

Sensory testing with point of folded paper – a comparison with standardized nylon monofilaments

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Abstract

Background: Semmes–Weinstein monofilaments are ideal for sensory testing, however they are not freely available. An effective, cheap method for sensory testing, without risk of disease transmission would be ideal, for field clinics in developing countries. Kumarasinghe (2001) introduced use of point of folded paper for sensory testing in leprosy patients.

Aims: 1. To test efficacy of point of folded paper as a tool for sensory testing, compared to nylon monofilament (NMF) in the Neuropen[®] (Owen Mumford, Oxon, UK) 2. To compare 45 gsm (grammes per sq. metre) paper and 80 gsm paper as a tool for sensory testing compared to the NMF.

Methods: **Part I:** 80 gsm and 45 gsm paper was used. A4 size paper (210x297mm) was cut into 4 equal parts and each was folded twice and creased to give a sharp point. Healthy volunteer medical students were recruited. They were requested firstly to say whether they feel touch/pressure with the 3 different materials and then compare sensations of points of 45 gsm and 80 gsm folded paper with the Neuropen NMF. Volar aspect of forearms were tested separately. Subjects were blinded and same observer carried out tests. Paper points were pressed lightly, perpendicular to skin, as in the case of NMF. Subjects were requested to state whether the sensory testing methods were 'not different', 'slightly different' or 'totally different'.

Part II: Ten consecutive patients diagnosed as tuberculoid (TT) and borderline tuberculoid (BT) leprosy, attending Dermatology Clinic at Colombo North Teaching Hospital were tested separately with monofilament of Neuropen and point of twice folded, ordinary prescription paper (45 gsm). Patients were blinded to the device used each time for testing sensations within and outside the hypopigmented patches.

Results: **Part I:** There were 80 (55.2%) males and 65 (44.8%) females (n=145). Mean age was 23.9 yrs (range 21-27 yrs). All subjects said that touch/pressure was felt with all three materials (NMF, 45 gsm and 80 gsm paper). In the comparison of 45 gsm paper with NMF, 56.5% stated that sensation was 'not different', 42.7% said 'slightly

different', only 0.68% said sensation was 'totally different'. When 80 gsm paper and NMF were compared 30.3% stated that it was 'not different', 66.2% said 'slightly different' and only 3.4% said that it was 'totally different'.

Part II: In all 10 patients (6 M, 4 F, 22-60 years) tested, both NMF and paper points were able to elicit the appropriate responses by patients about area of sensory impairment. Sensory impairment elicited correlated with the lesions of leprosy.

Conclusions: Sensory testing with point of folded paper is a suitable alternative to standardized NMF. 45 gsm paper point was more closely comparable to the NMF than 80 gsm paper. Sensory testing on leprosy patients with sensory impairment confirmed that it can be used successfully in leprosy patients as well. Sensory testing with point of paper would be valuable in field clinics in developing countries where suitable NMF are not available.

Introduction

Sensory impairment is a characteristic feature of paucibacillary leprosy. Demonstration of sensory loss on a hypopigmented macule or macules generally points to a clinical diagnosis of paucibacillary leprosy in an endemic area. The first author reported for the first time, successful use of point of folded paper as a tool for sensory testing in leprosy patients and described the technique. (Kumarasinghe, *Int J Dermatol* 2001)¹. Metal pins are unsuitable for successive patients (if the same pin is used) due to risk of transmitting diseases such as HIV/AIDS and hepatitis B. This is of particular relevance in those developing countries where both leprosy and HIV disease are prevalent. If pins are used, their disposal also needs to be carried out properly. The standardized Semmes-Weinstein nylon monofilaments, or instruments such as Neuropen[®] (Owen Mumford Ltd. Woodstock, Oxon, UK) using the same principle² are recommended for sensory testing. Neuropen is a clinical device that assesses both pain and pressure perception². In a comparison of the Neuropen against standard quantitative sensory-threshold measures for assessing nerve function, Paisley et al have reported

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that it is a sensitive device for assessing nerve function². However, Neuropens or Semmes-Weinstein nylon monofilaments are not freely available in many hospitals and field clinics in developing countries. Furthermore, in some countries in Africa and Asia, where leprosy is still a major public health problem, the diagnosis and treatment of leprosy is done by healthcare workers (who are not qualified physicians), based on the clinical appearance of lesions and sensory testing, without any microbiological or histopathological confirmation.

