The Clinical Function Comparison of Post Operative Nerve Grafting and Nerve Transfer in Patients with Brachial Plexus Injury

by Heri Suroto

Submission date: 09-Feb-2021 11:28AM (UTC+0800)
Submission ID: 1505098182
File name: 12._The_Clinical_Function_Comparison.pdf (742.18K)
Word count: 3259
Character count: 17747

The Clinical Function Comparison of Post Operative Nerve Grafting and Nerve Transfer in Patients with Brachial Plexus Injury

Agung Tristyanto[1], Heri Suroto[2]

[1]Department of Orthopedics And Traumatology Faculty of Medicine Universitas Airlangga Surabaya Indonesia, [2]Department of Orthopedics And Traumatology Faculty of Medicine Universitas Airlangga. Jalan Mayjen Prof. Dr. Moestopo 47 Surabaya Indonesia 60285

Abstract

Background: Brachial plexus injury is most commonly caused by motorcycle accidents and leads to a deficit of motor strength, pain and disability of the upper limb. The main purpose of reconstructive action of brachial plexus injury is to restore the function of the shoulder and elbow. **Aim:** This study aimed to compare the clinical function of post-operative nerve grafting with nerve transfer in patients with brachial plexus injury.

Methods: This study enrolled a sample of patients who had surgery and evaluated the range of active movement of shoulder abduction and elbow flexion; motor strength using the scale of the British Medical Research Council (BMRC); neuropathic pain using Visual Analog Scale (VAS); and upper extremity disability using the Quick Disability of the Arm, Shoulder, and Hand (Quick DASH) questionnaire.

Results: 30 patients were divided into groups of nerve grafting and nerve transfer with each group consisting of 15 patients. 13 patients (87%) of each group had motor strength of functional shoulder abduction (>M3) (p = 0.874). 13 patients (87%) had better functional elbow flexion motor strength (>M3) in the nerve transfer group than 11 patients (73%) of the nerve grafting group (p = 0.036).

Conclusion: The postoperative nerve transfered clinical function showed a better elbow flexion function with a lower severity of upper limb disability.

Keywords: *brachial plexus injury, nerve grafting, nerve transfer.*

Introduction

Brachial plexus injury is a peripheral nerve injury in the upper limb which is often diagnosed and neglected by medical practitioners because of waiting for a functional recovery, resulting in motor and sensory deficits, accompanied by pain and limitation of limb function which are mutually debilitating. Consequently, it results in a decreased life quality of patients and more negative impacts in terms of psycho-socio-economic[1].

As the number of survivors increases from high-speed motorcycle cidents, the number of brachial plexus injuries also increases. From several epidemiological studies in the United States and Europe, 10-20% of peripheral nerve injuries are brachial plexus injuries with a prevalence of 1.2%, in which 80-90% of such injuries are caused by motor vehicle accidents[2]. Brachial plexus injury is found in the 15-25 year-old male patients[3].

The management of brachial plexus injury is still considered a futile attempt by some peripheral neurologists until the 1960s. However, it changes drastically along with the development of physiology

Corresponding author:
Heri Suroto
Department of Orthopedics And Traumatology Faculty of Medicine Universitas Airlangga. Dr. Soetomo Teaching Hospital Surabaya Indonesia 60285
Jalan Mayjen Prof. Dr. Moestopo 47 Surabaya Indonesia 60285, Email: surotofk@gmail.com

knowledge and peripheral nerve reconstruction techniques. The nerve grafting technique is quite effective in bridging the gap that is too wide after the excision of the nerve segment of the brachial plexus that is damaged and contains fibrotic tissue, compared to the previous action of shortening the collarbone to perform end-to-end coaptation of the neural stump proximal to distal[4].

Nerve graft acts as a source of the endoneurial tube in which the axonal regeneration occurs. Autogenous nerve graft has another advantage, which is capable of providing a viable source of Schwann cells[5]. Neurotization techniques are published in the form of direct connection of functional donor nerves to the injured recipient nerves. It has provided a major advance in the technique of brachial plexus injury neural reconstruction[6].

The main purpose of neural reconstruction in brachial plexus injury is to restore clinical function and achieve optimal patients' quality of life[7]. The success of nerve reconstruction with micro surgical techniques should be followed by the assessment of patients' clinical function as postoperative follow-up[8] both oriented to surgeons such as range of movement (ROM) measurement of joint activation and motor strength recovery, as well as patient-oriented assessment such as neuropathic pain severity and upper limb dysfunction[9]. From that statement, the aim of this study to compare the clinical function of post-operative nerve grafting with nerve transfer in patients with brachial plexus injury[10].

