Preliminary data on VibraTip®, a new source of standardised vibration for bedside assessment of peripheral neuropathy

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Preliminary data on VibraTip®, a new source of standardised vibration for bedside assessment of peripheral neuropathy

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Abstract

Testing vibration sense is a recognised component of neuropathy assessment. One hundred consecutive patients attending diabetic annual review and podiatry clinics were enrolled in a study to compare a 10 g Semmes–Weinstein monofilament and a 128Hz tuning fork with VibraTip®, a novel, key-fob-sized source of fixed amplitude vibration for the identification of peripheral neuropathy. Patients were tested sequentially with the three devices in random order on either the left or right foot. Of the 100 patients 55 felt both the vibrating tuning fork and VibraTip, the remaining 45 patients felt neither. Pressure from the 10 g monofilament was perceived by 53 patients of whom 51 also felt VibraTip®. VibraTip® proved a practical, hygienic, simple, rapid and very specific test of the integrity of vibration sense, easily controlled with a null stimulus, that appeared highly engaging for patients. As the utility of testing for neuropathy is no more or less than a strategy to persuade patients to change their behaviour, VibraTip® may be a useful addition to sensory nerve function testing at the clinical interface.

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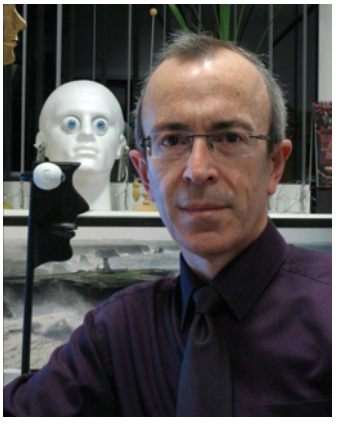
Key words: neuropathy, pallesthesia, vibration



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Introduction

Loss of the ability to feel vibration is increasingly prevalent with advancing age and, together with paraesthesia and loss of proprioception, is also characteristic of large fibre neuropathy. The latter is significantly associated with risks of tissue damage and cardiovascular risk factors such as hypertension, dyslipidaemia, obesity, male sex and smoking.[1,2] While testing vibration sense is universally taught to medical undergraduates as an integral component of nervous system clinical examination, its principal utility in the diabetic clinic is as an educationally compelling demonstration to patients that they are at risk and may need to modify their behaviour accordingly. The concept that disordered sensory nerve function may continue to provide 'feeling' and even pain, but that these sensations no longer protect from tissue damage sustained by climbing into a bath that is too hot or wearing ill-fitting shoes, for example, is a difficult and complicated message to get across and rehearse often enough to make a difference.

Tuning forks applied directly to the skin have been used to test the integrity of vibration sense since the beginning of the 20th century[3-5] but there is little agreement about the optimal frequency of vibration[6] or the method for making the tuning fork vibrate in the first place. Tuning forks are cold to the touch and require pressure to impart vibration, both of which incur variability and impair specificity, additionally their size makes them cumbersome to carry around and difficult to use without inappropriate cueing. Tuning forks were designed to produce a set pitch rather than set amplitude, and the initial stimulus intensity varies depending on how hard they are struck, how much time has elapsed since they were struck and how firmly they are applied to the skin. Tuning forks left out on the wards have a

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Figure 1. VibraTip®: a new device using standardised vibration for detection of peripheral neuropathy

Figure 2. Standardised vibration is activated by squeezing the casing between finger and thumb and is felt at the rounded tip of the device

propensity to go missing. Once locked away, they are no longer available at the point of use.

More specialised equipment such as Reidel–Seiffer calibrated tuning forks, biothesiometers and neurothesiometers are generally confined to specialist and research settings and in use have specific requirements about application pressures that are rarely addressed. This lack of consistency is exacerbated by the irresistible urge to 'hit the tuning fork harder and try again' if the patient is unable to feel it in the first place. These factors increase the time required and reduce the overall utility of testing for pallesthesia in the clinical arena. Lastly there is no precedent for autoclaving tuning forks or wiping them between patients to address infection control imperatives.

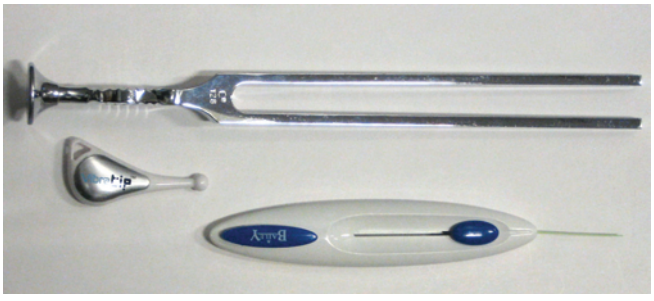
The device

VibraTip® contains a micro-vibrating motor powered for many months of routine use in a clean, sealed, disposable unit (figure 1). It was designed to overcome many of the limitations of tuning forks by providing a constant source of gentle vibration activated by squeezing the casing firmly between finger and thumb (figure 2). By gently touching the patient's skin twice with the rounded tip of the device, each time for about half a second, explaining that 'this is touch one' and 'this is touch two' while making either of the two stimuli vibrate, it provides a rapid and specific assessment of the integrity of vibration sense. In very quiet settings, any sound from the device audible over background noise can be effectively masked by only activating it while the explanations 'this is touch one' or 'this is touch two' are recited. The result is a specific vibration stimulus of arbitrary but reproducible amplitude with high face validity.