Therefore, a user-friendly, effective, cheap, reproducible, practical method, without any risk of disease transmission would be beneficial, for sensory testing in the field clinics in developing countries. Such a method would be very useful and cost effective in the global perspective.

Sensory testing, with the sharp point of twice folded paper has many advantages over other methods. It carries no extra cost as paper is universally available, it is user friendly and patient-friendly, children do not get scared of paper as with pins, there is no risk of disease transmission or injury and the disposal of the tested paper is not a problem unlike in the case of pins. The first author has used this technique for sensory testing in clinical cases of leprosy and found it to be useful and effective (Fig 1), however no formal study has been conducted before, to validate 'point of folded paper as a tool for sensory testing'. There are no other literature on this simple method of sensory testing. Although tip of ball pen has been used by some^{3,4}, if reused repeatedly, it can also transmit disease like a metal pin. Tooth picks also have been used by some, but they are also often not available in field clinics.

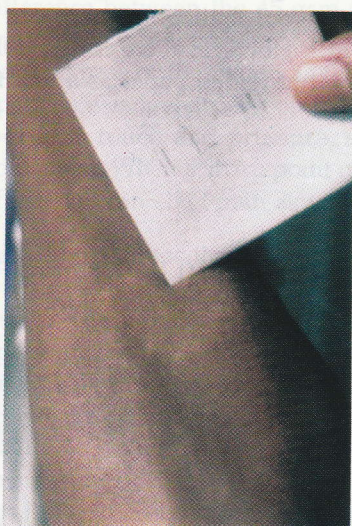


Figure 1. Testing touch/pressure sensation on the left forearm of a patient with a semianaesthetic hypopigmented macule with the point of 45gsm paper. The patient was clinically diagnosed as having tuberculoid leprosy and the biopsy confirmed the clinical diagnosis.

Aims

1. To test the efficacy of sharp point of folded paper as a tool for sensory testing in comparison to the standard nylon monofilament of the Neuropen[®].
2. To compare freely available, thin 45 gsm (grammes per square metre) paper and 80 gsm paper as a tool for sensory testing in relation to the nylon monofilament

Methods

Ethical approval for this study was obtained from the Ethical Review Committee of the Faculty of Medicine, University of Sri Jayewardenapura, Sri Lanka.

Volunteer medical students were recruited for the study in response to notifying the student body of the Faculty of Medicine, University of Sri Jayewardenapura. Paper specification: 80 grammes per square metre (80gsm) photocopy papers and 45 gsm papers were used for testing. The papers were procured from a paper supplier. Each A4 size paper (210X297 mm) was cut into 4 equal rectangular parts. Then each of these single sheets of paper was folded twice, pressing to get a sharp crease, halving every time. The sharp point of the folded paper was pressed perpendicular to skin, similar to the way a bristle (monofilament) is pressed for sensory testing. One piece of folded paper was used to test only one person. Similarly, 45 gsm paper, equivalent in thickness and texture to what is available at the Out Patients' Department clinics was also folded and taken for sensory testing. The standardized monofilaments of Neuropen[®] (10 g maximum pressure) were used for comparison. On each subject, a nylon monofilament (NMF) was pressed perpendicular to the skin surface of the test area until the monofilament slightly bowed (bent). The Neuropens were obtained from the Anti Leprosy Campaign (Courtesy Dr. Sunil Settinayake, Head-Anti Leprosy Campaign, Sri Lanka and Mr. Adrian Basnayake, ABC Pharma Services, Colombo, Sri Lanka).

