Functional Outcome of Tendon Transfer for High Radial Nerve Palsy

Muhammad Amin Cheema, Usman Saeed Bajwa, Haider Amin Cheema

ABSTRACT

Objective: To determine the early functional outcome of flexor tendon transfer for high radial nerve palsy.

Methods: This descriptive study was conducted in Millat Orthopedic and Trauma Surgery Hospital Sargodha from 2002 to 2008. Patient selection criteria was: when there was little or no likelihood of sufficient regeneration of damaged radial nerve and damage of the nerve, the extensor muscles supplied by the nerve, or both was beyond repair. FCR set of transfer was done in all patients. Subjective evaluation of improvement in activities of daily living (ADL) was done by interview and completion of a questionnaire. Also asked whether if they have the chance again they would have had the operation. Objective evaluation was done by measuring related active range of motion (ROM), pinch, grip and extensor and residual flexor power by meters preoperatively, at 3 months and six months of follow up.

RESULTS: A total of 69 patients with mean age 39 years. Males were 86% patients while 14% were female. In 71% patients the dominant limb was involved while in 19% nondominant one. The mean follow up period was 20 months (range 8-36 months). Percent value of active ROM in all transfers (n=69) fell into good or excellent categories in most of the cases. Although transferred limb had less power but there was significant functional improvement in all (100%) patients. All reported improvement in daily activities following the procedure and all answered would have the operation again. All patients had returned to their previous job. There was some resting radial wrist deviation in 3 cases but rarely sufficient to require further surgery. Mild bowstringing of the transferred Palmaris Longus to rerouted Extensor Pollicis Longus was noted but was not severe enough to warrant reoperation.

Conclusion: FCR set of tendon transfer for high radial nerve palsy enable the patient to regain wrist extension, finger extension and power of handgrip resulting in a good functionality of the injured limb and patient satisfaction within a relatively short period.

Key words: FCR set of tendon transfer, functional outcome, high radial nerve palsy.

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INTRODUCTION

Radial nerve injury is one of the most debilitating injury affecting function in the hand because of impairment of grasp. These injuries are not uncommon in our society resulting in poor quality of living, dependency & loss of livelihood. The most prominent features of this injury are loss of wrist extension, finger metacarpophalangeal joints extension and a combination of thumb extension and abduction. Tendon transfers is considered the standard treatment even at the initial stages of the treatment. Pre requisite for tendon transfer include extensive denervation (Portion of the nerve is lost), considerable time has passed since the injury without recovery of function and when the results of nerve repair is poor[1]. Following sets of tendon transfers for high radial nerve palsy can be considered: FCR transfer, Superficialis transfer and FCU transfer. Pronator teres (PT) for restoration of wrist dorsiflexion and rerouted palmaris longus (PL) for restoration of thumb extension and abduction are almost common in each set of transfers. Any of these combinations considered to be useful for the purpose has been utilized[2]. Results of tendon transfer are considered favorable when there is good wrist extension, finger extension, thumb extension and hand grasp[3]. There are reports of 84% improvement in hand function following tendon transfer for injury to radial

nerve with increase in power grip(48%) and tip pinch(62%) advocating early tendon transfer to reduce disability and avoid prolonged external splintage.[4,5].

The Objective of this study was to determine the early functional results of FCR tendon transfer Procedure for patients with high radial nerve palsy.

Department of Orthopaedics, Milat Orthopedic & Trauma surgical Hospital ,Sargodha
Correspondence Author: Muhammad Amin Cheema
Correspondence E-mail: mamincheema@hotmail.com

METHODS

This descriptive study included 69 patients diagnosed with high radial nerve palsy from February 2002 until December 2009 and was carried out at Millat Orthopedic and Trauma Surgery Hospital Sargodha. All operations were carried out by the same operating surgeon having more than 10 years of work experience though the assistants were different. The inclusion criteria were patients having little or no likelihood of sufficient regeneration of damaged radial nerve, damage of the nerve was beyond repair and those treated non-surgically for at least six months post-injury.All patients with brachial plexus injury and cerebral palsy were excluded from the study. Informed written consent for the surgery and publication of research was taken from all the patients. Tendons transferred to restore lost functions in all patients were: pronator teres (PT) to extensor carpi radialis brevis (ECRB) for wrist extension, flexor carpi radials (FCR) to extensor digitorum communis (EDC) for fingers extension and Palmaris longus (PL) to re-routed extensor pollicis longus (EPL) for thumb extension and abduction.PT was exposed through dorsal incision and transferred to ECRB. Palmaris Longus(PL) and FCR were exposed and transferred through volar incision.The Pulvertaft weave technique was used for suturing the tendon with 2/0 non-absorbable sutures. During suturing all tendons were repaired and tensioned in the functional wrist position (wrist extension between 45 to 60 degrees) whilst thumb and fingers were all in full extension. Postoperatively, all patients were protected by an above elbow volar POP splint for four weeks in MCP, PIPJ and DIP full extension and wrist in 30 to 40 extension.Below elbow slab with the fingers and wrist in extension was used for four weeks and then for 3 months at nights. All of the patients had undergone physiotherapy for one month after full time splint removal and after that they were instructed to use their limbs as a practice without physiotherapy. At the final follow up the patient was interviewed, and physical examination was performed. Patients were asked about improvement in ability to perform different activities of daily life by a questionnaire.

