Egypt, J. Plast. Reconstr. Surg., Vol. 36, No. 2, July: 233-238, 2012

Comparison between Conventional Microsurgical Technique and Fibrin Glue in Repair of Peripheral Nerve Injuries

SOBHI A. HWEIDI, M.D.**; SAMIA M.A. SAIED, M.D.*; TAREK A. ABULEZZ, M.D.* and GAMAL Y. ELSAYED, M.D.*

The Departments of Plastic & Reconstructive Surgery, Sohag Faculty of Medicine, Sohag University and General Surgery, Plastic & Reconstructive Surgery Unit, Zagazig University**, Egypt*

ABSTRACT

Thirty patients suffering from peripheral nerve injuries in the upper limb have been managed by secondary nerve repair. Clinical assessment was the same in all cases as well as surgical exploration and preparation of both ends of the injured nerves. Before coaptation of both ends, cases were divided randomly into two groups.

Group 1: Fifteen patients where coaptation of both nerve ends were performed by conventional microsurgical repair using 8/0 and 9/0 ethilon sutures.

Group 2: Fifteen patients where coaptation of both nerve ends were performed by the use of fibrin glue.

The limb was splinted for four weeks and physiotherapy started later. Follow-up was performed according to a planned protocol until 18 months postoperatively, and both motor and sensory recovery was evaluated and recorded according to standard scores. The final outcome showed that the use of fibrin glue is easier, faster and more reliable for coaptation of nerve ends and gives similar results or slightly better outcome than the conventional suturing techniques.

INTRODUCTION

Understanding of the pathophysiological processes in a nerve trunk and its neurons after transection injury is essential in order to choose the correct surgical treatment, its timing and the rehabilitation program [1].

The microsurgical techniques currently used for the repair of peripheral nerve injuries were pioneered by Millesi in the 1960s. Over the past 50 years, surgical techniques have improved tremendously. However, the clinical outcomes following nerve repair have remained unsatisfactory [2].

Fibrin glue, composed of (human fibrinogen + apoproptin, which are fibrinolytic inhibitors, and thrombin, that activates fibrinogen), makes for an easier and faster suture. It has been used systematically by some authors especially for nerve grafting [3].

Fibrin glue and microsutures has been compared in a recent study in the repair of rat median nerve and found that nerve repairs performed with fibrin sealants produced less inflammatory response and fibrosis, better axonal regeneration, and better fiber alignment than the nerve repairs performed with microsuture alone. In addition, the fibrin sealant techniques were quicker and easier to use [4].

Aim of the work:

The aim of this study is to compare between conventional microsurgical suturing technique and fibrin glue in repair of peripheral nerve injuries as regard:

- Motor recovery.
- Sensory recovery.

PATIENTS AND METHODS

Thirty patients were included in this study during the period starting from June 2008, to June 2012. All patients suffered from peripheral nerve injuries in the upper limb (at the wrist). All of them were operated upon 3-6 months after the injury. The operation included exploration of the injured nerve and coaptation of both ends without tension.

Wide exposure, tourniquet, microsurgical techniques, equipments and good lighting were necessary in all cases after exposure, external neurolysis was performed and both ends of the nerve were trimmed until the neuroma and fibrous tissues were excised and healthy group fascicles were seen under magnification occupying the whole surface of both nerve ends.

Mild wrist flexion (20-30º) was applied and proper orientation of both ends was done depending on the topography of both sides and the longitudinal blood vessels along the surface of the nerve. Both ends are gently approximated by Jewlers forceps to make sure that there is no tension to start approximation of both ends. At this point we divided our cases into two groups.

Group 1:

Included fifteen cases where approximation is performed by conventional microsurgical repair employing epineurial 8/0 and 9/0 sutures.

Group 2:

Included fifteen cases where approximation is performed using fibrin glue instead.

In group 1, it was necessary to use a cable nerve graft to bridge a nerve defect and avoid tension in five patients, while in group 2; nine patients needed a nerve graft. The donor nerve graft was the sural nerve.

