Brief Report

Early detection of sensory nerve function impairment in leprosy under field conditions

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Abstract

Aim: To assess the fine sensation of palms and soles in field conditions, to enable early detection of nerve function impairment before the loss of protective sensation, thus preventing the development of disability.

Methods: A cross-sectional descriptive study was conducted at seven tertiary referral hospitals located in different states in India. This study included all newly diagnosed patients affected by leprosy, who were registered during the period between March 2011 and April 2012. A detailed history was taken along with charting and voluntary muscle testing /sensory testing (VMT/ST) for the diagnosed patients. The sensation was measured using 0.2 gm Semmes-Weinstein filaments for palms and 4 gm for soles first, followed by 2 gm Semmes-Weinstein filaments for palms and 10 gm for soles.

Results: Among the 374 patients, 106 were identified with sensory nerve function impairment. Of the 106 patients, 84 were identified with absence of both fine and protective sensation and 22 patients had a loss of fine touch sensation with protective sensation intact.

Limitation: This study was conducted only among patients who were newly diagnosed with leprosy. Hence, future longitudinal studies in a larger population will add more validity to the study.

Conclusion: The patients who had loss of fine sensation would have been missed by the normal leprosy programme protocol which uses 2 gm and 10 gm filaments for testing sensory loss before initiating steroid therapy. Further research is needed to determine whether testing for fine sensation with 0.2 gm Semmes-Weinstein filaments for palms and 4 gm for soles can be introduced at all specialized leprosy centres to detect nerve function impairment at an earlier stage followed by steroid therapy.

Key words: Leprosy, sensory testing, nerve function impairment, disability, Semmes-Weinstein filament

Plain Language Summary

Leprosy is a chronic bacterial infection that attacks the peripheral nerves. This may cause nerve function impairment, which, if not detected early and addressed effectively, leads to serious medical and social problems in the affected person. In the leprosy programme, sensory testing is done using 2 gm Semmes-Weinstein monofilament for palms and 10 gm for soles, which detect protective sensation but not fine sensation. The fine sensations are lost long before the loss of protective sensation in the palms and soles. This Indian study was carried out in seven tertiary referral hospitals for leprosy and aimed to detect sensory nerve function impairments early by using 0.2 gm and 4 gm Semmes-Weinstein monofilament in field conditions, thus preventing the development of disability. In total, 374 newly diagnosed leprosy patients were included. Of the 374 patients, 84 (22.5%) had lost both fine and protective sensation and 22 (5.9%) patients had a loss of fine touch sensation with protective sensation intact. This study shows that the patients who had lost fine sensation would have been missed in the normal leprosy programme protocol which uses 2 gm and 10 gm filaments for testing sensory loss before initiating steroid therapy.

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Introduction

Preventing permanent disabilities due to nerve function impairment remains a major concern in leprosy control.[1] Mycobacterium leprae, the causative agent of leprosy, infiltrates Schwann cells of peripheral nerve fibres.[2] Subsequently, the nerve fibres can be damaged by the accumulation of bacteria and hypersensitivity reactions of the immune system. The decline of nerve function can take place before, during and/or after leprosy treatment. Early detection (within six months) and corticosteroid treatment may prevent further decline.[3] Nerve Function Impairment distinguishes leprosy from other diseases in several ways: it is insidious, often painless, generally neglected by the affected person and his/her family, progressive if not treated, and results in irreversible nerve damage. Motor and sensory nerve function impairment are still the worst complications of leprosy,[3] and if not detected early, and addressed effectively, lead to serious medical and social problems in the affected person.

Several studies,[4] mostly operational, and undertaken mainly to manage complications, have been done but the problem of early nerve function impairment in leprosy and its association with various social, clinical and epidemiological parameters, has not been thoroughly investigated and needs further research.[5] Thus, we are forced to use clinical experience and available tools astutely and effectively in field conditions for early detection of nerve function impairment, without recourse to expensive/ hi-tech laboratory tests. This necessitates studies to devise ways of assessing the risk of nerve function impairment and prevent it, by developing specific diagnostic tools for field application.[6]

In the leprosy programme, sensory testing is mostly done using 2 gm monofilament for palms and 10 gm for soles, which detects protective sensation but not fine sensation. The fine sensations are lost long before the loss of protective sensation in the palms and soles. Therefore, this study aimed to assess the deterioration of fine sensation of palms and soles before the loss of protective sensation and to assess the suitability of fine touch testing Semmes-Weinstein filaments for field application. This will detect nerve function impairment early and prevent the development of disability.

