# My study on microsurgical repair of injured peripheral nerves in 1990s

**Sudhir Singh**

Hon. IMA Professor (Academy of Medical Specialities- IMA) & Senior Consultant plastic surgery, Getwell Hospital, Varanasi Uttar Pradesh, India

***Corresponding Author: Sudhir Singh**
Email: s.sulekha@gmail.com

## Abstract

**Aim:** The aim of this study is to evaluate the result of microsurgical repair over non microsurgical treatment of injured peripheral nerves. We also tried to see the efficiency of venous cuffe applied over epineural repair of nerves. The role and feasibility of use of venous conduit of more than 8 cm length to manage extensive nerve gap was tried.

**Materials and Methods:** a). Sample Design: Thirty cases of microsurgical repair of peripheral nerve injuries were selected during late mid1992 to mid1994 and it formed Group B of study. Group A consisted of double number of patients that is sixty who had undergone non microsurgical repair of peripheral nerve injuries in past between 1985 to early mid1992. Microsurgical results of Group B patients were compared with non microsurgical results of Group A patients. b). Tools & Techniques: Whenever possible preoperative electro diagnostic studies like NCV done to form baseline study, then followed by postoperative NCV also in most cases. The accurate recording of data, investigations, and evaluation of the results of repair were done.

**Observation:** Incidence is increasing with age due to increase in life span and more males are involved as they are more exposed to hazardous life. Even business community and students are being affected but earlier the farmers were more commonly affected. Urban cases have risen now and almost equating with earlier rural incidence. Other modes of injury have also become more common than past incidence of pure cut injury. More of microsurgical neurolysis and decompression of nerves were done in comparision to more of non microsurgical epineural nerve repair required earlier due to difference in nature of injury which came to us. It was due to many cases of nerve traction and compression injuries in microsurgical treatment patients. First time use of venous tube to bridge the nerve gap of 8cm was tried by us but clinical result even after long duration was not good. However the strands of nerve growth fibres could be detected under high microscope after slicing the venous tube to see inside when tendon transfer was planned for the patient. The neuro venous biopsy from proximal part was seen to have nerve growth in it.

**Conclusion:** All patients who underwent microsurgical treatment had better recovery. Median, radial and ulnar nerves are involved more than other nerves. Ulnar nerve treated by microsurgical treatment had sensory recovery almost at par with median nerve. Venous cuffe were found to be beneficial which prevented abnormal axonerration but however long vein tube was not good inspite of nerve growth inside the proximal part of nerve seen after biopsy which was done when tendon transfer was planned as ultimate care of the patient.

**Future Aspect:** Future of peripheral nerve repair will lie in accurate rotational placement perhaps using tissue glue and neurotrophic agents and the work in this field will be interesting in relation to the work which has been done on neurotrophism in free lying nerve ends.

**Keywords:** Nerves repair, Veinous tube, Nerve regeneration, Microsurgical repair, Neurolysis, Venous cuffe.

## Introduction

The foundations upon which peripheral nerve surgery is built is based on the principles which felicitate the natural regenerative process of the nerve. It is recognized that the quality and speed of regeneration of nerve is improved when there is minimum amount of scar tissue across a gap. So a microsurgical repair under magnification is definitely better than naked eye repair. In established case of peripheral nerve injury the affected limb or part should be thoroughly examined clinically as well as by electrical studies and record should be maintained to compare with postoperative results.

**Factors Influencing Peripheral Nerve Repair:** Mechanical factors as well as the amount of time which is allowed to elapse between injury and repair are to some degree under the control of us but other factors such as the age of the patients, the type of the nerve, the level of injury and cause of injury influence the final functional outcome after nerve repair or reconstruction (Terzis & Smith 1991).

### Delay factor

Regenerative capacity of the cell body and proximal structure is maintained as long as cell death does not occur.

**Age factor**
Younger age has better results. It may be due to differences in the velocity of slow axonal transport(Coteman C.C. 1991).

**Type of nerve factor**
Pure nerve fibres have better result than in mixed nerve.

**Level of nerve injury factor**
Proximal Injuries carry a worse prognosis (Terzis & Smith 1991).

**Associated Injury factors**
The less a nerve is traumatised, the greater the likelihood of successful functional recovery.

