ASSESSING THE OUTCOME OF NERVE RECONSTRUCTION WITH EXTENDED NERVE GRAFT

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ABSTRACT

In this study, we evaluated the functional outcomes of nerve reconstruction for nerve gaps exceeding 7 cm, using sural nerve autografts. The cases primarily involved brachial plexus injuries and peripheral nerve injuries. The most frequent causes of these injuries were motorcycle accidents and workplace incidents, predominantly affecting young individuals. The best outcomes for nerve injuries are achieved through primary coaptation. All the patients in our study underwent delayed nerve reconstruction rather than primary repair for various reasons, resulting in outcomes that were not as favourable as those of primary repair. Despite using avascular nerve grafts to bridge long nerve gaps, many of our patients still experienced meaningful recovery. Motor function recovery outperformed sensory function recovery across all types of reconstructions. Hence, in situations where facilities and expertise for vascularized nerve grafts are unavailable, attempting reconstruction with an extended nerve graft for long nerve gap is justified.

Key words: autograft, vascularised nerve graft, extended nerve graft, nerve gap

INTRODUCTION

Traumatic nerve injuries are prevalent, primarily caused by road traffic accidents leading to Brachial plexus injuries and workplace accidents resulting in Peripheral nerve injuries [1-4]. Most of these injuries affect the upper extremity, often causing severe debilitation and lifelong reductions in quality of life and income [5-8].

Despite advancements in surgery and a better understanding of the neurophysiology of nerve regeneration, there remains a significant need for improved nerve grafting options to treat injuries with gaps exceeding 5 cm [9-12]. Even reconstructions using autografts often yield poor results [1,13-17]. Additionally, there is no consensus on the maximum gap that can be effectively bridged by a nerve autograft [18-21]. However, it is generally agreed that recovery after nerve reconstruction diminishes when autografts exceed 6 cm in length [22-29]. In our study, we evaluated the motor and sensory functional recovery in patients who underwent nerve reconstruction with autografts for gaps exceeding 7 cm. Few studies have examined bridging nerve gaps over 5 cm using artificial conduits. Some research indicates that better outcomes are achieved with vascularized nerve grafts [30-34].

Our study included 46 patients, with 22 suffering from Brachial plexus injuries and 24 from peripheral nerve injuries. The average age of the patients was 26.5 years, ranging from 18 to 48 years. The most common causes of injury were motorcycle accidents (48%) and workplace incidents (35%). The study took place from January 2022 to December 2023, with the interval between injury and surgery ranging from 3 to 6 months. The average follow-up period was 18 months, ranging from 12 to 24 months. In all cases, the sural nerve was harvested, with the average length of the nerve graft being 15 cm (ranging from 10 to 25 cm)[Fig. 1-3], and coaptation was performed using epineural sutures with 10-0 prolene.

Figure -1. sural nerve graft harvest

Figure -2. Spinal accessory nerve to Nerve to Biceps branch transfer

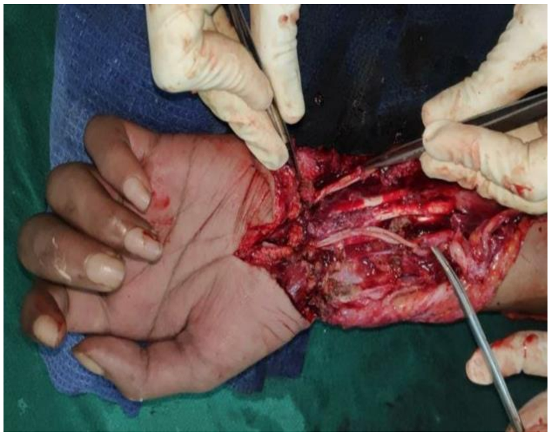

Figure-3. Combined ulnar and median nerve reconstruction with sural nerve graft

Pre-operative evaluation included clinical sensory and motor assessments, nerve conduction studies, MRI of the brachial plexus, and a routine pre-anesthetic check-up. Motor assessment involved visual inspection of muscle bulk, manual muscle testing, measuring range of motion, British Medical Research Council grading of muscle strength, and nerve conduction studies. Sensory assessment encompassed evaluations for touch (fine and crude), temperature sense (hot and cold), vibration sense (128 Hz), two-point discrimination (static and dynamic), Mackinnon-Dellon scale for sensory recovery grading, and nerve conduction studies.