Whether s/he was overall satisfied with the operation (yes/no), whether s/he would be willing to undergo the same operation on the opposite limb provided the same occurred to that, whether s/he has been able to return her/his job, and finally when s/he had been able to use the limb usefully for daily activity (the time to maximum recovery). On physical examination, the related active ranges of motion were recorded and arbitrarily divided into four categories for simplicity of calculations: Excellent, good, fair and poor. (table 1)

Table 1. Criteria for grading range of motion of wrist, thumb and fingers.

	Excellent	**Good**	**Fair**	**Poor**
Wrist extension	0-80^o	0	45^o Extension lag	70^o Extension lag
Fingers extension	0-10^o	0	45^o Extension lag	90^o Extension lag
Thumb abduction and extension	80-99^o	60-80^o	30-50	0-29^o
Wrist flexion	Full	0-20^o	0	Dorsiflexed

The important study variables were analysed through SPSS version 22 and data presented in tables where necessary.

RESULTS

There were 59(86%) male and 10(19%) female patients with average age of 39 years (range 8-65 years). Fracture of the affected limb was found in 19 patients and vascular repair was required in 9 patients. Average interval from injury to tendon transfer was 19 months (5 months to 64 years). Preliminary soft tissue coverage operations were required in 3 patients. In majority(74%) patients the dominant limb was involved while in 19% patients the nondominant one. The mean follows up period was 20 months (range 6-36 months).

All of the patients reported subjective improvement in activities of daily life following the procedure and all showed overall satisfaction with the operation. Majority(96%) expressed willingness to undergo similar operation in opposite limb for similar clinical problem. The mean time to job return was 4.5 months. Percent value of active ranges of motion of all transfers fell into good or excellent categories in most of the cases [Table 2]

Table 2. The active range of motion of wrist, thumb and fingers.

	Excellent	**Good**	**Fair**	**Poor**
Wrist extension	62 (89%)	3 (51%)	4 (6%)	
Fingers extension	13 (19%)	46 (66%)	10 (15%)	
Thumb abduction and extension	10 (14%)	25 (36%)	26 (40%)	9 (10%)
Wrist flexion	7 (11%)	57 (81%)	5 (8%)	

Table 3. Force at various leverage points as percentage of contralateral limb (for successful transfer) (n=69)

Action	**Method**	**% of normal side**
Power grip	Pressure bag	40% (5-86%)
Pinch grip	pinch meter	53 % (6-100%)
MP extension	Intrinsic meter at proximal phalanx	53% (5-130%)
Wrist extension	Intrinsic meter at metacarpal heads	30% (8^80%)

Table 4. Patients` opinion on ability to perform activities of daily life.

Personal care	Dressing	100%
	Tooth brush	100%
	Tap	100%
	Cup	83%
	Fork	83%
	Knife	83%
	Spoon	67%
Communication	Books	100%
	T. V	100%
	Telephone	100%
	Writing	67%
Transport	doors	100%
	Handles	100%
	Driving	83%

The ability to simultaneously extend the fingers and the wrist was observed in about half of the patients. No complication directly attributable to operation was observed. Forearm pronation was adequate in all of the patients. No patient complained of decreased wrist flexion, though actually it was found in many. The transferred limb had less power than the normal but there was significant functional improvement in all (100%) patients [table 3].

All the patients could make a fist without difficulty. We did not observe any cases of significant radial deviation of wrist. Majority(90%,n=62) of the patients returned to their previous job without any difficulty while only 10%(7) had some difficulty in performing their previous job.

Patients` opinion on ability to perform activities of daily life is shown in table 4.

Illustrations of required early functional results are given in figure 1 to 3 as case examples.