Each subject was told that sensory testing would be done to compare the three tools, but they were blind-folded during testing. Before they were asked to comment on the relative differences of the sensation, they were asked whether they feel the touch/pressure of the point of paper as well as the Neuropen. The pressure exerted during testing was just the pressure needed to slightly bend the NMF and for paper it was the pressure needed to give rise to a small dell like depression (transient) at the point of pressure. For paper, pressure was not continued until the paper bent. Both NMF and the paper points were pressed against the skin at a 90 degree angle (perpendicular) to the skin surface. A separate piece of paper (under each 45 gsm and 80 gsm thickness categories) was used for each individual, to avoid blunting of the point

of paper due to repeated use. The same observer did all the tests to avoid observer bias. Initially each subject was asked to compare sensation between point of 45 gsm paper and the Neuropen nylon monofilament and later, 80 gsm photocopy paper and the Neuropen monofilament. The subjects were requested to say whether the two modalities used for each comparison were 'not different', 'slightly different', or 'totally different' as they perceive the test with different devices. Each subject was tested for the same comparisons (45 gsm paper vs monofilament, 80 gsm paper vs monofilament) on ventral aspects of both forearms. The data of each subject was recorded on separate data sheets.

In the second part of the study, 10 consecutive patients diagnosed as tuberculoid and borderline tuberculoid leprosy, attending the Dermatology Clinic at Teaching Hospital, Ragama were tested separately (technique as described above) with the monofilament of Neuropen and the point of ordinary prescription paper (45 gsm). They were asked to comment whether they felt a difference in the intensity of the touch/pressure sensation in the hypopigmented lesion and outside the lesion when tested with each device. In this part of the study no attempt was made to compare the sharpness of two devices; they were assessed whether each type of material was able to detect sensory impairment accurately. Patients were blinded to which device was used each time.

Results

Part I: There were 80 (55.2%) males and 65 (44.8%) females with a total of 145. The age of subjects ranged from 21-27 years with a mean of 23.9 yrs. Results were tabulated for each forearm separately and then the average was taken. All the subjects responded positively when pressure/touch sensations were tested with the point of folded paper. Table 1 summarises the comparison of sensations when tested with 45 gsm

paper vs Neuropen monofilament and 80 gsm paper vs Neuropen monofilament. Sensation for each forearm was recorded separately but later the averages were taken for left and right forearm measurements before calculating percentages for different levels of perception (not different, slightly different or totally different).

In the comparison of 45 gsm paper with the monofilament, 56.5% said the sensation was 'not different', 42.7% said that sensation was 'slightly different', only 0.68% said that the sensation was 'totally different'. When 80 gsm paper and monofilament were compared 30.3% stated that it was 'not different', 66.2% stated that it is 'slightly different' and only 3.4% said that it was 'totally different'.

Part II: In the 10 patients (6 M, 4 F, 22-60 years) tested, both NMF and the paper points were able to elicit the appropriate responses by the patients about the area of sensory impairment. The sensory impairment correlated with the hypopigmented lesions of TT and BT leprosy.

Discussion

Leprosy bacillus is a neurotrophic mycobacterium, thus nerve involvement in leprosy is a characteristic feature⁵. Early detection of leprosy is important from the points of view of the patient and the community. A delay in diagnosis may lead to more complications and spread of the disease among the community. Therefore, detection of leprosy in field settings is important. Practical, user friendly, simple, but sufficiently efficient tools for assessing sensory loss are valuable. Von Brakel reviewed several modalities used for sensory testing in field settings, including finger touch, cotton wool, ball point pen, pin prick and monofilament^{3,4}. However there is no published data on use of point of folded paper as a tool for sensory testing.

Table 1. Difference of perceived sensation on the right (R) and left (L) forearms when 45 gsm and 80 gsm paper were compared with the Neuropen[®] nylon monofilament (maximum pressure 10 g) in 145 subjects

Sensation	'Not different'		'Slightly different'		'Totally different'	
45 gsm paper vs nylon monofilament	R- 86	L - 78	R -58	L - 66	R-1	L-1
	Mean 82 (56.55%)		Mean 62 (42.75%)		Mean 1 (0.68%)	
80 gsm paper vs nylon monofilament	R- 43	L - 45	R - 97	L - 95	R-5	L-5
	Mean 44 (30.34%)		Mean 96 (66.20%)		Mean 5 (3.44%)	

Semmes-Weinstein monofilaments have been used effectively for sensory testing in leprosy patients^{6,8}. Neuropen^R (Owen-Mumford, UK) is a commercially available device for sensory testing which has a standard nylon bristle with a specified maximum weight (e.g. 10 g) before it bends². It is based on graded Semmes-Weinstein monofilaments. It has been used successfully for sensory testing, particularly in evaluating peripheral neuropathy of diabetic patients². However this instrument is not freely available and is relatively expensive for a developing country (33.50 US Dollars).

