International Surgery Journal
Disawal A et al. Int Surg J. 2021 Mar;8(3):874-878
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20210919

Original Research Article

Sensory outcomes after repair of median and ulnar nerve with nerve graft

Ankit Disawal*, Sunil Srivastava

Department of Plastic and Reconstructive Surgery, Sawai Man Singh Hospital Jaipur, Rajasthan, India

Received: 12 December 2020
Revised: 22 January 2021
Accepted: 05 February 2021

***Correspondence:**
Dr. Ankit Disawal,
E-mail: drankitdisawal@gmail.com

ABSTRACT

Background: Peripheral nerve injuries in upper extremities are common. These injuries have significant impact on patient's life. Appropriate treatment is important for patients to regain functional recovery.
Methods: Study conducted on patients treated on Department of Plastic and Reconstructive surgery from January 2018 to May 2019. Study was done to evaluate the sensory recovery of median and ulnar nerve in the forearm after defects were repair by autologous nerve graft. Evaluation was performed in 24 patients. Rating of sensibility was presented by British medical research council scale. Satisfactory sensory recovery was defined as MRC grading S3+ and S4.
Results: We evaluate the result of median and ulnar nerve reconstruction as regards to factors affecting functionally the result of operation, which are age, injury level, graft level, and denervation time. Median nerve grafting done in 14 patients and sensory recovery S4 achieved in 2 patients (14%), S3+ in 4 patients (29%). Ulnar nerve grafting done in 10 patients and sensory recovery S4 achieved in 2 patients (20%), S3+ in 2 patients (20%). There was not statistically significant difference in sensory recovery of median and ulnar nerve. There was not statistically significant difference by age, level of injury, graft length, denervation time.
Conclusions: There was no significant difference in sensory recovery of median and ulnar nerves. Mode of injury influences results. Results were comparatively better in younger patients and in patients who had undergone repair within shorter time.

Keywords: Autograft, Denervation period, Functional sensation, Nerve reconstruction, Peripheral nerve injury, Recovery

INTRODUCTION

Peripheral nerve injuries in upper extremity have a tremendous impact on patient's social and professional life. Failure to intervene in these nerve injuries causes worsening of hand functions which can lead to permanent upper limb dysfunction. Median and ulnar nerve are the nerve of special clinical significance in forearm. These nerve nearly dominant all the functions of hand. Injuries of these nerves lead to disability and incapability to work, emotional burden to patients.[1]

There are various techniques to repair the damaged nerve. The options of management are primary repair, auto graft, allograft, and various transfers (tendon/nerve/free functional muscle). End to end epineural suture is done when both ends (proximal and distal) of injured nerve does not generate excessive tension. Autologous nerve graft is used when there is large gap between ends of nerve. Nerve graft performed in tensionless manner has shown better results than end to end approximation performed under tension.[2] Regeneration after nerve reconstruction takes place approximately 1 mm per day.

The goal of treatment after peripheral nerve injury to is to restore critical function and sensibility to the extremity and proper reconstruction should aim to restore the nerve's continuity without excessive tension.

The results of treatment are unpredictable and restoration of full functions are generally never complete normal as preinjury.[3] There are many factors which may affect the final outcome of treatment such as age, delay between injury time and repair, type of injured nerve, level of lesion, length of nerve defect, associated injuries, repair techniques, surgical skills.

Isolated or combined injuries of median and ulnar nerve are common. Compared with median and radial nerve injuries ulnar nerve injuries gives weaker functional recovery.[4,5]

Functions of hand is greatly reduced without sensation. Sensory end organs are less sensitive to denervation than motor end organs. Degree of functional sensation preserved decreases with a delay in intervene to repair nerve longer than 6 months while protective sensibility recovery is possible many years after nerve injury.[6]

METHODS

The retrospective study was conducted on Department of Plastic and Reconstructive surgery in the period from January 2018 to May 2019. Study aimed to analyze the late results of sensory recovery after secondary reconstruction of median and ulnar nerve in the forearm by autograft. Study also evaluates prognostic factors affecting sensory recovery outcome.

We evaluated 24 patients with adequate follow up period. 19 males and 5 females met inclusion criteria. The patient's age ranged from 10 to 62 years with an average of 30 years.

Inclusion criteria

Criteria for inclusion in the study was damaged median and ulnar nerve repair by auto grafting in forearm region with minimum follow up of 1 years between repair and examination.

Exclusion criteria

Combined injury of both nerve and additional nerve injury other than median and ulnar nerve cases are excluded. Other exclusion criteria were nerve injury resulting from infection and inflammatory conditions or polyneuropathies, nerve injury at a different level than forearm.