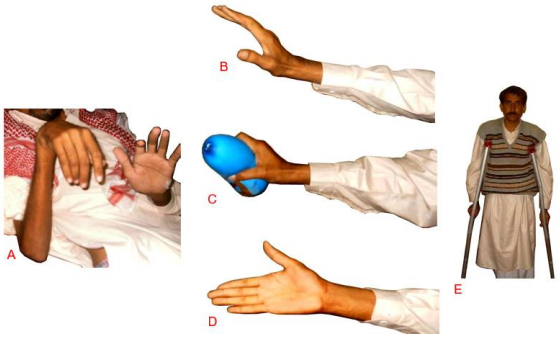

Fig. 1. pre-operative A. Post firearm Rt. mid-thigh amputation and during treatment for amputation got post-injection right radial nerve palsy. Post-operative, B. Fingers & wrist extension, C. Air filled balloon grasping and compressing actively, D. Complete active thumb extension & E. Using the operated hand for walking with crutches.

Fig. 2. post-operative: A. Active wrist, thumb and metacarpophalangeal joint neutral extension. B. Complete active wrist extension with metacarpophalangeal joint flexion. C. Complete active wrist and finger extension.

Fig. 3. post-operative: A. Active wide grasping of filled bowl. B. On active thumb extension and abduction there is some prominence of palmaris tendon that is insignificant to require re-operation.

DISCUSSION

In this large series of FCR set of tendon transfers for high radial nerve palsy early results have been very encouraging as almost all patients had returned to their previous job. Ongoing continuous improvement regarding dexterity, coordination and power is expected with further usage of operated hands.

Radial nerve palsy is a cause of considerable morbidity and disability.[6] In cases of irreparable radial nerve palsy median and ulnar nerve innervated muscle tendons are used as donors to reduce the disability.

Brown[7] is of opinion that when other treatment options fails early tendon transfer should be done. Our selection criteria of patients: flaccid paralysis for 3 months, failed nerve repair and nerve is irreparable, was also based on this notion.

During this study we have observed that the post-firearm and post-injection radial nerve palsies almost nerve recover. So early tendon transfer is recommended in these situations. This was an additional finding.

Gaur and Swarup[8] advocated to use both FCR and FCU but warned that FCU is needed for better wrist flexion and ulnar deviation. Based on this principle we opted for FCR set of transfers and because of this flexion and ulnar deviation of wrist was maintained in our patients. Furthermore, Green DP[2] also has strong preference for FCR set of transfer because the same reasons as Gaur athough FCU transfer is difficult than FCR transfer. According to the post-operative objective evaluation significant improvement in wrist and finger extension and hand grip was seen in this study. This might he due to motivated re-education to perform combined motions for wrist extension proration of the forearm and simultaneously wrist extension.

Chuinard [9] and others [10,11] documented the results of early tendon transfers for radial nerve palsy good to excellent. Our study also favors these findings as the largest bulk of patients fell into good grading in each measured para-meters with none of the patients falling in poor grades.

Majority(90%) of our patients returned to their previous job without difficulty and only 10% had expressed some difficulties. Other studies [1,12,13,14,15] reported the ability to return to previous job without difficulty observed in 73.2% of patients and with some difficulties in 19.5% of their patients. Our results were slightly better perhaps being operated by a single surgeon.

In this study athough the transferred limb had less power than the contralateral normal hand but there was significant functional improvement in all the patients and no patient had any complaints of a reduced power of grip. The reason may be due to their accommodation to the procedure or to the improvement in grip strength they expressed as a result of surgery.

The results of our study at six months are encouraging as all the patients had re gained motions and function of the hand and wrist and rehabilitated to their social life and previous jobs.

This study has some limitations.Our sample size is small and design of the study was descriptive.Furthermore our follow up duration was short.We therefore recommend further well designed studies with larger sample size and longer follow up to confirmed our results of the procedure.

CONCLUSION

FCR set of tendon transfer for high radial nerve palsy enable the patient to regain wrist extension, finger extension and power of handgrip resulting in a good functionality of the injured limb and patient

satisfaction within a relatively short period. Moreover, consistent improvement in hand function occurs postoperatively. If there is no recovery at three months time early tendon tranfers must be done to regain hand functions.

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Authorship and contribution Declaration

Muhammad Amin Cheema, Conception and design, Collected the data, interpreted the data, Drafted the manuscript

Usman Saeed Bajwa, Revised the manuscript critically for important intellectual content

Haider Amin Cheema, Final approval of the version for publication