In median nerve grafting, the coverage number of cables needed were 5-7 cables while the ulnar nerve needed 4-6 cables and radial nerve 5-8 cables. The cables were glued together with few drops of fibrin glue. In group 1, coaptation was done between the graft and both ends of the nerve with micro sutures, and in group 2 fibrin glue was used for coaptation of the graft to both proximal and distal ends of the injured nerve.

Postoperative Assessment:

- *Motor function:* Manual muscle strength testing was used to evaluate the recovery of the intrinsic muscles of the hand: The abductor pollicis brevis (APB) was used for the median nerve, the abductor digiti minimi (ADM) was used for the ulnar nerve and the extensors of the metacarpophalangeal joints for the radial nerve. Motor function was assessed according to the 0-5 grades of the "Nerve injuries Committee of the British Medical research Council".

- *Sensory assessment:* The sensory recovery grading system was used (Zachary, Holmes and Moberg modifications of Height scheme).

Demographic data of the 30 patients included in this study are shown in (Table 1).

Postoperative Care and Followup:

While the patients were still under anesthesia, they were put in a plaster cast to support the operated side. This was maintained for a period of four weeks following surgery. After cast removal, all patients were included in a comprehensive course of physiotherapy.

Strict follow-up of the patients included in this study, was done for a period of 2 years according to the following schedule:

• Every week for the first month.

• Every month for the next five months.

• Every 3 months for the next 24 months.

RESULTS

The final outcome scores of all 30 cases with a mean follow-up of 18 months; acceptable recovery was achieved if there was at least a fair motor or sensory outcome.

Results of all 30 cases were analyzed in 15 of 30 (50%) cases with microsuturing nerve repair (group I) and in 15 of 30 (50%) cases with fibrin glue nerve repair (group II).

In group (I), five patients was treated by using sural nerve cable graft and 10 patients was treated by direct nerve repair.

In group (II), nine patients was treated by sural nerve cable graft and 6 patients were treated by direct nerve repair.

Motor function was classified in six grades, from M0 to M5 using "The British Medical Research Council Grading System". The final scores for muscle strength were categorized as follow:

0 or 1 = Bad

2 or 3 = Fair

4 or 5 = Good.

In all cases the normal hand was used as a control, scoring 5.

Sensory function was classified according to the modification of "The Highet's scheme Classification System" as follow:

S4 or S3+ = Good

S3 or S2+ = Fair

S2, S1, S1+or S0 = Bad

Good and fair results were estimated as useful functional recovery.

Group I: Total rate of functional motor recovery in peripheral nerve injuries treated by conventional microsuturing technique was 93.3% (14 of 15 nerve elements), 66.7% (10 of 15 patients) was good, 26.7% (4 of 15 patients) was fair and 6.7% (1 of 15 patients) was bad.

Total rate of functional sensory recovery in peripheral nerve injuries treated by conventional microsuturing technique was 100% (15 of 15 nerve elements), 66.7% (10 of 15 patients) was good, 33.3% (5 of 15 patients) was fair.

Group II: Motor recovery in peripheral nerve injuries treated by fibrin glue was 100% (15 of 15 nerve elements), 66.7% (10 of 15 patients) was good, and 33.3% (5 of 15 patients) was fair.

Sensory recovery in peripheral nerve injuries treated by fibrin glue was 100% (15 of 15 nerve elements), 80% (12 of 15 patients) was good, 20% (3 of 15 patients) was fair.

Fig. (1): During exploration of median nerve injury at the wrist showing both ends and the intervening neuroma.

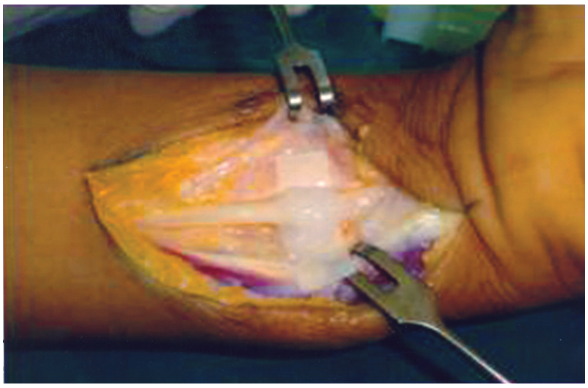

Fig. (2): Repair of median nerve injury at the wrist with fibrin glue.