Reconstruction of median nerve done in 14 patients and ulnar nerve in 10 patients. Time between injury and nerve reconstruction were recorded. Sensitivity of the thumb and little finger was assessed using two point discrimination.

Results were rated based on The British Medical Research Council Scale. The British Medical Research Council introduced in 1954 scales for sensory testing of peripheral nerve function. This scale was later modified by MacKinnon and Dellon to include classic two point discrimination. This modified method of end result evaluation is Highet's scale. This is most widely accepted classification for function testing. Rating is scored from S0 to S4. S3+ and S4 are graded as satisfactory sensory recovery and S0 to S3 graded as unsatisfactory.

The follow up duration was up to 2 year.

Patients were divided into 2 groups on basis of 1) age, below 25 years and above 25 years, 2) injury level, proximal and distal forearm injuries, 3) length of auto graft up to 5 cm and over 5 cm, 4) time between injury and reconstruction, denervation time up to 6 months and over 6 months.

Study approved by ethical committee of hospital. Data analysis was done with IBM SPSS statistic 2.0 software. The analyses applied to these variables were non-parametric statistics. For establishment of difference between the frequencies, the χ^2 test (chi square test) at the level of statistical importance ($p<0.05$) with contingency tables was applied.

British medical research council grading

Classification of sensory recovery (within the autonomous zone)

S0: Absence of sensibility, S1: Recovery of deep cutaneous pain sensibility, S1+: Recovery of superficial pain sensibility, S2: Return of some degree of superficial pain and tactile sensibility, S2+: Return of superficial pain and some tactile sensibility, with an over-response, S3: Return of superficial pain and tactile sensibility; no over-response, S3+: As in S3, but sensory localization and some two point discrimination (between 7 and 15 mm)*, S4: Complete recovery; two point discrimination between 2 and 6 mm* (*Modified by Mackinnon, S.E. and Dellon, A.L).

RESULTS

We studied the results of sensory recovery after median and ulnar reconstruction. We analyzed results with reference to factors affecting outcome such as age, site of injury, delay between injury and repair, graft length. We used MRC grading of sensory perception

Regarding mechanism of injury, we had machine injuries in 6 (25%) patients, electric burn in 10 (42%) patients, sharp injuries with knife and glass in 3 (12%) patients, and explosive injury in 3 (12%) patients.

Table 1: Mechanism of injury and relative frequency.

Mechanism of injury	Number (%)
Machine injury	6 (25)
Electric burn	10 (42)
Sharp injury	3 (12)
Explosive injury	3 (12)
Accidental injury	2 (8)

In regarding age, patients were divided in two groups (<25 years, 9 patients and >25 years, 15 patients). In first group 3 patients (33%) achieved S4 sensory recovery, S3+ in 3 patients (33%), S3 in 3 patients (33%). In another age group of >25 years, sensory recovery of S4 is obtained in 1 patient (6%), S3+ in 3 patients (20%), S3 in 3 patients (20%). The results were not statistically significant difference in these age groups.

Table 2: Sensory recovery and percentage of patients grouped on basis of age.

Sensory recovery	Age <25 years	Age >25 years
S0	-	-
S1	-	3 (20%)
S2	-	5 (33%)
S3	3 (33%)	3 (20%)
S3+	3 (33%)	3 (20%)
S4	3 (33%)	1 (6%)
Total	9	15

By the time, delay between injury and repair, we studied patients divided in two groups, one with denervation time up to 6 months with 16 patients, and another group with denervation time over 6 months with 8 patients. In first group 3 patients (19%) had S4 sensory recovery, 5 patients (31%) had S3+ sensory recovery. In other group 1 patient (12%) had S4 sensory recovery, 1 patient (12%) had S3+ sensory recovery. Difference between two groups was not found statistically significant.

Table 3: Sensory recovery and percentage of patients grouped on basis of denervation period.

Denervation time		
Sensory recovery	**<6 months**	**>6 months**
S0	-	-
S1	1 (6%)	2 (25%)
S2	2 (13%)	3 (38%)
S3	5 (31%)	1 (12%)
S3+	5 (31%)	1 (12%)
S4	3 (19%)	1 (12%)
Total	16	8

On basis of graft length, two groups were formed. One with graft length up to 5 cm, we had 14 patients. Another group with graft length over 5 cm, we had 10 patients. In first group sensory recovery of S4 was achieved in 3 patients (21%), S3+ was achieved in 4 patients (29%). In other group sensory recovery of S4 was obtained in 1 patient (10%), S3+ recovery in 2 patients (20%). The results were not statistically significant comparing both groups.

Table 4: Sensory recovery and percentage of patients grouped on basis of graft length.

