Peripheral Nerve Injuries of The Upper Extremity - Result Of Late Repair

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KEY WORDS

Late repair.

ABSTRACT

One hundred different types of peripheral nerve injuries of the upper extremity in eighty patients is the subject of study. The results of late repair between 3 months and 1 year and functional recovery thereof has been studied, both clinically and electrophysiologically. Better results are observed in children and teenagers as compared to adults. Clinical evidence of recovery is a better guide than the electrophysiological findings.

INTRODUCTION

The present study has been undertaken to evaluate the functional recovery of patients who had repair of peripheral nerves of upper Extremity between 3 months and one year after injury.

MATERIALS AND METHOD

Thirty patients had suffered from injuries of the ulnar nerve, 14 of the median nerve and 18 of the radial nerve. Remaining 18 patients sustained injuries involving more than one nerve. 14 patients of this group had Median and Ulnar nerve injuries, 2 patients had Ulnar & radial nerve injuries. Thus the total number of nerves injured were 100 in 80 patients: Ulnar 48, Median 30 and Radial 22. A study of these patients with reference to their pre-operative asseeement, surgical management, post operative follow up to asses functional recovery was carried out.

AGE AND SEX INCIDENCE

While the majority of the patients (39 out of 80) in this study were between the ages of 21-30, 8 of them were below 10 years and 5 were above 40. Only 5 of them were females.

MECHANISM OF INJURY

76 out of 80 patient had injuries with sharp weapons. 3 had their injuries with low velocity missiles and one had avulsion injury.

LEVEL OF INJURY

Majority of the nerve injuries were found to be at the level of the wrist as would be evident from table-1.

ASSOCIATED INJURIES

TABLE - 1

Level of lesion	Median	Ulnar	radial	multiple	Total
Arm	x	2	1	9	12
Spiral grove	x	x	14	x	14
Elbow	x	3	1	1	5
Forearm	5	5	2	4	16
Wrist	8	20	x	4	32
Palm	1	x	x	x	1

Out of 14 median nerve injuries 5 had associated tendon injuries. 6 patients with isolated ulnar nerve lesion and tendon injury and one had supracondylar fracture. 2 Patients with isolated Radial nerve injury had laceration of triceps muscle. Out of 18 patients with multiple nerve injury - 8 had tendon injuries and/or injury to brachial vessels.

TIME INTERVAL BETWEEN INJURY AND REPAIR

All patients had late repair of the nerves between 3 months and 1 year except 4 in whom primary repair of the nerves were undertaken. In one patient of Ulnar nerve injury, the repair was carried out two and half years after the injury.

All patients in this present study were operated upon by the first author.

MAGNIFICATION AND METHODS OF REPAIR

In all cases dissection and repair of the nerves were carried out using magnifying loupe with 2 and 5 times magnification respectively.

Group funicular repair was undertaken using 8/0 or 10/0 Nylon. Special care was taken to identify epineural vessels on the surface of the nerve both at the proximal and distal site to match the ends. Attention was paid to maintain correct axial alignment. It has been observed in many instance that the cut ends of the explored nerves were not much retracted due to their adhesions with the surrounding muscles or tendons. Gaps of 2 to 4 cms. were closed directly by mobilising both ends. Defect beyond 4 cms. were approximated by interposition of Nerve grafts.

FOLLOW UP

5 Patients out of 80 in this study were not available for follow up. 17 patients were followed up for 6 months to 1 year and 61 patients were followed up for 2 1/2 to 6 years. All patients were assessed by the author in collaboration with Neurologists. Patients were followed up initially at 6 weeks and subsequently at 3 months interval with respect to the following parameters:

1) Motor function
2) Sensory recovery
3) Motor and Sensory nerve Conduction velocity
4) Electromyographic findings
5) Co-ordination activity, e.g., key pinch, power grip, pick up test, etc.

METHODS OF ASSESSMENT OF MOTOR AND SENSORY RECOVERY

MOTOR RECOVRY -

Motor function was tested and graded according to the M.R.C. classification. Opp pollicis, Abd.