**Trophic factor**
Mammalian studies have implied that regenerating cutaneous nerve can find their path to the appropriate types of receptors over short distances. Nerve Growth Factor plays a role of paramount importance in the development, maintenance and regeneration of sympathetic and sensory nerves. It is released by tissues innervated by sympathetic and sensory axons and there are high affinity receptor specific for NGF(nerve growth factor) present on these nerve membranes. NGF bound to the nerve cell membrane is internalized and then transported in a retrograde fashion to the cell body where it effects neuronal metabolism. It exhibits a stimulatory effect on growth of axons and can prevent the retrograde axonal reaction following severance of an axon and subsequent cell death. It has a role in the guidance of regenerating axons to their target organs (Terzis & Smith 1991). The axonal growth cone specifically respond to some chemical produced by the target organ that is Nerve Growth Factor (Dr. Prakash Udai 1991). Robinson H. Peter et al have used ACTH 4-9 to stimulate nerve growth factor by its local application which has resulted in successful bridging of 8 mm segmental loss of nerve without any nerve graft or nerve conduit. The ultimate histologic appearance of the regenerated nerve treated with ACTH 4-9 is better over that with nerve graft or other technique (Peter H. Robinson 1991).

## Materials and Methods

The present study is based on the observations and evaluation of the progress of the patients after operation. There is thorough follow up studies by using various methods on cases of peripheral nerve injuries of different sites and sides of the body.

**Sample design**
Thirty cases of microsurgical repair of peripheral nerve injuries were selected during late mid1992 to mid1994 and it formed Group B of study. Group A consisted of double number of patients that is sixty who had undergone nonmicrosurgical repair of peripheral nerve injuries in past between 1985 to early mid 1992. Microsurgical results of Group B comprising of thirty patients were compared with non microsurgical Group A.

**Tools & techniques**
Whenever possible preoperative electrodiagnostic studies like NCV were done to form baseline study and followed by postoperative NCV also in most cases. The accurate recording of data, investigations, and evaluation of the result of repair were done in the hospital.

## Observation

The results of Group B comprising of microsurgical repair of injured nerves of 30 patients done from mid1992 to mid 1994 is compared with retrospective study of non microsurgically treated cases from December 1985 to February 1992 which formed Group A of 60 patients.

Future of peripheral nerve repair will lie in accurate rotational placement perhaps using tissue glue and neurotrophic agents and the work in this field will be interesting in relation to the work which has been done on neurotrophism in free lying nerve ends (Baily B N, 1994).

**Incidence**
This does not indicate the exact incidence of peripheral nerve injuries in the community since these type of cases are also managed outside by other surgeons. Here we have taken total ninety cases of nerve injury repair that is retrospective study of 60 cases Group A(Non microsurgical treatment) from 1985 to 1992 and prospective study of Group B(Microsurgical treatment) of 30 cases from 1992 to 1994.

**Table 1:** Age distribution of Group A and Group B samples.

| Class Interval | Group 'A' | | Group 'B' | |
|---|---|---|---|---|
| | No. of cases | % | No. of cases | % |
| Less than 10 yrs | 7 | 11.66 | 1 | 3.33 |
| 10-20 yrs | 18 | 30.00 | 11 | 36.67 |
| 20-30 yrs | 22 | 36.66 | 4 | 13.34 |
| 30-40 yrs | 10 | 16.66 | 6 | 20.00 |
| 40-50 yrs | 3 | 5.00 | 6 | 20.00 |
| 50-60 yrs | - | - | 1 | 3.33 |
| 60-70 yrs | - | - | 1 | 3.33 |
| Total | 60 | 100.00 | 30 | 100.00 |

Table 1 shows that patients of all age groups from less than 10 to 70 years have been operated since 1985. About 37% patients were in age group 20 to 30 years before 1992 where as later on 10 to 20 years age group has attained same level. Even older age patients are coming into picture. This reflects that more injuries are becoming common in elderly patients also as life span of active life has increased. They are the people more prone to develop complications. So stress on physiotherapy and rehabilitation regarding management of these patients has been crucial.