Fig. (3): Median nerve graft at the wrist.

Fig. (4): Repair of both median and ulnar nerves at the wrist with fibrin glue.

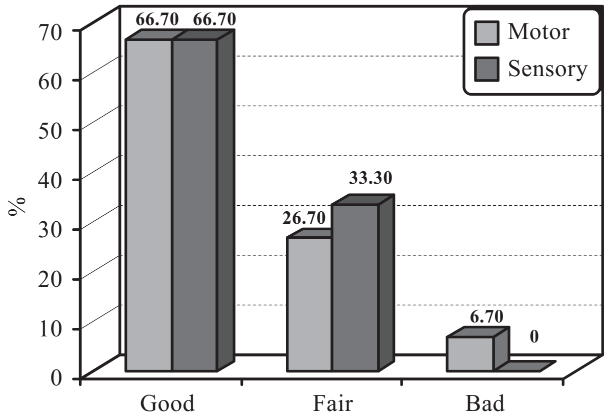

Fig. (5): Motor and sensory recovery in (group I).

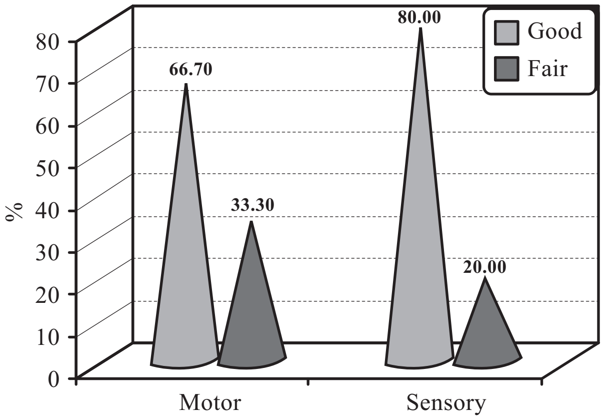

Fig. (6): Motor and sensory recovery in (group II).

Table (1): Demographic information of the studied groups.

Parameter	Group (I) No.	Group (I) %	Group (II) No.	Group (II) %
Sex:				
Male	13	86.7	12	80
Female	2	13.3	3	20
Affected side:				
Right	10	66.7	11	73.3
Left	4	26.7	3	20
Bilateral	1	0.7	1	0.7
Associated injuries:				
Tendons injury	6	40	5	33.3
Vascular injury	4	27.7	3	20
Soft tissue loss	3	20	–	–

Fig. (7): Motor recovery after repair of injured ulnar nerve.

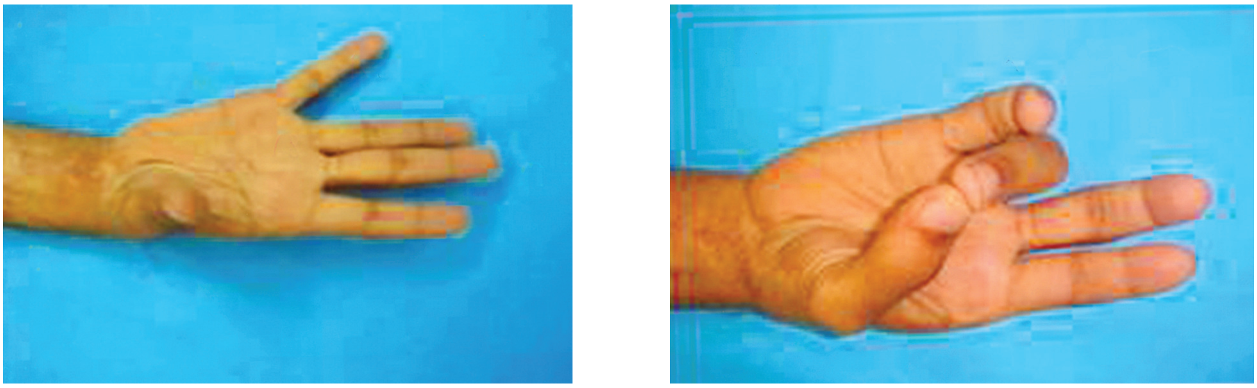

Fig. (8): Motor recovery after repair of injured median nerve.