Method

This study used an observational analytic study, with a retrospective cohort design, in which the researchers performed a comparative analysis of current postoperative clinical function in two groups of patients who had performed different surgical actions in the past.

The sample of the study was patients with brachial plexus injury post-operative nerve grafting and nerve transfer, and conducted on January 1, 2009 until September 30, 2014 in Dr. Soetomo Teaching Hospital Surabaya. The sampling technique applied consecutive sampling, in which each patient who fulfilled the inclusion and exclusion criteria was included in the study sample until the required sample number was obtained.

The inclusion criteria were nerve grafting and nerve transfer performed by one operator, the surgery was conducted minimal and maximum within 9 months after the trauma event, and the clinical function evaluation was conducted at least 6 months after the surgery. On the other hand, the exclusion criteria included brachial plexus injury patients who have performed reconstructive actions other than nerve grafting and nerve transfer (eg. tendon transfer, free functioning muscle transfer, arthrodesis), obstetrical brachial plexus injury and patients who were not willing to participate in the research. The procedure of data collection started from collecting medical record database of inpatient and medical record of Orthopedics and Traumatology Outpatient Dr. Soetomo Teaching Hospital Surabaya to record the population of patients with brachial plexus injury that have been encountered nerve reconstruction. The sample was grouped into two groups, post-operative nerve grafting group and nerve transfer group. Further measurements of postoperative clinical function were conducted by using Data Collection Sheet and QuickDASH questionnaire, either by meeting patients at Orthopedics and Traumatology Outpatient Dr. Soetomo General Hospital or conducted home-visite.

The demographic distribution of sex, age, diagnosis, incidence time to operation (in months), and time difference of surgery until evaluation (in months) was presented using descriptive statistics of mean value, standard deviation, minimum value, maximum value, median or the value of a number in percentage. On the other hand, the normality data test was conducted by using Kolmogorov-Smirnov test. If the data was normally distributed, Independent t-test was applied. However, if the distribution of data was not normal, it assessed by using Mann-Whitney test. The results were statistically significant if $p < 0.05$. The computer program used to perform statistical analysis was SPSS program version 16.0 (SPSS Inc., Chicago, Illinois, USA).

Result

This study used a sample of 15 patients in the nerve grafting group and 15 patients in the nerve transfer group. A total 15 patients (50%) with brachial plexus injury were aged 21-30 years old (7 patients in postoperative nerve grafting group and 8 patients in postoperative nerve transfer group). On the other hand, the second most age range was 11-20 years old of 6 patients (4 patients in postoperative nerve grafting group and 2 patients in postoperative nerve transfer group). The mean age of nerve grafting group was 27.2 years old and the nerve transfer group was 29.93 years old. The

independent t-test was performed because of the normal data distribution with p = 0.510.

In sex distribution, brachial plexus patients were dominated by male patients as many as 24 patients (11 in post-operative nerve grafting group and 13 patients in postoperative nerve transfer group). Female patients were 6 patients (4 patients in post-operative nerve grafting group and 2 patients in post-operative nerve transfer group). In nerve grafting group, there were 11 male patients (73.3%) and 4 female patients (26.7%). The nerve transfer group obtained 13 male patients (86.7%) and 2 female patients (13.3%). The gender variable was tested with Fisher's exact test with p = 0.651. There was no significant difference in gender variables.

The diagnosis of patients with major brachial plexus injury was found complete postganglionic type (C5-6-7), preganglionic type (C8-T1) of 15 patients in postoperative nerve grafting group. The rest were postoperative nerve transfer patients: 9 patients with incomplete upper injury type (C5-6) and 6 patients with incomplete upper injury type (C5-6-7). From 15 patients in nerve grafting group, the patients were complete injury type (100%). The result of Chi-square test was conducted with p =0.000. There was a significant difference. The result of statistical test using independent t-test (normal data distribution) showed that there was no significant difference between the two groups, either from the time incidence until the surgery (p = 0.052), and from time difference of surgery until the evaluation (p = 0.959). Overall, the sample characteristics between the nerve grafting and nerve transfer group were homogeneous.