**Table 2:** Distribution of sample according to sex.

| | Group A | | Group B | |
|---|---|---|---|---|
| Particular | No. of cases | % | No. of cases | % |
| Male | 51 | 85.00 | 25 | 83.33 |
| Female | 9 | 15.00 | 5 | 16.67 |
| Total | 60 | 100.00 | 30 | 100.00 |

Table 2 shows the preponderance of the males over females in both groups as males are more prone to outdoor hazardous life.

**Table 3:** Distribution of sample according to occupation

| S. No. | Particular | Group A | | Group B | |
|---|---|---|---|---|---|
| | | No. of cases | % | No. of cases | % |
| 1. | Services | 9 | 15.00 | 5 | 16.67 |
| 2. | Student | 4 | 6.67 | 10 | 33.33 |
| 3. | Business | 3 | 5.00 | 5 | 16.67 |
| 4. | Farmers | 26 | 43.33 | 4 | 13.33 |
| 5. | House wife | 7 | 11.67 | 3 | 10.00 |
| 6. | Labourer | 9 | 15.00 | 3 | 10.00 |
| 7. | Non Specifie | 2 | 3.33 | - | - |
| | Total | 60 | 100.00 | 30 | 100.00 |

Table 3 shows the various occupations of different patients. In Group A the majority were farmers but later on students and business community have taken the lead as shown in Group B.

**Table 4:** Distribution of sample according to Rural/ Urban background

| S. No. | Particular | Group A | | Group B | |
|---|---|---|---|---|---|
| | | No. of cases | % | No. of cases | % |
| 1. | Rural | 36 | 60.00 | 12 | 40.00 |
| 2. | Urban | 12 | 20.00 | 12 | 40.00 |
| 3. | Mixed | 12 | 20.00 | 6 | 20.00 |
| | Total | 60 | 100.00 | 30 | 100.00 |

Table 4 shows that majority of patients were from rural section in Group A but now urban origin is fast rising and approaching equal to rural population.

**Table 5:** Distribution of sample according to the mode of injury

| S.No. | Particular | Group A | | Group B | |
|---|---|---|---|---|---|
| | | No. of cases | % | No. of cases | % |
| 1. | Cut injury | 26 | 43.33 | 12 | 40.00 |
| 2. | Gun shot | 12 | 20.00 | 2 | 6.67 |
| 3. | Blast injury | 3 | 5.00 | - | - |
| 4. | Road Accident | 6 | 10.00 | 3 | 10.00 |
| 5. | Volkman's contracture | 2 | 3.33 | - | - |
| 6. | Others (Carpal tunneal, post injection, abscass finger etc.) | 11 | 18.33 | 13 | 43.33 |
| | Total | 60 | 100.00 | 30 | 100.00 |

Table 5 shows cut injury has been a major factor in both Groups A and B but however other mode of injuries were seen in Group B at a higher level.

**Table 6:** Distribution of sample according to the type of nerves involved.

| S.No. | Particular | Group A | | Group B | |
|---|---|---|---|---|---|
| | | No. of cases | % | No. of cases | % |
| 1. | Ulnar N. | 24 | 40.00 | 4 | 13.33 |
| 2. | Median N. | 10 | 16.66 | 7 | 23.33 |
| 3. | Combined ulnar & Median | 12 | 20.00 | 3 | 10.00 |
| 4. | Radial | 3 | 5.00 | 7 | 23.00 |
| 5. | Med. +Uln + Rad | - | - | 1 | 3.33 |
| 6. | Sciatic | 2 | 3.33 | 1 | 3.33 |
| 7. | Digital | 2 | 3.33 | 2 | 6.67 |
| 8. | Post. Interosseous | 1 | 1.66 | - | - |
| 9. | Lateral Popliteal | 4 | 6.66 | 1 | 3.33 |
| 10. | VIC | 1 | 1.66 | - | - |
| 11. | Brachial plexus | 1 | 1.66 | 2 | 6.67 |
| 12. | Axillary No | - | - | 1 | 30.33 |
| 13. | Musculocutaneous | - | - | 1 | 3.33 |
| | Total | 60 | 100.00 | 30 | 100.00 |

Table 6 shows that ulnar nerve lesions were quite common in Group A and it has become one third in occurrence in Group B. Infact 23 percent of cases in Group B constituted of Radial nerve injuries.