Study design

A cross-sectional study of 100 consecutive patients attending hospital-based diabetes annual review and podiatry clinics in Bristol was designed to determine whether the fixed amplitude of vibration has any clinical utility. Subjects were tested for the presence of peripheral neuropathy using a 128 Hz tuning fork, a 10 g monofilament and VibraTip® (figure 3) in block randomised order. Each stimulus was gently applied to either the patient's left or right foot in five different places, comparing vibration from tuning fork with damped tuning fork, VibraTip® with and without activation (as described above) and 10 g monofilament applied as recommended or held above the foot but without touching the skin surface. Agreement between the three methods was examined using a kappa-statistic and McNemar's test to investigate whether any of the methods led to increased rates of diagnosis.

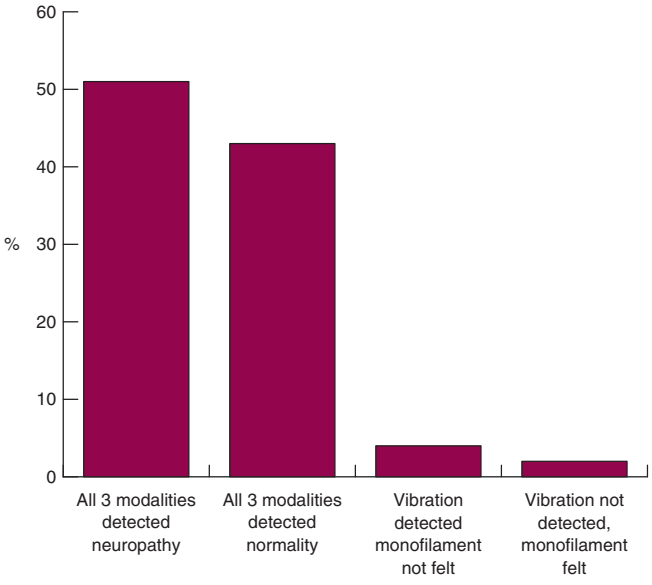
Figure 3. Instruments used to test for presence of peripheral neuropathy: 128 Hz tuning fork, VibraTip® and 10 g monofilament.



Results

For the non-vibrating presentation of VibraTip®, no patients thought they could feel vibration when no such vibration was

Figure 4. Agreement in detection of sensory impairment between 128 Hz tuning fork, VibraTip® and 10 g monofilament in 100 adult patients with diabetes



being applied. With the tuning fork, four patients stated that they could feel 'some' vibration from the non-vibrating tuning fork but were indecisive. The vibrating tuning fork and VibraTip® were both felt by the same 55 of 100 patients and not by the other 45 patients. If the clinician gave the tuning fork an extra hard hit with the patella hammer, however, a few subjects (n=3) claimed to perceive some vibration who did not perceive it on initial presentation. This probably resulted from vibration propagating further up the leg (bone conduction) and increased audibility leading to inappropriate cueing. For the monofilament 53 patients were able to feel the sensation, of which 51 were the same as for the VibraTip® results. Agreement was similar between the detection methods (figure 4).

Discussion

In neuropathy testing by experienced and interested operators, Rydel–Seiffer graduated tuning forks have been shown to correlate well with thresholds obtained in diabetic patients with electromagnetic instruments such as a Bio-Thesiometer (Bio-Medical Instrument Company, Newbury, OH, USA).[7,8] In practice, testing is often limited by the availability of appropriate instruments and lack of sufficient time to instruct the patient about what sensations to look out for and how to respond. Irrespective of the above, the fundamental utility of neuropathy testing rests on whether the demonstration of nerve dysfunction will bring about changes in behaviour that reduce risk of tissue damage.[9] Unless a device to test nerve function is to hand and an irrefutable result obtained, the demonstration may not be compelling enough to induce patients to modify their behaviour. Why wait until a neuropathic threshold has been exceeded before educating patients about protective footwear? By being given a device to keep on the bedside table (not necessarily to use) VibraTip® might remind a person with diabetes to put a hand in his or her shoe before putting a foot in it.

Key messages

- Reconsider neuropathy testing as an educational tool to reduce risk-taking behaviour
- The new device has a vibration perception threshold similar to a standard 128 Hz tuning fork: neuropathy detection was comparable to using a 10 g monofilament
- The new device is rapid, reliable and hygienic
- Patients and clinicians found the new device very acceptable

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