The result of ROM comparison of shoulder abduction showed no significant difference between nerve grafting group (71.33° ± 32.87°) and nerve transfer group (61.67° ± 34.52°). The statistical test was conducted by using independent t-test normal with p = 0.439. However, in contrast to elbow flexion ROM results, the nerve transfer group (102.67° ± 36.35°) was better than nerve grafting (86.67° ± 48.32°) (Table 1).

Table 1. Comparison of Post-operative Clinical Functions

Variable	Nerve Grafting (n = 15)	Nerve Transfer (n = 15)	p
Shoulder abduction ROM*	71.330 ± 32.870	61.67 0 ± 34.52 0	0.439
Elbow flexion ROM*	86.670 ± 48.320	102.670 ± 36.350	0.031
Shoulder Abduction Motor (BMRC)**	3(2-4)	3(2-5)	0.0874
Functional Motor M >3***	13 (87%)	13 (87%)	
Elbow Flexion Motor (BMRC)**	3 (1-4)	4 (1-5)	0.036
Functional motor M > 3***	11 (73%)	13 (87%)	
Neuropathic Pain (VAS)**	2 (0-7)	1 (0-3)	0.236

Upper extremity disability (QuickDASH score)*	42.67 ± 21.92	24.60 ± 14.83	0.014

From that table the difference was statistically significant, since the independent t-test result had p =0.031. The minimum motor strength of shoulder abduction on the motor scale of BMRC in the nerve grafting group was M2, the maximum value was M4, and the median value was M3. On the other hand, the nerve transfer group obtained the minimum value of M2, the maximum value of M5, and the median value of M3. To compare the motor strength of shoulder abduction, statistical test was assessed with Mann-Whitney test because the normality test (Kolmogorov-Smirnov test) obtained abnormal data distribution. The results obtained p =0.874, where there was no significant difference between the nerve grafting group and the nerve transfer group. It corresponds to the number of samples with the motor strength of functional shoulder abduction with a value of >M3 (useful motor recovery). Between the nerve grafting group and the nerve transfer was the same, i.e. 13 patients each (87%) (on table 1).

The comparison of elbow flexic motor strength showed that nerve transfer group was better than nerve grafting group. The difference was statistically significant since the results of statistical tests with Mann-Whitney test (abnormal data distribution) had p =0.036. This is consistent with the number of samples with functional elbow motor strength with a value of >M3 (useful motor recovery) in the nerve transfer group of 13 patients (87%), more than the nerve grafting group of only 11 patients (73%) (Table 2).

Based on the VAS scale in the nerve grafting group, the minimum value was 0, the maximum value was 7 and the median value was 2 (Table 2). The statistical test used was Mann-Whitney test because the distribution of data was not normal with p = 0.236. There was no significant difference between nerve grafting with nerve transfer group. The nerve transfer group had greater amount of sample than nerve grafting group in lower VAS scales (8 patients in nerve transfer vs. 6 patients in nerve grafting on VAS 1 scale, and 2 patients in nerve transfer vs. 1 patient in nerve grafting on VAS 0 scale).

The comparison of upper limb disability severity based on the QuickDASH score in the nerve transfer group (24.60±14.83) was lighter than the nerve grafting group (42.67±21.92). The difference was statistically significant, since independent t-test results had p value = 0.014 (p <0.05) (Table 2).

Discussion

The comparison of elbow flexion ROM in this study was better in nerve transfer group than nerve grafting group. The difference was significant. ROM flexion elbow post operative nerve transfer results obtained better than previous research (Dolan RT, 2012). There was no significant difference between the nerve grafting group and the nerve transfer. This is in accordance with previousudies. Meanwhile, other researchers have published a recovery of motor strength >M3 in 80% (total 577 patients) and 73.7% (total 19 patients) post-operative nerve transfer[7]. The significant difference showed that nerve transfer group was better than nerve grafting. It corresponds to the number of samples with a functional elbow flexion motor strength with a value of >M3 (useful motor recovery) in the nerve transfer group, more than in the nerve grafting group.

Brachial plexus injury often occurs as a result of trauma resulting in a paralysis of clinical function in the upper limb. Almost 50 years ago, there have been many reconstructive actions in patients with brachial plexus injury[11]. The main purpose of reconstructive action on brachial plexus injury is to restore clinical function and achieve optimal patients' quality of life[7].

