

Neurosensory findings, symptoms and signs in young vibration exposed workers

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Introduction

- Vibration exposure is still common
- Tools vary in size, weight, acceleration amplitude and frequency
- Hand-arm-vibration-syndrome (HAVS)
- Vibration white fingers - VWF
- Sensorineural disturbances: a few – 80 %
- Interindividual susceptibility varies

Neurological symptoms

- Tingling
- Numbness and paraesthesia in fingers
- Decreased skin sensitivity
- Reduced grip strength
- Difficulties with manipulative tasks
- Increased vibration thresholds
- Increased temperature thresholds

Aims of the study

- To study early neurosensory effects by quantitative vibrotactile and monofilament tests in young workers with hand-held vibration exposure.

Materials and methods

- Exposed group – young male workers from automechanic shops and construction enterprises using e.g. screw drivers, grinders, impact drills and jig saws
- Mean age 20.9 +/- 1.1 y
- Referents – young male workers, mainly restaurant employees
- Mean age 20.7 +/- 0.9 y

Materials and methods 2

- Baseline study 2004-2005:
- 142 male workers
- 41 male referents
- Several questionnaires (e.g. working and medical history, smoking, alcohol consumption, vibration exposure: type of hand-held tools, time when the exposure started, exposure duration and daily use, and vibration related symptoms)

Material and methods 3

- Physical examination
- Vibrotactile perception thresholds (31.5 and 125 Hz); dig II and V bilaterally
- Semmes Weinstein's monofilament;
- 0.07 g, 0.2 g, 2.0 g, 4.0 g, 300 g
- Temperature thresholds
- Purdue dexterity test
- Jamar test, Pinch grip, 3 Chuck grip

Material and methods 4

- Five exposure indices were calculated
- Number of hours with vibration exposure
- $a \cdot t$ frequency weighted acceleration
- $a^2 \cdot t$ squared frequency weighted acceleration
- A(8) current 8-hour equivalent frequency weighted acceleration
- $a^2 \cdot t$ total vibration dose for both work and leisure time

Vibration dose	All workers		Highest exposed quartile	
	Median	Ranges	Median	Ranges
Total hours exposure (h)	610	5-17550	1925	1490-17550
$a \cdot t$ weighted total dose	1810	6-61315	8785	5365-61315
$a^2 \cdot t$ weighted total dose	8915	10-742545	74445	27005-742545
Current weighted A(8)	1.4	0-5.1	2.8	2.2-5.1
$a^2 \cdot t$ weighted total dose work + leisure	2760	6.1-67215	10210	6585-67215

Results

- Exposed group:
- Exposure time: 3.1 y (range 1 – 8 y)
- 8 % tingling sensations
- 10 % numbness in fingers
- 1 % both tingling and numbness
- No interference with work or leisure time
- Prevalence of symptoms was, however, not significantly higher than among the referents

Results monofilament tests

- Exposed group
- Abnormal monofilament testing
- 11 % dig II and 6 % dig V, right hand
- 10 % dig II and 6 % dig V, left hand
- Referents
- 7 % dig II and 5 % dig V, right hand
- 12 % dig II and 12 % dig V, left hand

Results logistic multiple regression

- Monofilament testing – dependent variable
- Age, height, examiner, vibration dose – independent variables
- None of the 5 calculated vibration doses gave a significant contribution to the model, neither in the total material, nor in the highest exposed quartile.
- No contribution to the model from any of the other independent variables.

Results vibration perception thresholds (VPT)

- Significantly raised vibration thresholds for 125 Hz in dig 2 bilaterally
- Other vibration thresholds were of the same magnitude in the two groups
- Multiple regression analysis: VPT vs age, height, examiner and vibration doses; none of the predictor variables (including 5 different dose calculations) were included in the models, neither in the total exposed group, nor in the highest exposed quartile.

Frequency (Hz)	Exposed group		Reference group	
	Digit 2			
	Left hand	Right hand	Left hand	Right hand
31.5 Hz	0.13 (0.03-0.75)	0.15 (0.06-0.81)	0.14 (0.05-0.41)	0.14 (0.05-0.40)
125 Hz	0.17 (0.05-1.16)	0.24 (0.05-0.92)	0.13 (0.04-0.67)	0.16 (0.03-0.96)
Frequency (Hz)	Exposed group		Reference group	
	Digit 5			
	Left hand	Right hand	Left hand	Right hand
31.5 Hz	0.15 (0.03-0.77)	0.17 (0.04-0.79)	0.15 (0.05-0.45)	0.15 (0.07-0.54)
125 Hz	0.24 (0.02-1.45)	0.25 (0.03-1.92)	0.19 (0.06-0.68)	0.21 (0.07-1.15)

Other exposures

- The consumption of alcohol and smoking was similar in the two groups
- The exposure to organic solvents was low in the two groups
- There was no exposure to neurotoxic substances such as N-hexane

Discussion

- Young cohort
- Short exposure-time, employed 1998-2005
- Mean exposure time 3.1 y (1-8 y)
- Raised VPTs in dig 2 bilaterally for 125 Hz in the exposed workers
- 125 Hz the peak sensitivity frequency within the interval of the instrument

Discussion 2

- Monofilament tests
- Most significant findings in dig 2 bilaterally
- Abnormal ≥ 0.2 g (diminished light touch)
- None of the workers showed any symptoms and signs of a CTS
- Advice on improved work practices and preventive measures was given to reduce the vibration exposure

Discussion 3

- The fairly short exposure time is probably the main reason for the sparse findings as latency time is often longer than a couple of years
- The limited exposure time may have been too short to cause substantial effects in larger myelinated nerve fibers such as $A\beta$, which will be reflected by monofilament testing

Discussion 4

- An overestimation of the vibration exposure to hand-held tools is not uncommon, in some studies from 2 – 4 and even up to eight times. This complicates the calculation of vibration doses.
- Accordingly direct measurements are preferable for risk assessment.

Discussion 5

- In summary, despite a fairly short cumulative vibration exposure elevated VPTs as well as abnormal results from monofilament testing was observed in dig 2 bilaterally among the workers.
- Thus, early neurophysiologic symptoms and signs may appear after short-time exposure also in young workers.

Discussion 6

- We hope to be able to continue the follow-up of this cohort and to relate coming neurophysiologic symptoms and signs to both on-going and previous vibration exposure.