{-}10 \text{ m/s}^2$ (A(8)): 3-10 years

$>10 \text{ m/s}^2$ (A(8)): 1-3 years.

Maximum latent period: Not known, probably months.

Induction period: Same as minimum duration.