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Basic nerve function assessment in leprosy patients

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Summary Nerve function assessment is important in the prevention of deformities in leprosy patients. Simple nerve function tests are presented which will make it easy for the leprosy worker to make records of nerve damage and will enable him to evaluate changes in nerve function.

Introduction

Deformities and disabilities in leprosy patients are due to nerve damage. Without this complication leprosy would not be the debilitating disease that it is for many of its sufferers. The following factors are often responsible for permanent nerve damage in leprosy patients:

1. Delay in reporting for diagnosis and anti-leprosy treatment.
2. An irregular or interrupted treatment.
3. Inadequacy of medical treatment, e.g. drug resistance, chronic ENL and release from control when the patient should have continued treatment.
4. Undetected early 'neuritis'.

Many patients first report for treatment when nerves are already irreversibly damaged. This is mainly due to the fact that in those countries where leprosy is endemic, basic health service facilities are not well developed and knowledge about the disease is deficient.

However, all too often patients in a leprosy control programme develop unrecognized nerve damage because nerve function assessments are not performed regularly.

Early recognition of decreasing nerve function and properly instituted medical treatment (corticosteroids) will usually prevent permanent nerve damage in most leprosy patients.

The medical officer or field worker may have told the patient to report any

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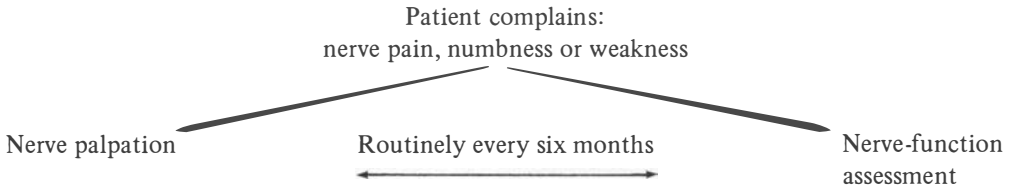


Figure 1. Nerve function should be assessed whenever the patient complains about pain, numbness or weakness and every six months to detect early nerve function loss.

nerve discomfort and weakness or numbness. He may also have established a routine of regular nerve palpation. But if nerve functions are not tested many patients may develop skin dryness, anaesthesia and paralysis unnoticed (Figure 1). It is generally accepted that nerve damage may sometimes occur without the patient being aware of it and in the absence of the classical signs of nerve inflammation. In our experience the basic nerve function assessment described here requires no more than 2–4 min.

When should nerve functions be assessed?

1. All new patients. A baseline is needed against which possible future changes can be assessed.
2. All patients with 'neuritis'. In the All Africa Leprosy and Rehabilitation Training Centre (ALERT) the assessments are usually repeated every 2–3 weeks to monitor the effect of the treatment.
3. Every time the patient reports nerve pain, weakness or numbness.
4. Routinely every 6 months for all patients to detect early nerve damage.

Muscle testing and sensory testing are reliable tests in the assessment and evaluation of nerve functions.

Muscle testing

The grading of muscle power is adapted from the grading system recommended by the Medical Research Council.[1]

Grade 5. Full range of movement of the joint on which the muscle or muscle group is acting. Normal resistance can be given.
Grade 4. Full range of movement but less than normal resistance.
Grade 3. Full range of movement but no resistance.
Grade 2. Partial range of movement with no resistance.
Grade 1. Perceptable contraction of the muscle(s) not resulting in joint movement.
Grade 0. Complete paralysis.

It is not enough to ask the patient to perform certain movements in order to assess the motor functions of a nerve. The examiner should always test for muscle resistance in patients with normal joint movements. This is particularly important as weakness, indicating early nerve damage, cannot be seen in most patients and should therefore be tested. The leprosy worker will soon get the feeling of what muscle power can be regarded as normal for the movements described below when he performs the tests on a number of people without nerve damage. The examiner should first demonstrate the correct movement for the patient and when the patient is able to perform the demonstrated movement resistance should be applied.

Test 1. *Facial nerve* (Figure 3)
The patient is asked to close his eyes tightly. The examiner tries to pull the eyelids apart when the patient is able to close his eyes. Weakness if present, will then be revealed. (Full range of movement = complete eye closure.)