Table (2): Motor and sensory recovery in (group I).

	Good	Fair	Bad
Motor recovery	66.7%	26.7%	6.6%
Sensory recovery	66.7%	33.3%	0

Table (3): Motor and sensory recovery in patients treated with cable grafting and direct repair in group I.

	Motor recovery		Sensory recovery	
	Good	Fair	Good	Fair
Cable grafting	40%	40%	40%	60%
Direct repair	80%	20%	80%	20%

Table (4): Motor and sensory recovery in (group II).

	Good	Fair	Bad
Motor recovery	66.7%	33.3%	0
Sensory recovery	80%	20%	0

Table (5): Motor and sensory recovery in patients treated with cable grafting and direct repair in group II.

	Motor recovery		Sensory recovery	
	Good	Fair	Good	Fair
Cable grafting	55.6%	44.4%	77.8%	22.2%
Direct repair	83.3%	16.7%	83.3%	16.7%

DISCUSSION

Traditionally, recovery is said to be poor for injured nerves that require more than 18 months to reach target muscles. Considering that the growth rate of a nerve is about 1 inch/month, with an initial lag of a few weeks, recommendations are that the sum total of delay until surgery plus the distance in inches should not exceed 18 months for potential recovery. It may be surprising that several patients showed an excellent result despite a sum total exceeding 18 months. However, this is within the span of 20 months the success rate did not decrease with longer delay or with older age **[8]**.

Nerve grafting is indicated for nerve repair when tension-free direct repair is not possible or when there is segmental nerve loss. The most common material used to bridging segmental nerve defects is autogenous nerve grafts **[9]**.

Intraneural scarring may develop if the severed nerve ends are not well coapted during repair. Surgeons repairing transected peripheral nerves strive to minimize scar formation by closely approximating the corresponding nerve fascicles.

Another cause of scarring is a suture provoked foreign-body reaction. Snyder addressed the problem of intraneural scarring resulting from poor coaptation and/or sutures.

Other approach has therefore been used to reduce scarring caused by sutures; these include nerve adhesion with fibrin glue. One study showed that the application of fibrin glue as a cuff reduced inflammation and avoided the production of suture granulomas. In addition, it has also been shown to enhance nerve regeneration following transection in a rat sciatic nerve model. Fibrin glue acts as a sealant; thus, it allows axonal regeneration even if it is placed at the interposition between two nerve stumps. It is a simple technique and is less time consuming than suturing [10].

The idea of using tissue adhesives for microneural anastomosis seems attractive based on the theoretic advantage of less tissue handling and consequent trauma and better coaptation of the nerve fascicles [11].

Fibrin glue anastomosis has been widely employed for many types of nerve repair because of its easy and rapid performance [12].

In our series, the aim was to compare between conventional microsuturing and fibrin glue in repair of peripheral nerve injuries as regard motor and sensory function recovery. This series included 30 patients who were subdivided into two main subgroups. Group (I), which is treated by using conventional microsuturing technique either by direct nerve repair or using autograft (sural nerve cable) when tension-free direct repair is not possible or when there is segmental nerve loss this group include 15 patients. Group (II) which is treated by using fibrin glue either by direct nerve repair or using autograft (sural nerve cable) when tension-free direct repair is not possible or when there is segmental nerve loss this group include 15 patients also.

In our series and as regards Group (I); the mean age was 21.4 years. Ten patients treated with direct repair by conventional microsuturing technique and five patients treated with sural nerve autograft using conventional microsuturing technique. Total rate of functional motor recovery in this group treated by conventional microsuturing technique was 93.3% (14 of 15 nerve elements), 66.7% (10 of 15 patients) was good, 26.7% (4 of 15 patients) was fair and 6.7% (1 of 15 patients) was bad. Total rate of functional sensory recovery was 100% (15 of 15 nerve elements), 66.7% (10 of 15 patients) was good, 33.3% (5 of 15 patients) was fair.