Following the surgery, the suture line was examined after 48 hours, sutures were removed at the two-week mark, and physiotherapy along with electrical stimulation to the affected muscles commenced after four weeks. Additionally, monthly assessments of Tinel's sign were conducted to gauge the rate of nerve regeneration.

RESULTS

In our study, we included a total of 46 patients, comprising 45 males and 1 female. Among them, 26 patients had injuries to their right hand, while 20 had injuries to their left hand. We measured various outcomes in these patients, which are detailed in the following charts [fig 4-8 and table 1.]

The overwhelming majority of patients were male, suggesting a potential link between gender and the likelihood of sustaining such injuries. The distribution of hand injuries between the right and left hands was fairly balanced, though slightly higher for the right hand.

The charts provide a comprehensive overview of the outcomes measured in these patients. These outcomes include both motor and sensory recovery, which were assessed through a variety of methods. Motor recovery was evaluated using visual assessment of muscle bulk, manual muscle testing, range of motion measurements, and the British Medical Research Council grading system for muscle strength. Nerve conduction studies were also employed to provide objective data on motor function recovery.

For sensory recovery, we utilized assessments for touch (both fine and crude), temperature sensation (hot and cold), vibration sense (128 Hz), and two-point discrimination (both static and dynamic). Additionally, the Mackinnon-Dellon scale for sensory recovery grading and nerve conduction studies were used to gather comprehensive data on sensory function recovery.

Postoperatively, patients underwent regular follow-ups to monitor their progress. The suture line was inspected after 48 hours, with sutures removed after two weeks. Physiotherapy and electrical stimulation of the involved muscles began four weeks post-surgery. Monthly assessments of Tinel's sign were conducted to evaluate the rate of nerve regeneration, providing ongoing insights into patient recovery.

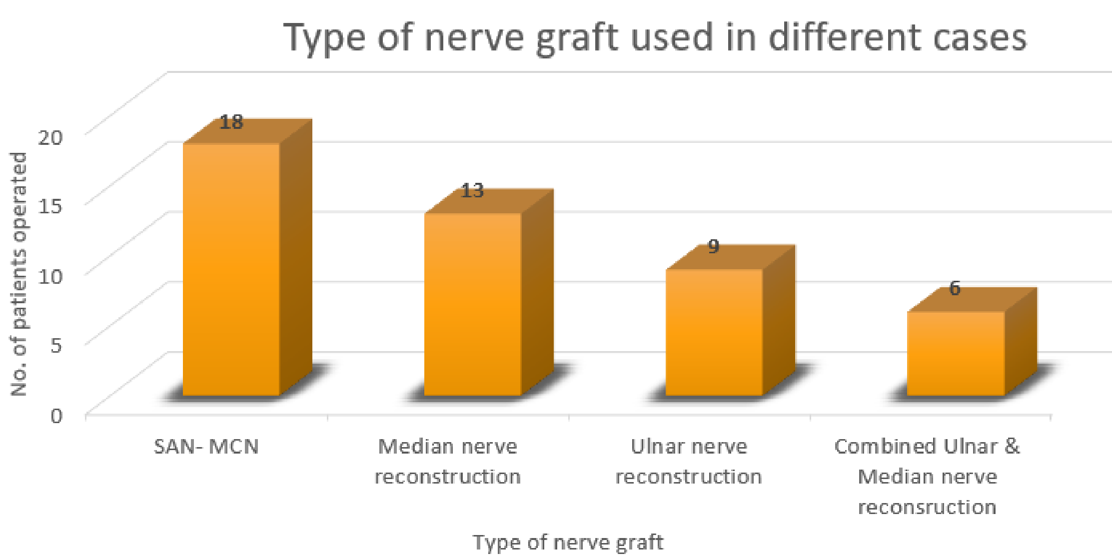

Figure – 4. Types of surgeries done using long autografts. SAN- spinal accessory nerve, MCN- musculocutaneous nerve.