Test 2. *Ulnar nerve* (Figure 4)
The patient is asked to move his little finger straight out and a little up (abduction). Resistance is applied at the base of the finger if this movement can be completed. With the supporting hand the examiner will be able to feel the contraction of the little-finger muscles.

Test 3. *Median nerve* (Figure 5)
The patient moves his thumb away from the palm of the hand at right angles (abduction). Resistance to this movement is applied perpendicular to the palm of the hand at the base of the thumb.

Test 4. *Lateral popliteal nerve*, deep branch (Figure 6)
The patient is asked to lift his foot (dorsiflexion). Resistance is applied by trying to push the foot down.

Testing these four movements routinely would be sufficient to detect the beginning of nerve damage to the motor fibres in most patients. These four tests are also mentioned in a paper by Ross and Pearson[2] but the importance of giving resistance to the movements is not emphasized. For the leprosy field worker it will be sufficient to use three grades of muscle strength only as illustrated in Figure 7. He should refer the patient that had normal muscle strength on a previous examination. For more detail, especially in the follow-up of patients with neuritis, one could in addition test the following movements:

Test 5. *Ulnar* (*Median*). Abduction of the index finger (Figure 8).
The patient is asked to move his index finger away from the long finger, while the index finger is slightly bent at the knuckle joint. Resistance is applied at the base of the finger after completion of this movement. The muscle responsible for this movement is very superficial and the contraction of this muscle can therefore be felt.

ALERT

PHYSIOTHERAPY DEPARTMENT (MUSCLE and SENSORY TESTING CHART)

Name: H. M. No: LFO 34

MUSCLE TESTING

Right								Left						
11-3 80	28/2 80	11-2 80	28-1 80	15-1 80	24/10 77	29/6 77	Date	29/6 77	24/10 77	15-1 80	28-1 80	11-2 80	28-2 80	11-3 80
							FACIAL							
4^+	4	4	4	4	5	5^-	Eyeclosure	5^-	5	4	3	3	4	4^+
							ULNAR							
2^+	2	0	0	0	5	3^+	Abd. 5th finger	2^+	5	2	?	2	3^-	3^-
							ULNAR/MEDIAN							
5^-	4	3	2	1	5	5	Abd. index finger	4^-	5	2	2	2^+	3^+	3
							MEDIAN							
5	5	5	3	3	5	5	Abduction thumb	5	5	0	2	4	5	5
5	5	5	3^+	3	5	5	Opposition thumb	5	5	0	2^+	3^+	4	5
							RADIAL							
5	5	5	5	5	5	5	Wrist extension	5	5	5	5	5	5	5

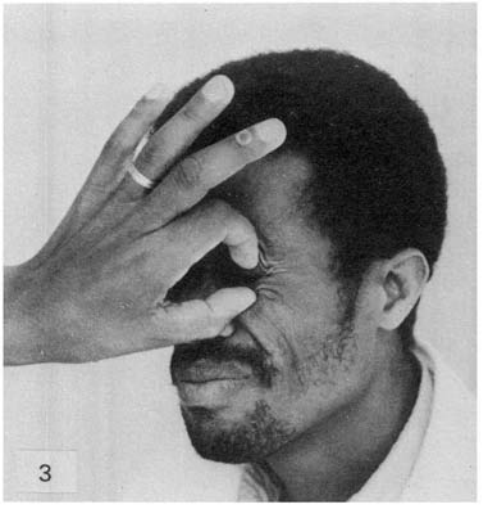
LAT. POPL.

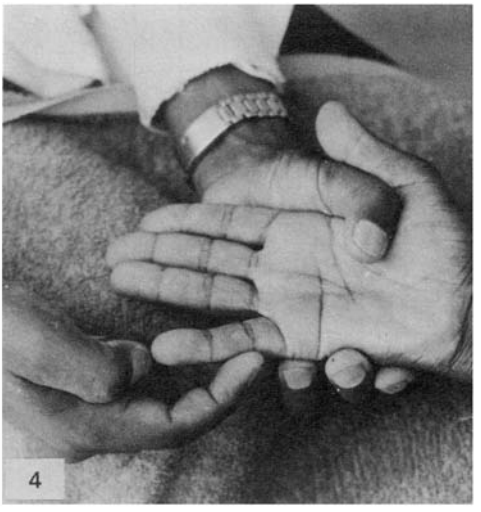
5	5	5	4	3^+	5	5	Dorsiflex. foot	5	5	4	4	5	5	5
5	5	5	5	5	5	5	Eversion foot	5	5	4	4	5	5	5
SZ	MK	MK	MK	SZ	SZ	LMH	Sign.	LMH	SZ	SZ	MK	MK	MK	SZ

First assessment weakness/paralysis in red. Follow-up assessments only deterioration in red!!