In our series and as regards Group (II); the mean age was 20.5 years. Six patients treated with direct repair by fibrin glue and nine patients treated with sural nerve autograft using fibrin glue. Total rate of functional motor recovery in this group treated by fibrin glue was 100% (15 of 15 nerve elements), 66.7% (10 of 15 patients) was good, and 33.3% (5 of 15 patients) was fair. Total rate of functional sensory recovery was 100% (15 of 15 nerve elements), 80% (12 of 15 patients) was good, 20% (3 of 15 patients) was fair.

Comparison of the results of Group I and Group II revealed that the use of fibrin glue in peripheral nerve injuries repair give the same or slightly better results than conventional microsuturing technique.

Fibrin glue may be advantageous to achieve nerve approximation in situations where suture application is difficult or impossible for technical reasons.

Fibrin glue appears to fulfill the criteria of being easier, faster, and more reliable means of nerve anastomosis.

Conclusion:

Comparison of the results of Group (I) and Group (II) revealed that the use of fibrin glue in peripheral nerve injuries repair give the same or slightly better results than conventional microsuturing technique

Fibrin glue may be advantageous to achieve nerve approximation in situations where suture application is difficult or impossible for technical reasons.

Fibrin glue appears to fulfill the criteria of being easier, faster, and more reliable means of nerve anastomosis.

Fibrin glue shortens the time of the operation more and more seriously especially in multiple technically difficult cable grafts.

REFERENCES

1- Battiston B. and Tos P. Microsurgical Techniques for Peripheral Nerve Repair, Reconstructive Microsurgery, Konstantinos N. Malizos Landes Bioscience, Georgetown, Texas U.S.A, p. 8-24, 2003.

2- Pabari A., Yang S.Y., Seifalian A.M. and Mosahebi A.: Modern surgical management of peripheral nerve gap, Journal of Plastic, Reconstructive & Aesthetic Surgery, 63: 1941-1948, 2010.

3- Narakas A.: The use of fibrin glue in repair of peripheral nerves. Orthop. Clin. North Am., 19: 187-99, 1988.

4- Ornelas L., Padilla L., Di Silvio M., Schalch P., Esperantes, Infante R.L., Bustamante J.C., Avalos P., Varela D. and Lopez M.: Fibrin glue: An alternative technique for nerve coaptation – Part-II. Nerve regeneration and histomorphometric assessment. J. Reconstr. Microsurg., 22: 123-8, 2006.

5- Bozorg G.A., Mosnier I., Julien N., EI Garem H., Bouccara D. and Sterkers O.: Long term functional outcome in facial nerve graft by fibrin glue in the temporal bone and cerebellopontine angle. Eur. Arch. Otorhinolaryngol., 262: 404-7, 2005.

6- MacGillivray T.E.: Fibrin sealants and glues. J. Cardiac. Surg., 18 (6): 480-87, 2003.

7- McGillicuddy J.E.: Techniques of nerve repair. In: Wilkins R.H. and Rengachary S.S. (eds): Neurosurgery, PP 3179-3191, 1996.

8- Moor B.K., Haefeli M., Bouaicha S. and Nagy L.: Results after delayed axillary nerve reconstruction with interposition of sural nerve grafts. Journal of Shoulder and Elbow Surgery, 19: 461-466, 2010.

9- Karabekmez F.E., Duymaz A. and Moran S.L.: Early Clinical Outcomes with the Use of Decellularized Nerve Allograft for Repair of Sensory Defects Within the Hand, American Association for Hand Surgery Meeting Article, Hand, 4: 245-249, 2009.

10- Ngeow W.C.: Scarless a review of methods of scar reduction at sites of peripheral nerve repair, Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 109: 357-366, 2010.

11- Elgazzar R.F., Abdulmajeed I. and Mutabbakani M.: Cyanoacrylate glue versus suture in peripheral nerve reanastomosis, Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 104: 465-72, 2007.

12- Grayeli A.B., Mosnier I., Julien N., El Garem H., Bouccara D. and Sterkers O.: Long-term functional outcome in facial nerve graft by fibrin glue in the temporal bone and cerebellopontine angle, Eur. Arch. Otorhinolaryngol., 262: 404-407, 2005.