All subjects stated that touch/pressure sensation was felt with all testing devices 45 gsm paper, 80 gsm paper and the Neuropen monofilament. The sharp point of folded paper appears to test touch/pressure sensations similar to the tip of a nylon monofilament. Our results indicate that freely available 45 gsm paper (available at all out patient department clinics in Sri Lankan Government hospitals) as well as 80 gsm photocopy paper are suitable objects for sensory testing. Infact, only 0.68% (45 gsm paper vs monofilament) and 3.4% (80 gsm photocopy paper vs monofilament) of subjects stated that the sensations are totally different when compared with the monofilament of the Neuropen. If the 'not different' and 'slightly different' groups are taken together, as an indicator of a suitable alternative to sensory testing with nylon monofilaments; 99.3% of the 45 gsm paper group and 96.4% of the 80 gsm paper group fall into this group. The average values for the two sides (right and left forearms) were very similar, again indicating that these readings are reliable.

The difference between the 45 gsm OPD paper and 80 gsm photocopy paper is probably due to the difference in thickness of the paper, as the thinner 45 gsm OPD paper gives a sharper point. The point of folded paper tests touch and pressure, similar to a nylon monofilament. When a sharp point of thin paper is pressed further it can elicit pain as well.

Testing with paper has the added advantage that there is no risk of injury to a patient with sensory impairment, as the paper bends after a minimal amount of pressure, unlike with a pin or another hard object such as a toothpick. Toothpicks are also not available freely in field clinics in remote areas. Checking sensations with pins is not recommended now due to risk of transmission of diseases such as HTV-AIDS and hepatitis B. Table 2 shows advantages of the point of folded paper as a tool for sensory testing. Checking sensations with the tip of the ball pen is also not suitable; in addition to staining the skin of the patient, if used repeatedly on different patients there is a risk of disease transmission (if there is a breach of skin). One

piece of paper can be used for one patient and this can be disposed easily. There is no need to look for a specific sharps disposal container as with sharp metal objects like pins.

Table 2. Advantages of sharp point of folded paper as a tool for sensory testing

- effective
- no added cost
- freely available
- no risk of disease transmission
- easy to dispose after use, unlike the pins
- no risk of injury to the patient
- child friendly
- no special training required
- ideal for field clinics in developing countries

The point of folded paper can also be slightly pressed and dragged along in any direction, on a hypopigmented macule for quick evaluation of boundaries of a patch of sensory loss, as there is no risk of injury to skin. Furthermore, a corner of a single layer of same paper can be used to test for soft touch as well.

The results of Part II of the study clearly shows that point of folded paper can be used effectively for sensory testing in leprosy patients, comparable to the nylon monofilaments.

The first author has used this method of sensory testing with point of ordinary 45 gsm and 80 gsm folded paper, in leprosy patients with sensory impairment on hypopigmented macules as well as on limbs with peripheral nerve trunk involvement and found it very practical and useful. A detailed study is underway evaluating efficacy of point of folded paper in leprosy patients with sensory impairment. This method may be useful in assessing sensory impairment due to any form of neuropathy such as diabetic peripheral neuropathy, in places where graded nylon monofilaments are not available. Here again, the absence of risk of injury in assessing diabetic sensory impairment is a distinct advantage of the paper method, compared to pins or toothpicks.

Conclusion

Sensory testing with the point of folded paper is a suitable alternative to standardized nylon monofilaments. 45 gsm paper point appeared to be more comparable to the nylon filament than 80 gsm paper. Sensory testing on leprosy patients with sensory impairment confirmed that it can be used successfully

in leprosy patients as well. This method of testing carries no added cost, is user friendly, effective, freely available and carries no risk of injury or disease transmission. Sensory testing with point of paper would be very valuable in field clinics in developing countries where standardized nylon monofilaments are not available. Initial trials of sensory testing with folded paper in leprosy patients have been very encouraging.

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