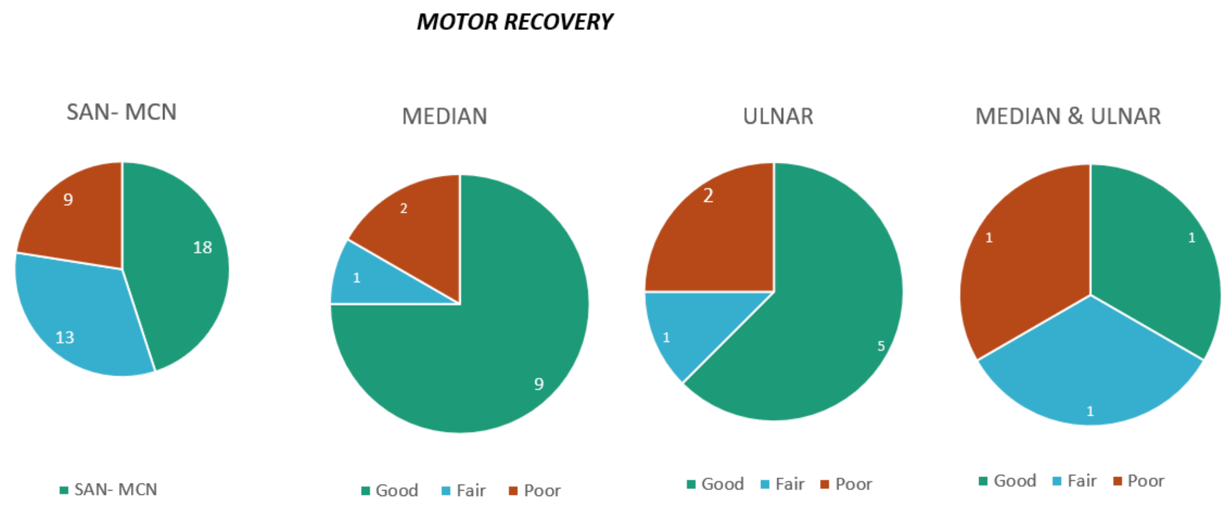

Figure -5. Motor recovery in various surgeries with long nerve graft as depicted.

SAN- MCN	LEFT (PRE-OP)	LEFT (POST-OP)	RIGHT(PRE-OP)	RIGHT(POST-OP)
DISTAL LATENCY(mS)	5.2	5.0	-	8.4
AMPLITUDE(mV)	10.7	10.8	-	8.3

Table -1. Comparing pre operative and post operative results of nerve conduction study in upper limb. SAN- spinal accessory nerve, MCN- musculocutaneous nerve.

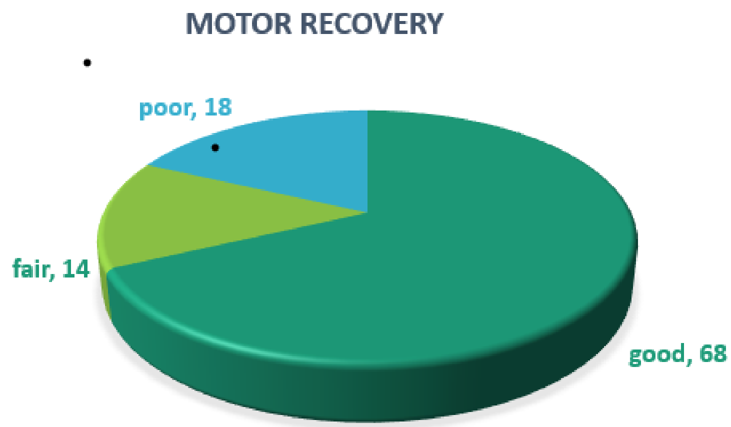

Figure 6. **Meaningful motor recovery ie, M3 muscle strength in 68% patients operated with long avascular autografts**