Comments:

Figure 2. Nerve-function assessment form as used in the All Africa Leprosy and Rehabilitation Training Centre (front page is shown). Outlines of hands and feet are printed on the backpage for sensory evaluation.
This patient reported for diagnosis and treatment on 29 June 1977 with bilateral ulnar weakness of two-months duration.
The patient was admitted to the hospital for treatment with corticosteroids. He recovered sensation and muscle strength. See muscle assessment of 24 October 1977. (Intermediate assessments are not shown.)
The patient then went home to the countryside for further treatment in his local clinic. He stopped his treatment and returned back to the hospital in January 1980 with new nerve damage of four-months duration.
Again the patient was admitted for treatment with corticosteroids.
The patient is recovering well as shown by serial muscle testings.





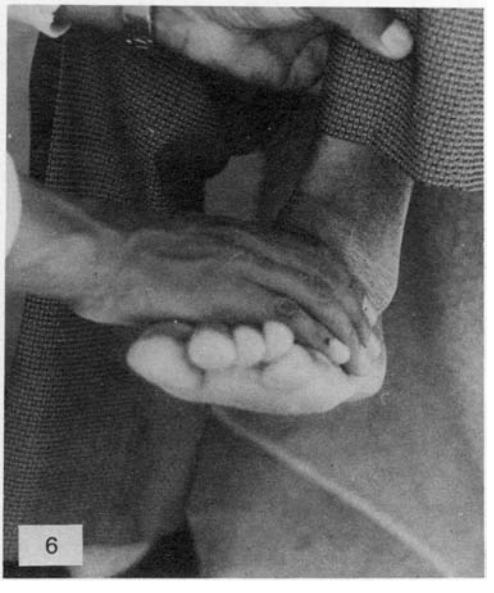


Figure 3. Test to detect early loss of motor function of the facial nerve.
Figure 4. Motor function test for ulnar nerve.
Figure 5. Motor function test for median nerve.
Figure 6. Motor function test for lateral popliteal nerve (deep branch).

Test 6. *Median*. Opposition of the thumb (Figure 9).
The patient is asked to move the thumb away from the palm of the hand with the pulp of the thumb facing the other fingers. Resistance is applied on the inside of the thumb at right angles to the resistance given in Test 3 by trying to push the thumb back.

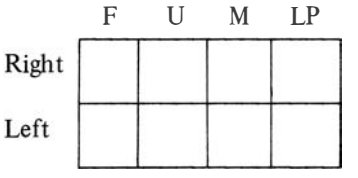


Figure 7. Testing of only the four basic movements (Tests 1–4).
This 'block' could be stamped or printed in the patient's record. A stamp can also be made with an outline of hands and feet for sensory testing. Simple grading: N, normal; W, weakness; P, paralysis.

Test 7. *Radial nerve.* Wrist extension (Figure 10).
The patient moves his clenched fist up. The examiner applies resistance trying to push the wrist down. Radial nerve (motor function) damage is not very common in Ethiopia and rarely occurs without associated ulnar nerve and median nerve damage.

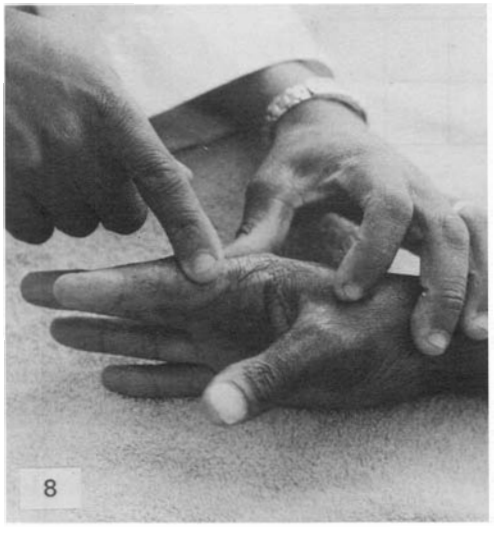
Test 8. *Lateral popliteal nerve*, superficial branch (Figure 11).
The patient moves his feet outwards (eversion) and at the end of this movement the examiner applies the resistance to the outside of the foot trying to move the foot inwards. Isolated weakness of the muscles that move the foot out is rare. When this movement is weak then there is also usually weakness of the muscles that lift the foot.