The success of nerve reconstruction with micro surgical techniques should be followed by assessment of patients' clinical function as postoperative follow-up (surgeon-oriented such as ROM) measurements of joint active and motor strength recovery, or patient-oriented such as the severity assessment of neuropathic pain and upper limb dysfunction)[9]. In this study, there was no significant difference in shoulder abduction ROM between the nerve grafting group and nerve transfer group. The results of this study are still better than previous studies, which only obtained shoulder abduction ROM of 57°[12]. Previous studies had better shoulder abduction ROM of postoperative nerve grafting results than this study of 120°[13]. However, the better shoulder abduction ROM of postoperative nerve transfer result was obtained in previous studies[14].

This result was also supported the operation of elbow flexion function reconstruction. It shows that all samples of nerve grafting group use sural nerve as nerve

graft interposition, whereas nerve transfer group used double-fascicular nerve transfer technique published by Mackinnon. Motor power postoperative nerve transfer may be better than nerve grafting. It may be due to the occurrence of nerve re-innervation to target muscles to travel more closely[15].

The percentage of patients with functional elbow flexion motor restoration with value >M3 postoperative nerve grafting in this study was not much different from previous research results[11]. While in patients with post-operative nerve transfer, the results of this study is also not much different from the results of research conducted by previous researchers[7]. There was no significant difference between the nerve grafting group and the nerve transfer. However, in the nerve transfer group, it has a larger number of samples at a lower VAS scale than the nerve grafting group.

The results are consistent with previous studies that demonstrate the presence of axons undergoing regeneration via cable nerve graft, resulting in neuropathic pain postoperative nerve grafting. Other results indicate if the mean VAS value decreases postoperative nerve transfer[16]. Then, the severity of upper limb disability based on the QuickDASH score in the nerve transfer group is lower than that of nerve grafting, resulting in significant differences. It is similar with the results of previous studies showing a lower mean score post operative nerve transfer[17].

Conclusion

Based on the result of the research, it can be concluded that elbow flexion ROM post-operative nerve transfer is greater than nerve grafting, motor elbow flexion strength post operative nerve transfer is better than nerve grafting and the upper limb disability severity postoperative nerve transfer is lower than nerve grafting.

Conflict of Interest: There is no conflict of interests.

Source of Funding: This study is self-funded.

Ethical Clearance: This study was approved by Ethical Commission of Health Research Faculty of Medicine University of Airlangga.

References

1. Ahmed-Labib M, Golan JD, Jacques L. Functional outcome of brachial plexus reconstruction after trauma. Neurosurgery. 2007;61(5):1016–23.
2. Andrew T, Wallace WA. Do brachial plexus injuries occur at initial impact in motor-cyclists? Br Med J. 1978;1(6128):1668.
3. Doi K, Muramatsu K, Hattori Y, Otsuka K, Tan S-H, Nanda V, et al. Restoration of prehension with the double free muscle technique following complete avulsion of the brachial plexus: Indications and long-term results. JBJS. 2000;82(5):652.
4. Leffert RD, Seddon H. Infraclavicular brachial plexus injuries. J Bone Joint Surg Br. 1965;47(1):9–22.
5. Nishiura Y, Brandt J, Nilsson A, Kanje M, Dahlin LB. Addition of cultured Schwann cells to tendon autografts and freeze–thawed muscle grafts improves peripheral nerve regeneration. Tissue Eng. 2004;10(1–2):157–64.
6. Narakas AO. The treatment of brachial plexus injuries. Int Orthop. 1985;9(1):29–36.
7. Dolan RT, Butler JS, Murphy SM, Hynes D, Cronin KJ. Health-related quality of life and functional outcomes following nerve transfers for traumatic upper brachial plexus injuries. J Hand Surg (European Vol. 2012;37(7):642–51.
8. Choi PD, Novak CB, Mackinnon SE, Kline DG. Quality of life and functional outcome following brachial plexus injury. J Hand Surg Am. 1997;22(4):605–12.
9. Bengtson KA, Spinner RJ, Bishop AT, Kaufman KR, Coleman-Wood K, Kircher MF, et al. Measuring outcomes in adult brachial plexus reconstruction. Hand Clin. 2008;24(4):401–15.
10. Maulida HN, Qulub F, Rosdiani AF, Purnama DS, Saraswati KD, Widiyanti P. Hollowfiber Polyurethane-Collagen Coating Chitosan as Nerve Graft for Therapy of Peripheral Nerve Injury in Extreme Paralysis. J Biomimetics, Biomater Biomed Eng. 2016;28:78.
11. Monreal R. Restoration of elbow flexion by transfer of the phrenic nerve to musculocutaneous nerve after brachial plexus injuries. Hand. 2007;2(4):206–11.
12. Bertelli JA, Ghizoni MF. Reconstruction of complete palsies of the adult brachial plexus by root grafting using long grafts and nerve transfers to target nerves. J Hand Surg Am. 2010;35(10):1640–6.
13. Mikami Y, Nagano A, Ochiai N, Yamamoto S. Results of nerve grafting for injuries of the axillary