Methods

A cross-sectional descriptive study was conducted at seven tertiary referral hospitals for leprosy disease in India at Shahdra (Delhi), Purulia (West Bengal), Barabanki (Uttar Pradesh), Naini (Uttar Pradesh), Kothara (Maharastra) and Chandkuri (Chaatisgarah). Persons reporting for the first time for diagnosis and treatment, registered in the referral hospital were included after taking consent. Totally, 374 patients were included in this study from March 2011 to April 2012.

Procedure

Initially, an orientation programme was conducted for the physiotherapists from the participating centres to ensure uniformity. Each patient had a detailed history taken along with body charting, voluntary muscle testing and sensory testing. After the registration, participants underwent nerve function impairment assessment which was recorded along with the routine sensory and motor nerve function testing.

Sensory testing: Sensation was measured using 0.2 gm Semmes-Weinstein filaments for palms and 4 gm for soles first for testing the fine sensation, followed by 2 gm Semmes-Weinstein filaments for palms and 10 gm for soles for testing the protective sensation. On each hand, three points on the ulnar nerve and three points on the median nerve were tested. On each foot, four points in the area of the posterior tibial nerve were tested [Figure 1].[7]

The sensory score for each point: For each site, the presence of sensation was scored '1' and the absence of sensation was scored '0'. The scores ranged 0–3 for ulnar nerve site of palm, 0–3 for median nerve site of palm and 0–4 for posterior tibial nerve site of sole for each testing of fine and protective sensation.

Motor testing: Muscle strength was tested with the modified Medical Research Council scale (0–5). The muscles strength was categorized as normal (Medical Research Council grade, 5 & 4), impaired (Medical Research Council grade, 3, 2 & 1) and paralysis (Medical Research Council grade, 0). Muscles innervated by the facial, ulnar, median, radial, and lateral popliteal nerves were assessed by asking the participant to perform five movements: eye closure, little finger abduction, thumb abduction, wrist extension, and ankle dorsiflexion.[8]

Ethical clearance was obtained from Research Ethical Committee of The Leprosy Mission Trust India, New Delhi and written consent from the participants was obtained. The collected individual data were entered and analysed in Microsoft database excel sheets (Microsoft Office Excel 2007).

Results

Among the 374 patients, 141 (37.7%) were females (32 children) and 233 (62.3%) were males (35 children) with an age range of 9 to 74 years. Of these, 247 (66%) were between 15 and 45 years. One-hundred and nine (29.2%)

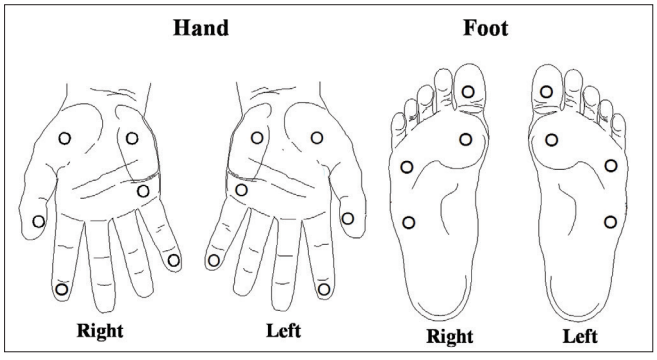

Figure 1: Monofilament test sites in hand and foot

were working as manual labourers/farmers, 94 (25.1%) were students and 83 (22.2%) were housewives. Two-hundred and seventy-one (72.5%) were either illiterate or had only primary education [Table 1].

At the time of reporting, 34 (9%) had grade 1 disability and 53 (14%) had grade 2 disability. The bacterial index was positive in 61 (16%) patients, with 37 (10%) having a bacterial index above two. One-hundred and twenty six (34%) were prescribed steroids along with multi-drug therapy at the first visit. The main cause (58%) for the delay in presentation was ignorance of the early signs of leprosy [Table 2].

About 28 (7.5%) of the participants had right ulnar nerve impairment; of these, 15 (4%) had paralysis. In the left ulnar nerve, 33 (8.8%) had impairment, of which 17 (4.5%) had paralysis. In the median nerve, about nine (2.4%) of the participants had impairment in the right nerve and six (1.6%) in the left nerve. Very minimal level of impairment was present in the facial and lateral popliteal nerve on both sides. There was no impairment in the radial nerve [Table 3].

The results of the sensory assessment of the participants is shown in Table 4. Out of the 374 patients included in the study, 106 (28.4%) had sensory nerve function impairment, of which 84 (79.2%) had lost both fine and protective sensation and 22 (20.8%) patients had a loss of fine touch sensation with protective sensation intact. The sites wise sensory assessment is shown in Table 5.

Among the sensory impairment of the 79 (21.1%) male patients, 18 (22.8%) had a fine sensory loss and intact protective sensation while it was similarly detected in four (14.8%) female patients. Of the 106 patients with sensory impairment, nine (8.5%) were aged below 15 years and two (1.9%) had a fine sensory loss. About 59 (55.6%) of the participants reported within six months after noticing the first symptoms; of these, 12 (20.3%) had fine sensory loss [Table 6].