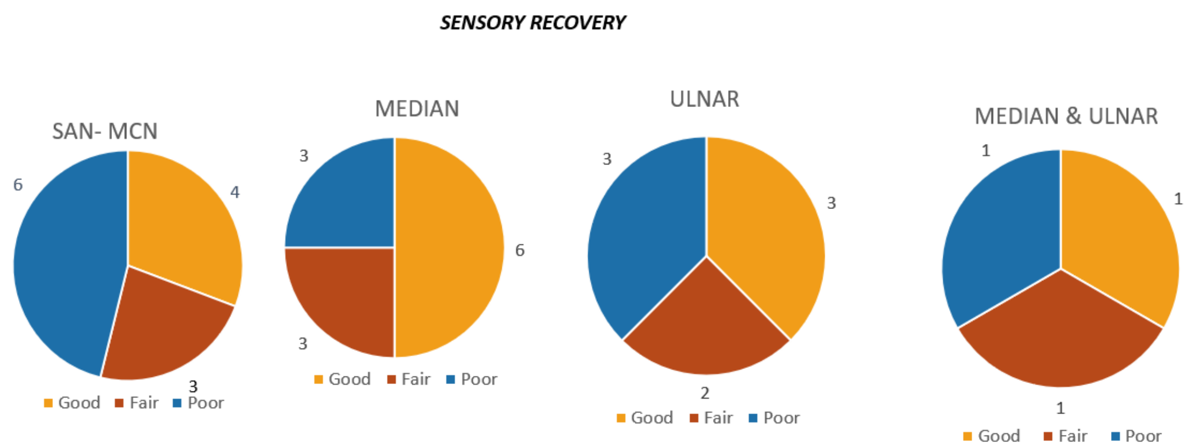

Figure – 7. Sensory recovery in various surgeries using long nerve grafts as depicted in figure

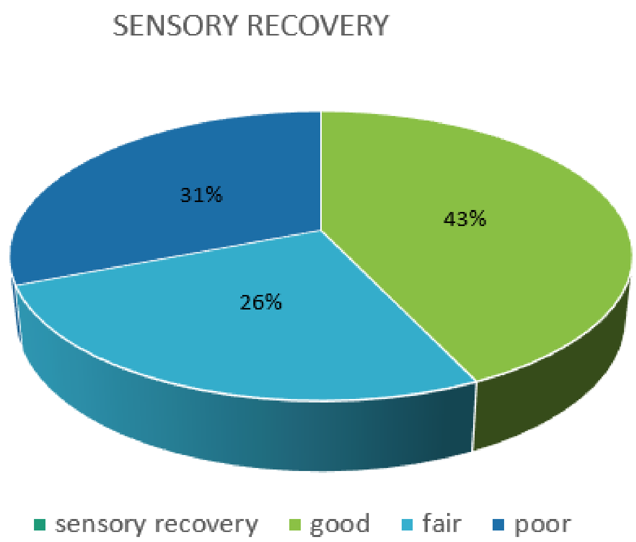

Figure -8. Sensory recovery was mainly assessed by 2 point discrimination test. S3 and S4 grades in Mackinnon and Dellon scale was considered as satisfactory recovery

From our study we found that the survival of all long nerve grafts were fairly good as there was variable degrees of recovery in all patients. Motor recovery was better compared to Sensory recovery. Median nerve recovery was better compared to Ulnar nerve results.

Sural nerve autograft when used for bridging long nerve gaps had advantages of being inexpensive, had a predictable recovery, had minimal wound site infection/ graft loss and less donor site morbidity.

Figure -9. Hypertrophic scar is a late complication seen at the donor site

CONCLUSION

From our study we came to a conclusion that long nerve grafts do provide a *meaningful functional recovery* in nerve reconstructions when used for bridging nerve gaps *more than 7cm*. Though the results are not up to par with primary neurorrhaphy, autologous long nerve graft is *certainly an option for nerve reconstruction when nerve coaptation is impossible and nerve gap is large*

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