Vibration Injury Network

Research Network on Detection and Prevention of Injuries due to Occupational Vibration Exposures

Comparison of vibrotactile and thermal thresholds with two different measurement systems

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Introduction

Standardised objective tests of the hand-arm vibration syndrome have been developed to assist the diagnosis of the severity of peripheral neuropathy and include the measurement of vibrotactile and thermal thresholds (Lindsell and Griffin, 1998). Several types of vibrotactile equipment have been used and, although standardisation has been attempted in ISO/FDIS 13091-1 (2001), a range of different conditions giving different results meet the requirements of this standard. At present, there is no corresponding standard for thermal thresholds. The purpose of this study was to examine vibrotactile and thermotactile thresholds obtained using two different measurement systems with different contact conditions for both vibrotactile and thermal threshold measurements.

Method

For the vibrometry, the main differences between the systems (V_a and V_b) were in the probe contact conditions: both systems had a 6 mm diameter probe but while system V_b had no surround around the probe and no control of contact force, system V_a had a 10 mm diameter surround (with a 2 N contact force) and a 1 N force on the probe. For the thermal aesthesiometry, the two systems differed in contact conditions (the force was 2N for T_a but not controlled for T_b) and in starting temperature (32.5 C for T_a and skin temperature for T_b).

Twelve male subjects took part in three sessions over a three-day period. Each session took place at approximately the same time of day. In all three sessions, subjects gave vibrotactile and thermotactile thresholds using both systems. Thermal thresholds were always obtained before vibrotactile thresholds. Finger skin temperature and external temperature were measured before each session.

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Results

The vibrotactile system V_a gave significantly lower thresholds at 16 and 31.5 Hz in all three sessions (Wilcoxon, $p<0.01$) (Table 1). At 63 Hz, V_b gave significantly lower thresholds in session three only. At 125 Hz V_b gave significantly lower thresholds in sessions one and two. At 250 Hz, V_b gave significantly lower thresholds than V_a in all three sessions.

In each of the three sessions, system T_a gave significantly higher hot thresholds than system T_b (Wilcoxon, $p<0.05$) (Table 2). There were no significant differences in cold thresholds between systems in any of the three sessions.

Table 1 Mean vibrotactile thresholds (dB re 10^{-6} ms^{-2}) across frequencies and sessions.
(** V_a significantly different from corresponding value with V_b, $p<0.01$)

Frequency	Session one		Session two		Session three	
	V_a	V_b	V_a	V_b	V_a	V_b
16	94 **	110	94 **	111	94**	111
31.5	104**	113	106**	114	103**	111
63	108	106	111	112	110	106*
125	108	103*	108	105*	107	104
250	108	103**	108	105**	107	104**

Table 2 Mean absolute thermal thresholds for both systems in three sessions
(** T_a significantly greater than corresponding value with T_b, $p<0.01$)

	Session one		Session two		Session three	
	T_a	T_b	T_a	T_b	T_a	T_b
Hot thresholds	38.3**	35.4	38.1**	35.6	38.0**	35.7
Cold thresholds	25.6	25.9	25.9	26.5	26.1	27.2

Conclusion

The vibrotactile thresholds measured by the two systems are consistent and differences can be explained by the known effects on thresholds of contact conditions between the finger and the probe (Maeda and Griffin, 1994). For instance, our findings suggest that the surround reduces thresholds at low frequencies and elevates thresholds at high frequencies, which is in agreement with previous studies (e.g. Harada and Griffin, 1991). The results have implications for the standardisation of measurements commensurate with ISO 13091-1 (2001). The differences between thermal thresholds require further consideration and are discussed in the paper.

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