Graft length		
Sensory recovery	**<5 cm**	**>5 cm**
S0	-	-
S1	1 (7%)	2 (20%)
S2	2 (14%)	3 (30%)
S3	4 (29%)	2 (20%)
S3+	4 (29%)	2 (20%)
S4	3 (21%)	1 (10%)
Total	14	10

Regarding injury level, in group of distal forearm injuries 17 patients were analyzed. S4 sensory recovery is achieved in 3 patients (18%), S3+ in 5 patients (29%). In group of proximal forearm injuries we had 7 patients. S4 sensory recovery is achieved in 1 patient (14%), S3+ in 1 patient (14%). There was not statistically significant difference in sensory recovery in these groups.

Table 5: Sensory recovery and percentage of patients grouped on basis of injury level.

Injury level		
Sensory recovery	**Distal forearm**	**Proximal forearm**
S0	-	-
S1	2 (12%)	1 (14%)
S2	2 (12%)	3 (43%)
S3	5 (29%)	1 (14%)
S3+	5 (29%)	1 (14%)
S4	3 (18%)	1 (14%)
Total	17	7

Table 6. Sensory recovery after median and ulnar grafting.

Sensory recovery	Median nerve	Ulnar nerve
S0	-	-
S1	2 (14%)	1 (10%)
S2	3 (21%)	2 (20%)
S3	3 (21%)	3 (30%)
S3+	4 (29%)	2 (20%)
S4	2 (14%)	2 (20%)
Total	14	10

In our study, we had done median nerve grafting in 14 patients. Sensory recovery S4 achieved in 2 (14%) patients, S3+ in 4 (29%) patients, S3 in 3 patients (21%), S2 in 3 patients (21%), S1 in 2 patients (14%). Ulnar nerve grafting done in 10 patients. Sensory recovery S4 achieved in 2 (20%) patients, S3+ in 2 (20%) patients, S3 in 3 patients (30%), S2 in 2 patients (20%), S1 in 1

patient (10%). S0 sensory recovery is not found in either of both groups.

DISCUSSION

Final recovery after peripheral nerve injury is complex matter because of variety of factors influencing nerve regeneration and outcome. The main prognostic factors are: age, type of injured nerve, length of nerve defect, level of injury, delay between injury time and repair ,repair techniques, nerve specification (pure motor, pure sensory, mixed). None of them can be modified strictly by the patients. The significant prognostic factors for sensory outcome found to be age and delay from previous researches.

When evaluating nerve function during postoperative follow-up it is imperative to know the sequence of recovery. The evaluation of touch includes perception of touch and pressure. The two point discrimination 2PD is mediated by slowly adopting nerve fibres that indicate the perception of touch and pressure.[7] Tactile gnosis is capability of hand to recognise the character of objects is the prime marker of functional recovery and it should be included in testing.[8]

British Medical Research Council Scales is easy to use and compare results. It is widespread method of testing sensory function. Two point discrimination measurement often used as a measurement of sensitivity in hand. It is based on subjective finding and patient's subjective experience is the most important outcome.[9]

Generally sensory nerve has a better recovery than motor nerve because muscle suffers atrophy during the long recovery period. Median nerve tends to have better prognosis in overall functional recovery (motor and sensory) than ulnar nerve. This may be due to median nerve has a shorter reinnervation pathways and innervates proximal, lager fingers and flexors compared with ulnar nerve.[10]

We did not found significant differences in sensory recovery after median and ulnar grafting. Many other studies between median and ulnar nerve injuries regarding sensory recovery found no significant difference.[11-13]

Mechanism of injury impacted on the results.[12] Extensive injuries made by electricity, explosion, and machines extensively destroy tissues. Such injuries have poorly vascularised surrounding tissue. They often treated after denervation period greater than 6 months and require extended graft length. Such injuries demonstrates comparatively lower functional outcome. Injuries caused by sharp objects such as knifes and glasses usually found to have shorter nerve defects. Most of these injuries underwent repair within 6 months and better results were obtained.

Age was found to be a main factor for recovery. This can be explained by factors like shorter regeneration distance and greater regeneration potential. Younger patients have better nerve regrowth and greater neural plasticity.[11] Some author mentioned in their literature that especially sensory recovery is better in younger patients than in older patients which is accordance with our findings.

Earlier study demonstrate unfavourable prognosis in outcomes after delay in nerve reconstruction of more than 6 to 12 months. Results of our study also find similar result. This advocated early secondary reconstruction of all injuries.

High median and ulnar nerve lesion are reported to have a very poor prognosis.[14,15] Proximal nerve injuries are distant from motor end plates and sensory receptors and regenerating fibres have to travel for a greater distance to reach in the hands. Results were not differing in groups divided by nerve reconstruction in different injury level. Extensive injuries usually extend up to proximal forearm and upper arm.