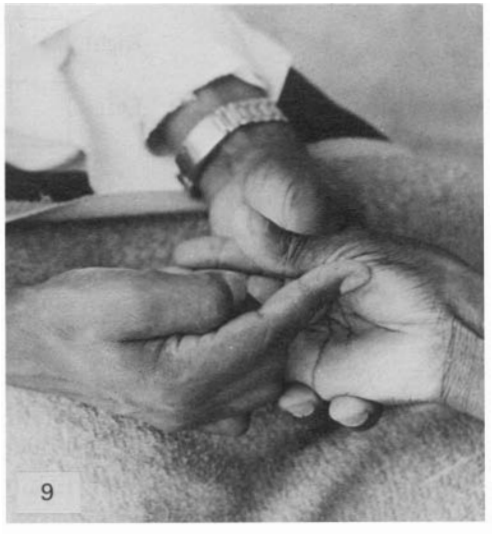
Sensory testing

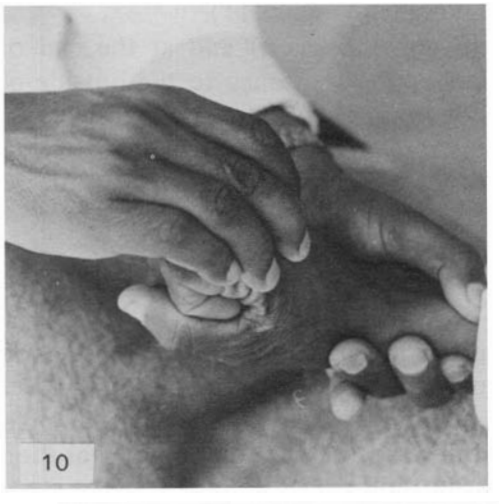
In many leprosy control projects and leprosy hospitals in Africa it is common practice to test sensation of the palm of the hands and the sole of the feet with a ball-point pen. The stimulus is applied to the skin gently and mild pressure is given just denting the skin. A more accurate evaluation of sensation is possible when the stimulus to the skin is not influenced so much by the force of application.

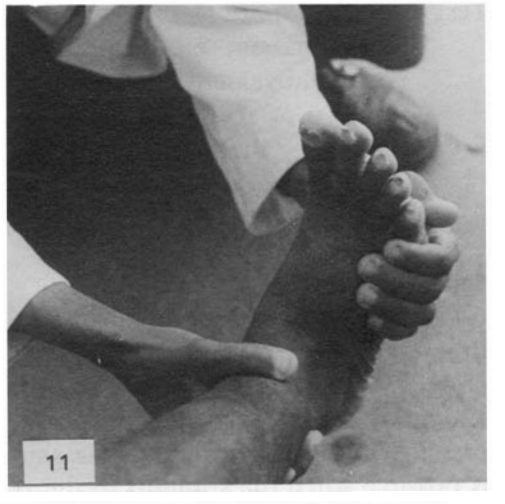
Naafs and Dagne[3] described a method of sensory testing in leprosy patients using standard monofilament nylon threads. The nylon thread is fixed to a handle leaving 1 inch of the thread free. The stimulus is then applied to the skin until the thread just bends, thus giving a standard pressure (Figure 12). Quantification of changes in sensory function is possible by using a set of nylon threads of different diameters. The stimuli are applied a certain number of times in circumscribed areas, e.g. the ball of the thumb for the median nerve. The number of stimuli felt are then noted (Figure 13).

Corneal sensation should be tested when there is no blink or insufficient eye closure. A wisp of clean cotton wool is rolled to a point and the margin of the cornea is tested for sensation.