and suprascapular nerves. J Bone Joint Surg Br. 1997;79(4):527–31.

14. El-Gammal TA, Fathi NA. Outcomes of surgical treatment of brachial plexus injuries using nerve grafting and nerve transfers. J Reconstr Microsurg. 2002;18(1):7–16.
15. Merrell GA, Barrie KA, Katz DL, Wolfe SW. Results of nerve transfer techniques for restoration of shoulder and elbow function in the context of a meta-analysis of the English literature. J Hand Surg Am. 2001;26(2):303–14.
16. Estrella EP. Functional outcome of nerve transfers for upper-type brachial plexus injuries. J Plast Reconstr Aesthetic Surg. 2011;64(8):1007–13.
17. Liu Y, Lao J, Gao K, Gu Y, Xin Z. Outcome of nerve transfers for traumatic complete brachial plexus avulsion: results of 28 patients by DASH and NRS questionnaires. J Hand Surg (European Vol. 2012;37(5):413–21.

The Clinical Function Comparison of Post Operative Nerve Grafting and Nerve Transfer in Patients with Brachial Plexus Injury

ORIGINALITY REPORT

15%	12%	12%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.unair.ac.id Internet Source	4%
2	www.medicolegalupdate.org Internet Source	1%
3	link.springer.com Internet Source	1%
4	Shin, A.Y.. "Nerve transfers for brachial plexus injuries", Operative Techniques in Orthopaedics, 200407 Publication	1%
5	www.amrita.edu Internet Source	1%
6	"OS02: Tuberculosis 1 : Oral Sessions", Respirology, 2013. Publication	1%
7	Cita Rosita Sigit Prakoeswa, Febrina D Pratiwi, Nanny Herwanto, Irmadita Citrashanty et al.	1%

	"The Effects of Amniotic Membrane Stem Cell-Conditioned Medium on Photoaging", Journal of Dermatological Treatment, 2018 Publication	
8	journals.sagepub.com Internet Source	1%
9	Heather L. Baltzer, Michelle F. Kircher, Robert J. Spinner, Allen T. Bishop, Alexander Y. Shin. "A Comparison of Outcomes of Triceps Motor Branch–to–Axillary Nerve Transfer or Sural Nerve Interpositional Grafting for Isolated Axillary Nerve Injury", Plastic and Reconstructive Surgery, 2016 Publication	1%
10	Spinner, Robert J., Alexander Y. Shin, Marie-NoÃ«lle HÃ©bert-Blouin, Bassem T. Elhassan, and Allen T. Bishop. "Traumatic Brachial Plexus Injury", Green s Operative Hand Surgery, 2011. Publication	1%
11	nvpc.nl Internet Source	1%
12	www.growingscience.com Internet Source	<1%
13	"The Pediatric Upper Extremity", Springer Nature, 2015 Publication	<1%

14	www.sau.edu.bd Internet Source	<1%
15	journals.plos.org Internet Source	<1%
16	www.magonlinelibrary.com Internet Source	<1%
17	"Posters", Knee Surgery, Sports Traumatology, Arthroscopy, 2012 Publication	<1%
18	Hywel Dafydd, Chih-Hung Lin. "Hand reanimation", Current Reviews in Musculoskeletal Medicine, 2014 Publication	<1%
19	Agung Dwi Laksono, Ratna Dwi Wulandari. "Relationship between Environment, Smoking Behavior, Education, Poverty, and Prevalence of Stunted Toddler in Indonesia: An Ecological Analysis", Research Square, 2020 Publication	<1%

Exclude quotes	Off	Exclude matches	< 10 words
Exclude bibliography	On		

The Clinical Function Comparison of Post Operative Nerve Grafting and Nerve Transfer in Patients with Brachial Plexus Injury

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6