Among the 22 fine sensory loss patients, 10 (45.5%) of them had lost fine sensation in the right ulnar nerve site of the hand while it was nine (40.5%) in the left hand. In the median nerve sites, Eight (36.4%) had lost fine sensation in the right hand and six (27.3%) in the left hand. In the foot, 10 (45.5%) had lost fine sensation in the right foot due to impairment of posterior tibial nerve while it was seven (31.8%) in the left foot [Table 7].

Discussion

Early detection of nerve function impairment improves prognosis and prevents deformity in leprosy, with delay in detection being strongly associated with an increased risk

Table 1: Demographic profile of the participants (*n* = 374)

Status	Frequency	Percentage	95% CI
Sex			
Male	233	62.3	0.572–0.672
Female	141	37.7	0.328–0.428
Age			
Below 15	67	17.9	0.142–0.223
15 to 30	150	40.1	0.351–0.453
31 to 45	97	25.9	0.216–0.307
46 to 60	36	9.6	0.068–0.131
Above 60	24	6.4	0.042–0.094
Marital Status			
Married	204	54.6	0.494–0.597
Single	162	43.3	0.382–0.485
Widow and separated	8	2.2	0.009–0.042
Occupation			
Manual labourer/farmer	109	29.2	0.246–0.340
Skilled labour	46	12.3	0.092–0.161
Clerical worker/ professional	11	2.9	0.015–0.052
Housewife	83	22.2	0.181–0.268
Student	94	25.1	0.208–0.299
Not working	31	8.3	0.057–0.116
Education			
Primary	132	35.3	0.305–0.404
Secondary	84	22.5	0.183–0.270
Graduate or higher	19	5.1	0.031–0.079
Illiterate	139	37.2	0.323–0.423

Table 2: Disease profile of the participants (*n* = 374)

Status	Frequency	Percentage	95% CI
Bacterial Index			
Negative	313	83.7	0.796–0.873
0.1–2	24	6.4	0.042–0.094
2.1–4	20	5.4	0.033–0.081
Above 4	17	4.6	0.027–0.072
RJ classification			
Tuberculoid	268	71.7	0.668–0.762
Boderline tuberculoid	64	17.1	0.134–0.213
Borderline borderline	9	2.4	0.011–0.045
Borderline lepromatous	10	2.7	0.013– 0.049
Lepromatous leprosy	23	6.2	0.040– 0.091
WHO disability grade			
Grade 0	287	76.7	0.721–0.809
Grade 1	34	9.1	0.064–0.125
Grade 2	53	14.2	0.108–0.181
EHF score			
Score 0	287	76.7	0.721–0.809
Score 1	21	5.6	0.035–0.085
Score 2	35	9.4	0.066–0.128
Score 3 and above	31	8.3	0.057–0.116
Treatment given at enroll			
Multi-drug therapy	248	66.3	0.613–0.711
Multi-drug therapy& Steroids	126	33.7	0.289–0.387

Table 3: Results of muscle power of the participants (*n* = 374)

Muscle Power	Right Side					Left Side				
	Facial	Ulnar	Median	Radial	Lat.Pop	Facial	Ulnar	Median	Radial	Lat.Pop
Normal	373 (99.7%)	346 (92.5%)	365 (97.6%)	374 (100%)	371 (99.2%)	374 (100%)	341 (91.2%)	368 (98.4%)	374 (100%)	372 (99.5%)
Impaired	1 (0.3%)	13 (3.5%)	7 (1.9%)	0 (0%)	0 (0%)	0 (0%)	16 (4.3%)	4 (1.1%)	0 (0%)	1 (0.3%)
Paralysed	0 (0%)	15 (4.0%)	2 (0.5%)	0 (0%)	3 (0.8%)	0 (0%)	17 (4.5%)	2 (0.5%)	0 (0%)	1 (0.3%)

Table 4: Nerves affected for the sensation the participants (*n* = 374)

Number of nerve affected	Frequency	Percentage	95% CI
No nerves	268	71.7%	0.668–0.762
1 nerve	40	10.7%	0.078–0.143
2 nerves	32	8.6%	0.09–0.119
3 nerves	11	2.9%	0.015–0.052
4 nerves	10	2.7%	0.013–0.049
5 nerves	0	0.0%	–
6 nerves	13	3.5%	0.019–0.059

Table 5: Results of sensory assessment of the participants (*n* = 374)