**Table 7:** Different Non microsurgical treatment in Group A and microsurgical treatment in Group B.

| | | Group A | | Group B | |
|---|---|---|---|---|---|
| S.No. | Particular | No. of cases | % | No. of cases | % |
| 1. | Epineurorrhaphy | 39 | 61.81 | 9 | 30.00 |
| 2. | Epineurorrhaphy + Venous cuffe | 4 | 7.27 | 5 | 16.67 |
| 3. | Neurolysis + Decompression | 13 | 23.63 | 13 | 43.33 |
| 4. | Nerve grafting | 4 | 7.27 | - | - |
| 5. | Venous tube | - | - | 3 | 100.00 |
| | Total | 60 | 100.00 | 30 | 100.00 |

Table 7 shows more of microsurgical neurolysis and decompression of injured nerves and first time use of venous tubes to bridge nerve gaps were done in Group B.

**Fig. 1:** Decompression neurolysis of radial nerve

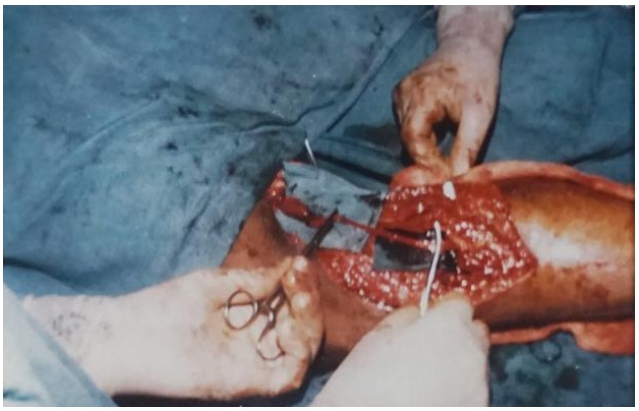
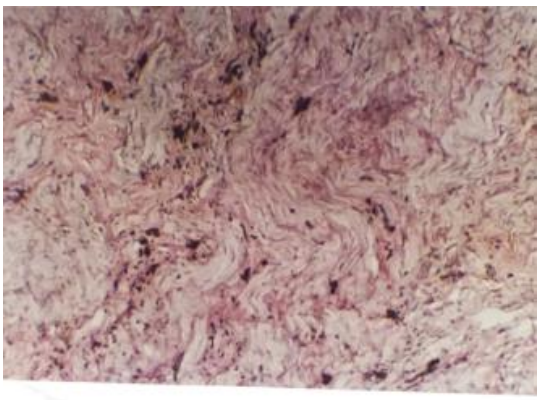


**Fig. 2:** DSC04357 venous tube



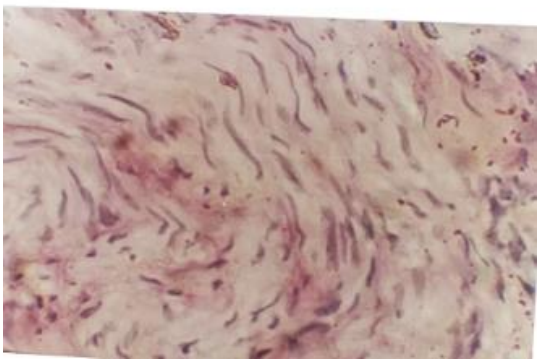


**Fig. 3:** Neuro venous biopsy of venous tube case

**Fig. 4:** Ulnar nerve epineurorapphy repair

**Fig. 5:** Ulnar nerve neurolysis

## Discussion

Ninety (90) patients have been studied who attended us from 1985 to 1994 that is more than 9 years duration either of their own or they were referred from other sources. The site of lesion is well documented because these peripheral nerves including those of lower limb are commonly injured at the superficial points where even minor cuts and injuries can produce peripheral nerve lesions.

Cases were evaluated clinically as well as electrodiagnostically as far as possible, The exploration of the nerve was done under anaesthesia. In few cases especially in which neurolysis were indicated, nerve stimulator was used. The results of repair were assessed in the follow up by clinical and electrodiagnostic tests. P. J. Smith & G. Maott(1986) have done some work on peripheral nerve injuries and have advised that Tinel Sign, although it is simple and quick but cannot be detected easily until about 2 to 3 months after injury. According to them this test including other motor and sensory tests if correlated with electrical findings then an indication of regeneration could be obtained ahead of clinical signs.