In our study ,We found better results in patients in which auto graft length was up to 5 cm and poor results in which increased graft length was used. Studies of other author relates our results.[18,19] Function recovery after graft placement depends on severity of injury and therefore depends on time of secondary repair and on graft length.[16,17]

There is need of study with larger sample size and longer follow up period.

CONCLUSION

Several variables influence outcome after peripheral nerve repair. Denervation time remarkably influence the function outcome in sensory recovery. Shorter duration from nerve injury to reconstruct had a better effect on overall efficiency of limb, especially when delay was shorter than 6 months. In younger patients, chances of satisfactory recovery are high. Better results were found in patients in whom auto graft length was up to 5 cm. There was no significant difference in sensory recovery of median and ulnar nerve. Two point discrimination is easy and quickly perform test of tactile sensitivity. It is imperative to know sequence of recovery during postoperative follow up period while evaluating nerve function.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by Institutional Ethics Committee

REFERENCES

1. Jaquet JB, Luijsterburg AJ, Kalmin S, Kuypers PD, Hofman A, Hovius SE. Median, ulnar, and

combined median-ulnar nerve injuries: functional outcome and return to productivity. J Truma. 2001;51(4):687-92.
2. Millesi H. Techniques for nerve grafting. Hand clin. 2000;16:73-91.
3. Beasley RW. Nerve injuries. In: Beasley's surgery of the hand. 1st edn. New York: Thieme; 2003:252-267.
4. Allan CH, Vanderhooft E. Functional outcomes after nerve grafting. Atlas Hand Clin. 2005;10:93.
5. Bruyns CN, Jaquat JB, Schreuders TA, Kalmijn S, Kuypers PD, Hovius SE. Predictors for return to work in patients with median and ulnar nerve injuries. J Hand Surg. 2003;28:28.
6. Flores AJ, Lavernia CL, Owens PW. Anatomy and physiology of peripheral nerve injury and repair. Am J Orthop. 2000:29:167-73.
7. Dellon AL, Curtis RM, Edgerton MT. Reeducation of sensation in hand after injury and repair. Plast Reconstr Surg. 1974;53:297.
8. Moberg E. The unsolved problem: how to test the functional value of hand sensibility. J Hand Ther. 1991;4:105-10.
9. Dahlin LB, Wiberg M. Nerve injuries of the upper extremity and hand. EFFORT Open Rev. 2017;2:158-70.
10. Murovic JA. Upper extremity peripheral nerve injuries: A Louisiana state university health sciences center literature review with comparison of the operative outcomes of 1837 median, radial and ulnar nerve lesions. Neurosurgery. 2009;65(4):A11-7.
11. Vordemvenne T, Langer M, Ochman S, Raschke M, Schult M. Long term results after primary microsurgical repair of ulnar and median nerve injuries: A comparison of common score systems. Clin Neurol Neurosurg. 2007:109:263.
12. Rujis AC, Jaquet JB, Kalmijn S, Giele H, Hovius SE. Median and ulnar nerve injuries: a meta-analysis of predictors of motor and sensory recovery after modern microsurgical nerve repair. Plast Reconstr Surg. 2005;116:484.
13. Roganovic Z, Pavlicevic G. Difference in recovery potential of peripheral nerve after graft repairs. Neurosurgery. 2006;59:621.
14. Battiston B, Lanzetta M. Reconstruction of high ulnar nerve lesion by distal double median to ulnar nerve transfer. J Hand Surg. 1999;24:16.
15. Kim DH, Han K, Tiel RL, Murovic JA, Kline DG. Surgical outcome of 654 ulnar nerve lesions. J Neurosurg. 2003;98:993.
16. Roganovic Z. Missile caused ulnar nerve injuries: Outcomes of 128 repairs. Neurosurgery. 2004:55:1120.
17. Daneyemez M, Solamaz I, Izci Y. Prognostic factors for the surgical management of peripheral nerve lesions. Tohoku J Exp Med. 2005;205:269-75.
18. Kabak S, Halici M, Baktir A, Turk C, Avsarogullari L. Results of treatment of the extensive volar wrist lacerations' the spaghetti wrist. Eur J Emerg Med. 2002;9(1):71-6.
19. Bolitho DG, Boustred M, Hudson DA, Hodgetts KA. Primary epineural repair of the ulnar nerve lesion in children. J Hand Surg. 1999;24:16.

Cite this article as: Disawal A, Srivastava S. Sensory outcomes after repair of median and ulnar nerve with nerve graft. Int Surg J 2021;8:874-8.