TABLE - 2

MOTOR RECOVERY OF ULNAR NERVE (NO.30)

Grade	Age group in yrs. 1-20 Addl.Pol.	No.of pts. 9 Other Intrinsics	Age group in yrs. above 20 Addl.Pol.	No. of pts. 21 Other Intrinscis	F.U. 6 M. to 1 year	Not followed up.
M5	-	-	-	-	-	-
M4	9	7	6	2	6 pts. showed onset progress of recovery	
M3	-	2	2	6	-	4
M2	-	-	2	2		
M1	-	-	1	1		

Pollicis brevis were tested individually to assessmotor function of the Median nerve. Abd. Digiti minim, the Interossei, the first dorsal Interosseus and Adductor pollicis were tested to assess the function of the Ulnar nerve, and extensors of elbow wrist and fingers for motor function of the Radial nerve.

SENSORY RECOVERY -

Protective sensations such as light and heavy touch, pain and temperature were tested. Proprioceptive sensations were tested for digital movement. Moberg pick-up test was also used to assess object identification. Two point discrimination was tested at the finger tips.

The patients were blind-folded for all tests. Functional ability of the patient was assessed by giving up of different objects.

Electrodiagnostic tests such as electromyographic study, motor and sensory nerve condition velocity study were also carried out. An attempt was made to correlate the result of such investigations with the clinical findings.

RESULTS AND ANALYSIS :

Results have been analysed separately amongst those below 20 and those above 20 years of age.

RECOVERY OF MOTOR FUNCTION :

Out of 9 patients of Ulnar nerve injury between age group 1-20 years. 9 had M3 + M4 level of motor function. Of the 21 patients who were above 20 years, 8 patients, showed motor recovery between M3 and M4. Two patients showed motor recovery of M2 and one patient of M1 respectively. 6 patietns were followed up between 6 months and 1 year and showed return of protective sensation and of motor power between M1 + M2. 4 patients were not available for follow up (table -2).

Out of 14 patients of madian nerve injury 4 were between 1-20 years and showed M4 and M5 activity, 5 patients above 20 years, also showed M4 and M5 activity. One had muscle power M3. Two patients of Median nerve injuries had associated multiple tendon injuries. They showed recovery of motor power of M1 and M2. The remaining two who were followed up for less than one year also showed onset of recovey (table-3).

TABLE - 3

MOTOR RECOVERY OF ULNAR NERVE (N = 14)

Grade	Age group in yrs. 1-20 Opp. pol.	No.of pts. 4 Abd. pol. Br.	Age group in yrs. above 20 Opp. pol.	No.of pts. 10 Abd. pol. Br.	Follow up 6m to1 yr.
M4-5		4	4	5	5
M3	-	-	1	1	2
M2	-	-	1	1	-
M1	-	-	1	1	-

Out of cases of isolated radial nerve injuries, two were below 20 and the motor power in them recovered to M4-5. 13 of 16 patients were above the age of 20 and showed motor recovery of Mr-5 and 2 of M3. One patient of 24 showed motor recovery of M1 only and required tendon transfer in addition (table-4).

TABLE - 4

MOTOR RECOVERY OF RADIAL NERVE (N=18)

Grade	Age group in yrs. 1-20	No.of pts. 2	Age group in yrs. above 20	No. of pts. 16
M4-5		2		13
M3	-		2	-
M1	-		1	-

Multiple nerve injuries. In this series of 18, 5 patients were between 1 and 20 years of age. 4 had activity level M4 and out of these one, a girl of 4 years, had primary repair of both median and ulnarnerves. A boy of 9 year had low velocity missile injury involving all three major nerves. 1 patient who was followed up upto 1 year also showed onset of recovery. Out of 13 patients above 20 years of age, 2 showed motor power of M3, 2 of M2, 3 of M1. 6 of them were followed up for less than 6 months. Poor results in this series are probably due to a combination of many factors i.e. age, level of injury and injury involving multiple nerves, tendons and vessels (table-5).