According to Millesi(1981) after approximately 6 months, there is significant drop in extent of recovery and so the attempt should be made to repair the nerve as early as possible. It is seen here that nerve repaired

primarily or before six months of duration of injury had better recovery than others irrespective of the procedure followed. On top of that those patients treated microsurgically fetched even better results.

Median nerve is a mixed nerve. It is difficult to identify the sensory and motor fibres separately but with the help of nerve stimulator results can be still be improved(Keshari R. S. 1989; Burke & O. Brien 1978). In median nerve sensory recovery occurs earlier in comparision to motor but however recovery is even better and faster in patients who have undergone microsurgical technique. If the injuries of median nerve at the wrist are repaired with in three months then the motor recovery can be expected much better(Grabb and his colleagues 1970). This is demonstrated in one case where motor recovery started appearing at the end of 2nd month itself.

However in two cases who had motor power grade 2 recovery even after 72 months of injury at elbow region is difficult to explain. One case had nerve entrapped in scarred area and had preoperative Grade 3 motor power and 25 percent sensory perception. This indicates that few fibres were intact and explained early recovery. Venous cuffe was also provided which prevented abnormal astray of axonerration and so helped in early recovery.

In case of Ulnar nerve the sensory recovery is not as significant as in case of median nerve in those patients who have undergone non-microsurgical treatment. However ulnar nerve treated by microsurgical treatment had sensory recovery almost at par with that of median nerve. Motor power recovery is poorer in non microsurgical treated patients. Other factors which are known to help in early and faster recovery of repaired nerves like vascularized soft tissue bed with similar quality of skin flap cover without any scarring in perineural area helps in allowing faster axonal regeneration of the repaired nerve. Besides intact vascularity, the nerve regeneration is further augmented in nerve repair by local or systemic nerve growth factors (Keshari R. S. 1989; Nigam Archna 1992; Baily B. N. 1994). With the use of microsurgical techniques in the present series of Group B, sensory reinnervation was found to be equal in ulnar and median nerves which is in contrast to Group A study comprising of nonmicrosurgical techniques. So it seems to be due to better identification of fascicles under magnification and near accurate co-optation. Also in present study that is in Group B of microsurgical repair technique, we have observed the beneficial effect of putting venous cuffe around epineurorraphy in contrast to report of few who think that putting venous cuffe at epineurropphy site is going to lead to fibrosis(Gudd C. M. Heijke et al 1993). In present series we have put venous cuffe around epineurrophy in 5 cases and found uniformly good results in all cases which confirms the positive role of venous cuffe around epineurroraphy in helping better axonal regeneration.

In cases of brachial plexus injury, there are only two cases of almost identical nature of the level of injury at the branch level. Both the cases were of traction injury and we got recovery in only one patient but not in the other. One case showed good improvement in both motor and sensory function by microsurgical decompression. Infact after one month of neurolysis the normal NCV appeared for left ulnar and median nerves. For radial nerve it took six months time and showed remarkable improvement. In another case decompression was done but with no result. It may be due to ischaemic neuritis by traction nerve injury leading to fibrosis (Millesi H, Rath T. H , Keihsner. R. & Zoch. G. 1993).

Since the number of cases of lower limb nerve injuries are too small, so no significant conclusion can be drawn by the present work.

**Physiotherapy, Occupational Therapy & Rehabilitation**

Microsurgical treatment of injured peripheral nerve is the major role played by microsurgeon but is not the end of story as the role of proper physiotherapy, occupational and proper rehabilitation is equally important(William & David 1987).

## Conclusion

The study is based on total number of 90 cases of various ages and sex groups. Sixty patients from 1985 onwards to mid1992 had undergone non microsurgical treatment. Thirty cases of present study had undergone microsurgical repair of injured peripheral nerves.

All patients who underwent microsurgical treatment had better recovery. Median, radial and ulnar nerves are involved more than other nerves. Ulnar nerve treated by microsurgical treatment had sensory recovery almost at par with median nerve.

Venous cuffe around epineurorrhaphy site was beneficial as it helped in better axonal regeneration which is interpreted from early and better recovery.

Brachial plexus traction injury respond favourably when it undergoes early neurolysis and decompression.

Venous tabulation results were poor because it was put after long duration of injury and graft length was quite excessive to show early result. Biopsy of

one venous tube showed nerve growth inside the lumen.

