

Digital rewarming time in the assessment of vibration-induced white finger

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WELSH CL. Digital rewarming time in the assessment of vibration-induced white finger. *Scand J Work Environ Health* 12 (1986) 249–250. An objective test is needed to confirm a patient's history of vibration-induced white finger. The rewarming time of fingers after cold provocation (hand cooling) in water at 10°C, during ischemia and accompanied by body heating, has been measured in three groups of subjects. For normal men the mean rewarming time was 1.38 (SD 0.48) min with an upper 99 % confidence limit of 2.63 min. For men with Raynaud's phenomenon who had not been exposed to vibration, the median rewarming time was 8.8 min. For men with vibration-induced white finger (VWF) the median rewarming time was 2.9 min. The rewarming time was significantly prolonged in the symptomatic groups when compared with that of the normal group, but it failed to discriminate between the patients with VWF and those with Raynaud's phenomenon with other etiologies.

Key terms: cold provocation, Raynaud's phenomenon.

It has proved difficult to develop an objective test for measuring the severity of vibration-induced white finger (VWF). Juul & Nielsen (1) described encouraging results using standardized cooling of the hand with arterial occlusion at the wrist and simultaneous body heating.

Subjects

The test was performed on three groups of subjects, normal men without a history of vibration exposure (group A), male patients who complained of Raynaud's phenomenon but who had not been exposed to vibration (group B), and men with VWF (group C).

Methods

A detailed history was taken from each subject, particularly concerning the severity and frequency of symptoms in the digits. Age, smoking habits, and occupational history were recorded. The subjects were asked to refrain from smoking for 1 h before the test. The subject lay supine on a couch covered first by a water blanket with a temperature of 40–45°C and then by a cotton blanket. Thermocouples were positioned on the volar surface of the distal phalanx of each digit of one hand and held in place with a strip of adhesive tape. The temperatures at the skin/thermocouple interface were recorded continuously with a potentiometric recorder (Ellab Z6D, Copen-

hagen). If the digital temperatures failed to reach 30°C after 15 min of body heating, the test was abandoned. If the recorded temperatures exceeded 30°C, a blood pressure cuff was inflated around the wrist to 40 mmHg (5 333 Pa) above the systolic blood pressure, and the hand was submerged in stirred water at 10°C. After 3 min of immersion the hand was removed from the water and dried. The blood pressure cuff was deflated and removed. The temperatures were recorded continuously during the rewarming period to beyond 30°C. The other hand was then tested.

The temperature recording from a normal finger is shown in figure 1. The rewarming time was defined as the time taken for the temperature to rise to 21°C from the temperature when the hand was removed from the water. The temperature recording from a subject with VWF is shown in figure 2.

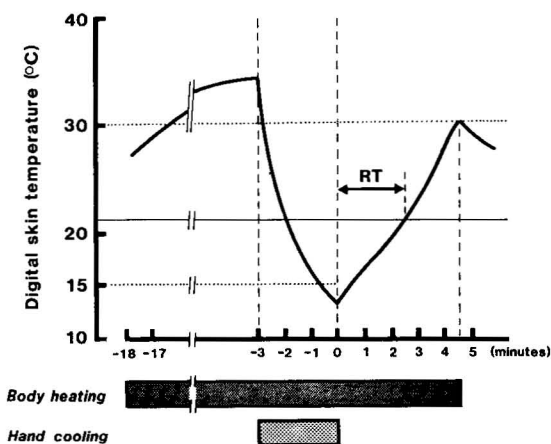


Figure 1. Rewarming times measured from the finger of a normal subject.

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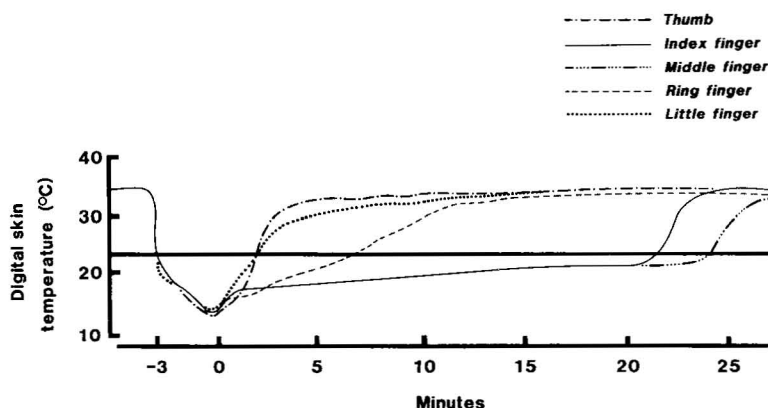


Figure 2. Rewarming times measured from the finger of a subject with vibration-induced white finger.

Statistical methods

The ages of the subjects were compared with Student's *t*-test. The number of smokers in each group were compared using the chi-square test with Yates correction. The rewarming times were compared by group with the Mann-Whitney *U* test.

Results

The characteristics of the groups tested are listed in table 1. The subjects in group B were significantly older than those in groups A and C ($p < 0.001$). No significant difference existed between any two of the groups with regard to the number of smokers.

The mean rewarming time for the normal men (group A) was 1.38 (SD 0.48) min. There was no significant difference for the rewarming time of the dif-

ferent fingers. The upper limit of normality was taken as the 99 % upper confidence limit.

The results of the groups tested are shown in table 2. The values of groups B and C were significantly different from those of group A ($p < 0.01$). For seven of the nine men in group B and five of the 96 men in group C the finger skin temperature did not rise above 30°C during the period of body heating.

Discussion

An important feature of the present test was the standardized conditions under which each subject was tested. Body heating insures that the sympathetic vasoconstrictor activity is low. The measurement of skin temperature is reproducible only if the influence of the sympathetic nervous system is inhibited (2).

Patients whose digital cutaneous temperature did not rise to above 30°C during 15 min of body heating were considered to have digital circulations which were severely occluded, and they were therefore excluded from the test, although the fact that the temperature of their fingers did not rise was noted and was in itself a very important finding.

The rewarming values of the normal subjects were not significantly different from those previously reported (1). The rewarming time was prolonged in men complaining of Raynaud's phenomenon when they were compared with normal subjects, and the differences were significant. There were no features of the rewarming that could be used to distinguish between the various causes of Raynaud's phenomenon.

Table 1. Characteristics of the subjects in group A (normal men), group B (men with Raynaud's phenomenon not caused by vibration), and group C (men with vibration-induced white finger).

Group	Age (years)			Number of current smokers
	Mean	SD	Range	
A (N = 20)	49.1	10.4	25-64	9
B (N = 9)	66.1	6.9	54-70	1
C (N = 96)	44.3	11.2	26-66	42

Table 2. Rewarming times of group A (normal men), group B (men with Raynaud's phenomenon not caused by vibration), and group C (men with vibration-induced white finger).

Group	Number of fingers	Time (min)	
		Median	Range
A	160	1.4	0.4-2.6
B	16	8.8	2.4-17.2
C	280	2.9	0.8-28.8

References

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