TABLE - 5

MOTOR RECOVERY OF MULTIPLE NERVE INJURY

Grade	Age group	Age group
M5	-	-
M4	4	-
M3	-	2
M2	-	2
M1	-	3
MO	1	6
Total	5	13

Sensory recovery has been analysed under the headings of protective sensation (i.e. light touch, heavy touch, pain and temperature) Proprioceptive sensation, two point discrimination (TPD), tactile locatisation (TL) and tactile discrimination (TD).

Although return of tactile discrimination and location was not complete in some cases, return of protective sensations and proprioception was satisfactory in all except one (table-6).

Ulnar nerve injury - out of 9 patients of ulnar nerve injury between 1-20 years of age, 6 had return of T.P.D. between 3-5mm, 1 between 508 mm. One patient showed two point discrimination of only 10mm. Out of 21 cases above 20 years of age only 5 had T.P.D. between 710mm and 16 patients (including 6 who were not followed up for 1 year) whosed protective and proprioceptive sensation. One did not show either, after 1 year. 10 patients showed tactile localisation and tectile discrimination.

Median nerve injury - There were 4 patients between 1-20 years of age. All of them had T.P.D. and TL presnt. Out of 10 patients above 20 years of age, T.P.D. was present in 4. Other had hyperasthesis, bizarre sensory pattern and gross functional impairment. One case had M2 motor function but T.P.D. and TL were absent. 2 were not followed up for longer period.

Return of protective sensation and proprioceptive sensation in cases of median nerve injury have thus been satisfactory except in a few cases. Assessment of two point discrimination has been little confusing because some of the patients could not discriminate even when they were tested over the finger tipes of the normal hand.

Multiple nerve injury - Out of 5 patients between 1-20 years of age 3 had T.P.D. and 4 had TL present. One was not followed up. Out of 13 patients above 20 years, one had return of T.P.D. between 7-10 mm and had good tactile localisation. One patient could recognise correctly but exhibited delayed response. Protective and proprioceptive sensation were present in 5 patients only. Follow up period in another 6 patients was too short to arrive at a definite conclusion. Poor result in respect to return of T.P.D. and TL and protective sensation in this group was probably due to age, higher level of the lesion and injury involving multiple nerves.

TABLE - 6

Sensory Recovery
Age Gr. Below 20 yrs.

NVS	No. of pts.	Prot.	Prop.	TPD	TL.TD	NF
U	9	9	9	8	9	-
M	4	4	4	4	4	-
Multiple nerve	5	4	4	3	4	1

Radial nerve has not been mentiojned separately for sensory recovery.

Electrodiagnostic Assessment :

Nerve conduction velocity studies were undertaken in 44 out of 62 patients of ulnar, median and multiple nerve injury and 16 out of 18 patients of radial nerve injury.

Motor condition velocity in most of the cases were nil before exploration. Nerve condution velocity estimated on different occasions after repair showed progressive improvement with the passage of time. However, in our study with maximum follow up upto 6 years after surgery, never conduction velocity reached a level equal to velocities in the contralateral arm in only a few patients.

Electromygraphic studies, with assessment for the rest potentials, appearance and recruitment of motor unit potentials and interference pattern after maxiual volitional effort showed improvement after repair. However, it continued to show features of denervation neuropathy and were not completely normal in any patient of the present seires.

Sensory nerve conduction assessment - The return of sensory nerve function was made from sensory nerve Axon potential (SNAP) and Sensory evoked potential (SEP) studies and sensory nerve conduction velocity stydies.

In a few cases cortical SEPs were available inspite of difficulty in getting a good SNAP. In SEP studies the first negative deflection (N20 component) was noted for the assessment.