Microsurgical nerve decompression, local injection of triamcilone followed by active and passive physiotherapy under supervision have given encouraging results.

**Area for further research**

Though a lot of work has been done on the management of patients with peripheral nerve injuries in whole world and repair by microsurgical technique is involved through out the world but it does not solve the real problem i.e. of identification of individual fibres whether sensory or motor is rather impractical in most of modern operation theatres of different hospitals especially developing and under developed countries. Therefore to overcome this problem and for better co potation of nerve fascicles more work is being done on successful use of venous tubes, synthetic tubes and various kind of glues. Therefore future of management of injured peripheral nerve lies more in the realms of biochemistry and tissue culture rather than finding out individual nerve fibre under most high power magnification for their mechanical co potation by 11/0 Nylon which is known to produce 11/0 intrafascicular neuromas rather than neural transmission(Baily BN, 1994). The role of nerve growth factors is also under trial by various experts in the world and only the time will tell about its definite nature and efficacy(P. Udai, Nigam Archana 1992).

Future of peripheral nerve repair will lie in accurate rotational placement perhaps using tissue glue and neurotrophic agents and the work in this field will be interesting in relation to the work which has been done on neurotrophism in free lying nerve ends (Baily B N, 1994).

## Source of funding

None.

## Conflict of interest

None.

## References

1. Terzis, J K And Smith: Principles, practices and techniques of peripheral nerve surgery, 1991.
2. Coteman, C.C.: Peripheral nerve surgerydiagnostic consideration. *J Neurosurg* 1991;178:215.
3. Prakash Udai: Physiological response to nerveinjury and role of nerve growth factors. Souvenir of workshop on microsurgical techniques, IMS, BHU, 1991.
4. Peter H. Robinson: Nerve regeneration through a two ply-biodegradable nerve guide in the rat and the influence of ACTH 4-9, Nerve growth factor. *Br J Microsurg* 1991;12(6):412-9.
5. Hanno M. Reappraisal of nerve repair. *Surgical Clin North Am* 1981;61(2):321-40.
6. Keshari R S, Tripathi F M, Clinical and electrodiagnostic studies in peripheral nerve injuries. Thesis for M.S., IMS, BHU,1989.
7. Burke P, O'Brien B. A comparision of three techniques in micro nerve repairs in dogs. *Hand* 1978;10:135-43.
8. Grabb W C, Bement SL, Koepke GH and Green RA. Comparision of peripheral nerve suturing in monkeys. *Plast Reconstr Surg* 1970;46(1):31-7.
9. Tripathi F M, Prakash U, Keshari R S, Shukla P K. Venous cuffe around microsurgical repair of injured peripheral nerves. *Microsurg* 1993;14(1):56.
10. Bailey B N : Personal communication(Letter) to Prof. F M Tripathi, 1994.
11. Guda C. M. Heijke, Pieter T. Klapper, Richard P, Dutrieux: Vein graft conduits versus conventional suturing in peripheral nerve reconstructions. *Microsurg* 1993;14:584-8.
12. Millesi H, T H Rath, R Relhsner and G Zoch: Microsurgical Neurolysis: Its anatomical and physiological basis and its classification. *Microsurg* 1993.
13. William W. Shaw and David A. Hidalgo: Microsurgery in trauma 1987.
14. Breidenbach, W C and Terzis J K: Vascularized nerve grafts, an experimental and clinical review. *Ann Plast Surg* 1987;18(2):137-46.
15. Solereanos DG and Urbaniak JR: Nerve graft polarity-Does it matter? Abstract, *Microsurg* 1993;30.
16. Glorgio A et al: Bridging nerve defects with combined skeletal muscle and vein conduits. Microsurgery 1993;14:247-51.
17. Bertelli JA, Mira JC: Nerve repair using freezing and fibrin glue: Immediate histologic improvement of axonal coaptation. *Microsurg* 1993;14:135-40.
18. Rastogi V, Kumar P: Peripheral nerve stimulator as an aid for therapeutic blocks. *Anaesth* 1983;38;162-80.

**How to cite:** Singh S. My study on microsurgical repair of injured peripheral nerves in 1990s. *IP Int J Aesthet Health Rejuvenation* 2020;3(1):22-8.