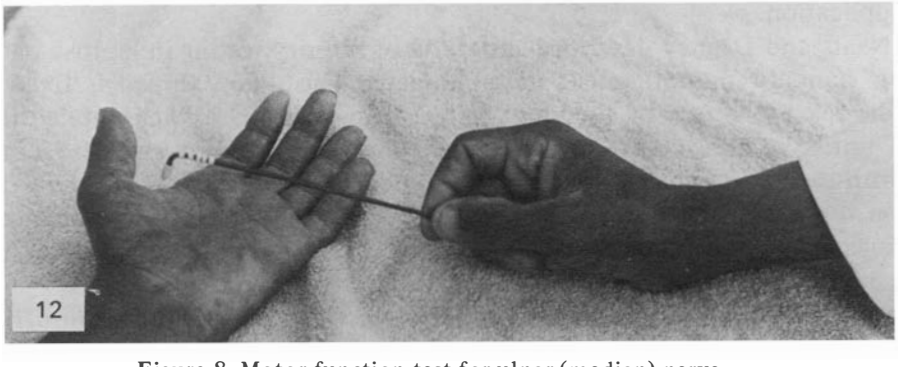


Figure 8. Motor function test for ulnar (median) nerve.
Figure 9. Motor function test for median nerve.
Figure 10. Motor function test for radial nerve.
Figure 11. Motor function test for lateral popliteal nerve (superficial branch).
Figure 12. Sensory testing using 'bristles'.

	No. of bristles				
	2	3	4	5	6
Right ulnar	0	1	1	1	1
R. median	3	5	5	5	5
Left ulnar					0
L. median	1	2	2	4	4

Figure 13. Sensory testing using nylon threads. Thenar and hypothenar area were tested five times each with every bristle. The number in the boxes indicate the number of times that the bristle was felt. Sensory loss of both ulnar nerves is shown. Almost normal sensation in right median distributed area, but diminished sensation in left median area. This is the same patient as in Figure 2, tested on 11 March 1980.

Discussion

Disability grading of the leprosy patients is done in most leprosy control projects. However, it would benefit the leprosy control programme and the patients more if regular nerve function assessments were also done. Disability grading is not a substitute for nerve function assessment. Using standard WHO grading the hand of a leprosy patient may be graded 1 on the first examination because of loss of sensation due to ulnar nerve damage. On a follow-up visit the patient may have also developed median loss of sensation but his disability will still be graded 1. Furthermore, weakness is not given a grade on the disability scale. It is not necessary to assess all the muscles that are supplied by the nerves that can become damaged in leprosy. The pathology is within the nerve and it would be very unlikely if the motor fibres of only one of the muscles, innervated by that nerve, were damaged. All muscles innervated by one nerve will be more or less weak to the same extent. The testing of one or two movements will therefore give sufficient information about nerve damage and changes in nerve function.

The Voluntary Muscle Test as described by Goodwin[4] has the following disadvantages:

1. Difficult latin names would have to be taught to all the leprosy workers.
2. The test is time consuming as many muscles have to be assessed.
3. Electromyographic examinations by Forrest and Basmajian[5] showed that most of the intrinsic muscles of the hand cannot be tested in isolation.

When we test intrinsic muscles of the hand, muscle groups rather than individual muscles are tested.

Thumb abduction might sometimes be weak in an isolated ulnar palsy due to the innervation pattern of the muscle flexor pollicis brevis and the abduction component of this muscle. Lumbrical muscles also cannot easily be tested in

isolation. Both lumbricals and interossei stabilize the fingers and will prevent the fingers from clawing.

Here again, the ability to take and maintain the lumbrical position against resistance in an isolated ulnar palsy will reveal weakness in the index and long fingers. Most patients with an ulnar palsy only will eventually develop four-finger clawing. We cannot always conclude that there is median nerve damage when muscle testing reveals slight weakness of thumb abduction and weakness or even complete loss of lumbrical position in the index and long fingers.

More muscles would have to be tested for the irregular types of nerve damage, e.g. high median nerve damage. An experienced assessor could give more detail to the grading by adding a $\frac{1}{2}$ or + or − sign to the whole number (Figure 2). The muscle tests presented here are easy to perform and should be known by all leprosy workers.

Acknowledgements

I would like to thank Miss J M Watson MCPT for introducing me to the assessment of nerve function in leprosy patients.

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