Sensory nerve conduction velocities were stdied by usual methods as well as from difference a latency of cortical SEPs, from evoked stimulation of a distal and a proximal site along the course of the nerve. Sensory conduction velocity showed improvement after repair. However in some cases, it was difficult to establish a correlation between the clinical observation of return of sensory function and of sensory nerve conduction velocity findings.

sociation with injuries of muscles, tendons and vessels. Likewise, result of repair of a single nerve at a proximal level, i.e. in the arm gives better result than in cases of multiple nerve lesion at the same level. Cildren and teenagers show better results following repair of injured nerves irrespective of whether the lesions are single or multiple, proximal or distal.

Age Gr. above 20 years

NVS	No.of pts.	Prot.	[illegible]	[illegible]	TL/TD	P.U. (6m.1.yr.)	Not followed up
Ulnar	21	16	16	5	10	6	4
Median	10	7	7	[illegible]	6	2	-
Multiple nerve	13	5	5	1	1	-	6

Re-education programme formed an important and integral part of the management particularly as all the cases treated in the present series were operated late.

In our series electronyographic studies support the view of seddon in many cases. It showed improvement after repair. However it continued to show features of denervation and were not completely normal in any partient of the present series. Electronyography may provide evidence of rennervation a few weeks prior to positive physical findings but it can not be taken to predict the quantity of quality of re-innervation, Omer (1975).

Thomas et al (1959) and others have pointed out that it is not uncommon for the maximum conduction velocity in some patients to be only slightly below the accepted normal range (55-65ml/sec). 40% patient had motor conduction velocity between 30-50 M/Sec. In sensory nerve conduction velocity about 32 percent had a conduction velocity of 30-50 M/Sec.

Recovery of motor function was excellent in Radial nerve repair and was good in ulnar and Median nerve repairs. Recovery of motor power to M3 -M4 was noted in 17 out of 30 patients of Ulnar nerve repair and to M4-M5 in 9 out of 14 patients of median nerve repair. Radial nerve repair showed good recovery even in lesions placed high in axilla.

Although primary nerve repair is known to yield better results, secondary or late repair undertaken between 3 months and one year after injury in the present series showed good recovery in majority of the patients.

Repair of injury of a single nerve undertaken even after a few months gives better result if unas-

DISCUSSION :

Result of repair of an injured peripheral nerve depends on many factors e.g. type of injury, age of patient, level of lesion, time elapsed between injury and repair, state of local nutrion and accuracy of repair (J.W.Smith, 1968).

In 56 percent patients of the present series of 80, the nerves were injured by sharp cuts. Results of repair in those sharp cut injuries were bettern than in the cases where the nerves were injured by low velocity missile (3 cases) or traction injury (1 case) sunderlal (1978) and many other workers have made similar observations.

Moberg (1968), Omer (1974)m J.W. Smith (1986), who reported exceptionally good recovery after nerve suture in very yound. The present study confirms that quality of recovery was good not only in children but also in teenagers, irrespective of whether the lesions are single or multiple proximal or distal. Chowdhury and Roy (1984).

The rate as well as the qualty of motor and sensory return following repair are said to be inferior in higher than in low placed lesions Sunderland (1968), Omer (1974), Smith (1986). Analysis of the cases in the present studym however, does not fully support this veiw.

31 out of 80 patients in this series had high

placed lesions and we had good recovery i.e. 80% in Radial & Ulner nerve lesions and 40% in case of multiple nerves. In Ulner nerve 30 percent had grade 4 or good recovery. In median nerve 57.1 percent had grade 4 and in radial nerve 83.3 percent had grade 4 recovery. Chowdhury and Mukherjee (1987). In multiple nerve injury only 22 percent including children had grade 4 recovery. Operation under magnification using magnifying Loupe and microsurgical technique and early institution of re-education programme in all cases have probably contributed to such results.

Electrodiagnostic studies :

Seddon (1972) and other based on their experience with Electromyographic studies, reported that motor activity appeared shead of clinical evidence of recovery. Clinical recovery may not be detectable even 3-4 months after detection of motor Unit action potentials following suture of a mixed nerve.

Clincal evidence of recovery of function has been found to be much better than the findings observed at the electro physiological studies in the present series.

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