Neurophysiologic Symptoms and Vibration Perception Thresholds in Young Vibration-Exposed Workers – A Follow-Up Study

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1. INTRODUCTION
Vibration exposure may cause the hand-arm vibration syndrome (HAVS), including digital vasospasms (vibration white fingers; VWF), sensorineural symptoms and/or muscular weakness and fatigue (Gemne, 1997). Neurophysiologic symptoms include numbness and/or tingling, impaired touch sensitivity, impaired manual dexterity and reduced grip strength in the hands. The Stockholm Workshop Scale is commonly used for sensorineural (SN) staging (0SN – 3 SN). Sensorineural symptoms of this in combination with difficulties in handling small objects may interfere both with the workers social- and work-related activities (Sakakibara et al., 2005).

2. OBJECTIVE
The objective of this work was to study the development of neurophysiologic symptoms and vibration perception thresholds in a cohort of young vibration-exposed workers.

3. METHODS
The follow-up study in 2006/2007 comprised 108 young male vibration-exposed workers (mean-age was 22.6 ± 1.0 y) from the machine shop and construction industries, who had been followed since they finished school. They were compared with 21 male non-exposed referents (mean-age 22.4 ± 0.9 y). All participants completed several questionnaires related to working and medical history, smoking, alcohol consumption, previous and on-going vibration exposure and symptoms of sensorineural disturbances. The neurophysiologic function was checked by the determination of vibration perception thresholds (VPTs) at 31.5 and 125 Hz and by Semmes Weinstein’s Monofilament tests. Measurements of vibrotactile thresholds were performed by delivering sinusoidal vibrations to the pulp of digits II and V, bilaterally (the up-and-down method of limits; von Békésy method), and registering the subjects response, using the HVLab Tactile Vibrometer system (HVLab, United Kingdom). The results were compared with the findings from the baseline study in 2004/2005. Parametric statistics were used for comparison of elements that showed a normal distribution (checked by Normal Probability Plots, Levene’s test). For elements with a skewed distribution, nonparametric statistical processing was applied (Mann-Whitney’s U-test; r = Spearman’s rho). P-values < 0.05 were regarded as statistically significant (2-tailed tests).

Multiple regression analysis was performed with VPT as the dependent variable, and with age, height, examiner and different vibration dose calculations as predictor variable (total hours of vibration exposure (h), a*t weighted total dose, a²*t weighted total dose, current weighted vibration exposure A(8) and total a²*t weighted total dose for work and leisure time). Model fits were checked by means of residual analysis (Altman, 1991)

4. RESULTS
Among the exposed workers, 18 subjects (17 %) reported tingling sensations, 9 reported numbness (8 %) and 5 reported both tingling and numbness in their fingers. This is a doubling of reported tingling sensations compared to the baseline study (8 %), while reported numbness was more or less unchanged (10 % at baseline study).

The exposed workers showed significantly raised VPTs for 32 Hz in digit II (p=0.036) and for 125 Hz in digit V, left hand (p=0.045). The other VPTs didn’t differ significantly between workers and referents. The exposed worker showed approximately the same median values of vibration perception thresholds (m/s²) in the follow-up study (31.5 Hz, digit II, left hand 0.11, digit II, right hand 0.13; 125 Hz digit II, left hand 0.16, right hand 0.17) as in the baseline study (31.5 Hz, digit II, left hand 0.13, digit II, right hand 0.15; 125 Hz, digit II, left hand 0.17, right hand 0.24).

A multiple regression analysis (VPTs as dependent variables; age, height, examiner and vibration doses as predictor variables) showed the strongest associations for the models including two of five calculated doses (current weighted A(8), r²=0.38; work+leisure a²*t weighted total dose, r²=0.29) in the highest exposed quartile (Table 1).

DISCUSSION
This is a fairly young cohort of machine shop and construction workers who have been followed since they participated finished school. The follow-up study showed an increase of reported neurophysiologic symptoms (tingling in vibration exposed workers as compared to the result from the baseline study. The vibration perception thresholds, however, were approximately at the same level...
at baseline and follow-up and no apparent deterioration was observed during the study period. A multiple regression analysis with VPTs as the dependent variable showed the strongest associations with two of five calculated vibration doses, A(8) and work leisure a²t weighted total dose, respectively.

In conclusion, neurophysiologic symptoms and vibration perception thresholds seem to appear after short-term exposure in this cohort of young vibration exposed workers, who will be followed up prospectively.

**REFERENCES**


**Table 1. Multiple regression analysis, digit II, left hand, 32 Hz, highest exposed quartile.** Parameter estimates and p-values. NS = non significant.

<table>
<thead>
<tr>
<th>Vibration dose definition</th>
<th>Intercept</th>
<th>Age</th>
<th>Height</th>
<th>Examiner</th>
<th>Vibration dose</th>
<th>R-squared significance of model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hours exposure (h)</td>
<td>0.78 (NS)</td>
<td>-0.026 (NS)</td>
<td>-2.9 x 10⁻⁵ (NS)</td>
<td>-0.05 (NS)</td>
<td>-1.1 x 10⁻⁶ (NS)</td>
<td>R² = 0.07 (NS)</td>
</tr>
<tr>
<td>A²t weighted total dose</td>
<td>0.84 (0.039)</td>
<td>-0.026 (0.036)</td>
<td>-0.001 (NS)</td>
<td>-0.05 (NS)</td>
<td>5.8 x 10⁻⁷ (NS)</td>
<td>R² = 0.22 (NS)</td>
</tr>
<tr>
<td>a²²t weighted total dose</td>
<td>0.75 (NS)</td>
<td>-0.023 (0.04)</td>
<td>-0.001 (NS)</td>
<td>-0.022 (NS)</td>
<td>9.9 x 10⁻⁵ (NS)</td>
<td>R² = 0.17 (NS)</td>
</tr>
<tr>
<td>Current weighted A(8)</td>
<td>0.98 (0.025)</td>
<td>-0.036 (0.006)</td>
<td>0.00 (NS)</td>
<td>-0.08 (0.045)</td>
<td>0.02 (NS)</td>
<td>R² = 0.38 (p = 0.042)</td>
</tr>
<tr>
<td>Work+leisure a²²t weighted total dose</td>
<td>1.30 (0.008)</td>
<td>-0.03 (0.035)</td>
<td>-0.003 (NS)</td>
<td>-0.062 (NS)</td>
<td>7.5 x 10⁻⁷ (NS)</td>
<td>R² = 0.29 (NS)</td>
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</table>

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The current Editor-in-Chief, Ramani Ramakrishnan, will be stepping down in 2012. A new Editor will be elected during the Annual General Meeting (AGM) in October 2012 and will become the new Editor-in-Chief from 2013 onwards. CAA is looking for an Assistant Editor who will work with Ramani Ramakrishnan and will be trained to be the next Editor. He or she will be nominated during the 2012 AGM and it is hoped that the membership will vote him/her to be the Editor-in-Chief.

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