Nerve		Present both fine & protective sensation	Absent fine Sensation & present protective sensation								Absent both fine & protective Sensation							
			1 site loss		2 sites loss		3 sites loss		4 sites loss		1 site loss		2 sites loss		3 sites loss		4 sites loss	
Ulnar Nerve																		
Right	322	86.1%	3	0.8%	9	2.4%	7	1.9%	–	–	2	0.5%	5	1.3%	26	7.0%	–	–
Left	322	86.1%	2	0.5%	6	1.6%	9	2.4%	–	–	6	1.6%	7	1.9%	22	5.9%	–	–
Median Nerve																		
Right	338	90.4%	8	2.1%	4	1.1%	5	1.3%	–	–	7	1.9%	3	0.8%	9	2.4%	–	–
Left	338	90.4%	6	1.6%	7	1.9%	2	0.5%	–	–	11	2.9%	4	1.1%	6	1.6%	–	–
Posterior Tibial Nerve																		
Right	330	88.2%	8	2.1%	4	1.1%	1	0.3%	3	0.8%	4	1.1%	2	0.5%	2	0.5%	20	5.3%
Left	336	89.8%	4	1.1%	1	0.3%	0	0.0%	4	1.1%	6	1.6%	2	0.5%	3	0.8%	18	4.8%

Table 6: Details of sensory nerve functions impairment of the 106 participants (*n* = 374)

Status	Absent fine Sensation &present protective sensation		Absent both fine &protective Sensation		Total	
	N=22		N=84		N=106	
Gender						
Male	18	4.8%	61	16.3%	79	21.1%
Female	4	1.1%	23	6.1%	27	7.2%
Age						
Below 15	2	0.5%	7	1.9%	9	2.4%
15 - 30	11	2.9%	36	9.6%	47	12.6%
31 - 45	7	1.9%	17	4.5%	24	6.4%
46 - 60	2	0.5%	16	4.3%	18	4.8%
Above 60	0	0.0%	8	2.1%	8	2.1%
Duration of delay after noticing the first symptoms						
Below 6 month	12	3.2%	47	12.6%	59	15.8%
Above 6 month	10	2.7%	37	9.9%	47	12.6%

Percentage: Denominator (*n* = 374)

of nerve function impairment at diagnosis.[9,10] This study emphasizes the early detection of sensory impairment by assessing the fine sensation to detect changes in nerve function earlier to a clinical nerve damage event, thus preventing functional impairment and disability.

The presence of nerve function impairment at diagnosis has been found to be a strong predictor of the risk of further immunological reactions or episodes of sensory or motor neuropathy,[11,12] and delayed reporting increases the risk of nerve impairment. The sensory impairment could be detected earlier by assessing the fine sensation using monofilament (0.2 gm for palms and 4 gm for soles) to prevent impairment and deformity, since the fine sensations will be lost before protective sensation. In this study, among the patients with sensory impairment, 22 (21%) had a loss of fine sensation, with intact protective sensation. *These patients would have been missed in the normal leprosy programme protocol which uses 2 gm and 10 gm filaments for testing sensory loss, before initiating steroid therapy.*

Testing the fine sensation by monofilaments is a cost-effective method to detect nerve function impairment at an earlier stage for initiation of early treatment and could be followed at all specialized leprosy centres and field level programmes. We believe that this method of assessment is very effective in endemic areas, especially in India, since it has the highest number of new cases reported every year, with five percent of them reported with grade 2 disability at the time of diagnosis.

Table 7: Details of loss of fine sensation of the 22 participants (*n* = 374)

Nerve	Loss of fine sensation									
	Site 1		Site 2		Site 3		Site 4		Total	
Ulnar										
Right	1	0.3%	7	1.9%	2	0.5%	–	–	10	2.7%
Left	0	0.0%	5	1.3%	4	1.1%	–	–	9	2.4%
Median										
Right	3	0.8%	2	0.5%	3	0.8%	–	–	8	2.1%
Left	4	1.1%	1	0.3%	1	0.3%	–	–	6	1.6%
Posterior Tibial										
Right	7	1.9%	1	0.3%	0	0.0%	2	0.5%	10	2.7%
Left	2	0.5%	1	0.3%	0	0.0%	4	1.1%	7	1.9%

Percentage: Denominator (*n* = 374)

The limitation of the study is that it was conducted only among patients who were newly diagnosed with leprosy. Hence, future longitudinal studies in a larger population will add more validity to the study.

Conclusion

This study shows that the patients who had lost fine sensation would have been missed in the normal leprosy programme protocol which uses 2 gm and 10 gm filaments for testing sensory loss before initiating steroid therapy, Further research is needed to determine whether testing for fine sensation with 0.2 gm Semmes-Weinstein filaments for palms and 4 gm for soles can be introduced at all specialized leprosy centres to detect nerve function impairment at an earlier stage, followed by steroid therapy.

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Declaration of patients consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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