

Outcome of Transfer Flexor Carpi Ulnaris And Palmaris Longus Tendons for Hand Deformity in Persistence Radial Nerve Palsy

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ABSTRACT

Objective; the aim of our study is to evaluate the functional outcome of transfer flexor carpi ulnaris and palmaris longus for patients with persistence radial nerve palsy by minimal tendon transfer technique.

Methods; The study included 10 patients 8 male and two female, mean age 25 years, range from 20 to 30 years. They underwent transfer of flexor carpi ulnaris (FCU) and palmaris longus (PL) tendon for patient with persistence radial nerve palsy, the duration of outcome of tendon transfer after radial nerve injury evaluated after one year. Clinical evaluation include wrist joint range of movement by Geniometry and compared with the contralateral normal side.

Results; The average ranges of wrist movements were as the follows: the mean wrist flexion was 52° (range 46° – 56°), the mean wrist extension was 34° (range 30 – 38), radial deviation 18° (range 16° – 20°) and ulnar deviation 21° (range 18 – 23). The mean extension of the fingers in wrist extension was 7° (range 5° – 10°) and in wrist neutral position was 12° (range 9° – 16°). The mean abduction of the thumb was 38° (range 35° – 44°). In comparison to the measure of joints in the contralateral normal hand, the final extension of the wrist was less, but extension of the fingers and MCP joints was similar to that of the normal hand. All of the patients in our study were able to extend their fingers with the wrist in the neutral position. Thumb abduction and extension was sufficient to deal with daily activities and, even, heavy jobs in most of the patients. Postoperative follow up of the patients was ranged (12–24) months. After 45 days, 80% of the patients were able to do the normal non heavy daily work. In 20% of cases recovery was not progressing satisfactorily at 5 weeks. These were referred to physiotherapy for a planned exercise program, which the two patients improved their movements.

Conclusion; The purpose of this study was to evaluate function of the hand after transfer of the FCU to EDC and PL to EPL, with



persistence high nerve injuries. The FCU & PL tendons transfer has some advantages over the other techniques, short duration of operation time, no morbidity, improve range of motion of hand and less surgical scares. It is a viable option to restore hand function and strength following radial nerve injuries.

Keyword; Persistence Radial nerve palsy, FCU and PL tendon transfer, minimal technique.

INTRODUCTION

Patients with complete radial nerve palsy have great difficulty in picking up heavy large objects, due to lack of extension of the wrist, fingers and thumb, so the second line treatment of persistent radial nerve palsy is tendon transfer, which leads to acceptable results in a majority of patients [1-3].

One of the earliest descriptions of tendon transfer for radial nerve palsy was by Franke, in 1898, he transferred flexor carpi ulnaris tendon (FCU) to extensor digitorum communis (EDC) through the interosseous membrane. In the same year, Capellen Transferred flexor carpi radialis tendon (FCR) to extensor pollicis longus (EPL)[4].

In 1916, Sir Robert Jones added the pronator teres tendon (PT) transfer to extensor carpi radialis longus (ECRL) or to extensor carpi radialis brevis (ECRB). Zachary in 1946, reported that the flexor carpi radialis muscle (FCR) should be preserved for wrist control which is control the wrist in pronation and supination due to insertion in 3rd metacarpal [3-12].

In 2002, Tubiana describe two basic methods of tendon transfer either use or not use the flexor carpi ulnaris tendon (FCU), he advice to avoidance of radial deviation of wrist by preserve the flexor carpi radialis longus [13-14]. Gousheh and Arasteh, performed tendon transfer in a small number of patients with radial nerve injury, transferred the flexor carpi ulnaris tendon (FCU) alone to extensor digitorum communis(EDC), an internal splint in addition with repairing the radial nerve [5]. Over 50 variations of tendon transfer, the most widely accepted combination is the triple transfer of pronator teres (PT) to extensor carpi radialis brevis (ECRB), flexor carpi ulnaris tendon(FCU) to extensor digitorum communis (EDC), and palmaris longus (PL) to the re-routed to extensor pollicis longus (EPL). This technique used for many years, [8, 12, 6].

AIM OF WORK

The aim of our study to reports the outcome of transfer of the flexor carpi ulnaris tendon (FCU) to extensor digitorum communis (EDC), and palmaris longus (PL) transfer to extensor pollicis longus (EPL) in 10 patients with non-expected to recover radial nerve function as the nerve had either been irreversibly damaged or had failed to recover after nerve repair at least one year previously. It is minimal technique to restore wrist and finger extension, also, extension and abduction of the thumb.

PATIENTS AND METHODS

All of our patients were suffering from complete loss of radial nerve function, and complaining from dropped wrist and inability to extend the fingers and loss of extension and abduction of thumb. The study included ten patients presented to Al-Wahda University

Hospital in the period from October 2015 to April 2017. These patients were eight men and two women with the average age of 25 (range 20–30) years old. All patients suffering from high radial nerve injury by humeral fracture, direct stab wounds, bullet or shell fragment injuries or iatrogenic injury during fixation of humeral fractures.

Surgical Technique;

A longitudinal incision was made in the distal third of the flexor aspect of the forearm over the flexor carpi ulnaris (FCU) muscle and tendon. The transfer flexor carpi ulnaris (FCU) tendon was transected just proximal to the pisiform and freed up proximally under direct vision. In most patients, we encountered a neurovascular pedicle from the main ulnar artery and nerve entering the proximal part of the distal third of the muscle. This was sacrificed to allow easier transfer of the tendon as the main neurovascular pedicle is located, more proximally, about 6 cm from the flexor carpi ulnaris (FCU) origin from the medial epicondyle. The muscle belly of flexor carpi ulnaris tendon (FCU) is long and usually extends close to the insertion of tendon. To facilitate precise suturing at the transfer site and a less bulky appearance, we usually excised 1 to 2 cm of the distal end of the muscle belly. Through a transverse incision on the dorsum of the distal forearm, the tendons of extensor digitorum communis (EDC), was exposed and any adhesions within their osseo-fibrous tunnels released. To increase the pulling force of the transferred flexor carpi ulnaris tendon (FCU), we often incised the proximal third of the extensor retinaculum. The flexor carpi ulnaris (FCU) tendon was then passed under the superficial fascia and around the ulnar border of the forearm to the dorsal incision. It is vital that the line of pull of the flexor carpi ulnaris tendon (FCU) is as straight as possible from the medial epicondyle to the extensor digitorum communis (EDC). With an assistant holding the wrist at 30° , the metacarpophalangeal joints at 20° and interphalangeal joints in full extension, the flexor carpi ulnaris tendon (FCU) was passed through the extensor digitorum communis (EDC). It was then sutured to extensor digitorum communis (EDC), with non-absorbable 3-0 prolene sutures, then the distal end of the palmaris longus (PL) was then passed through the same subcutaneous tunnel to extensor pollicis longus (EIP) and sutured to it with the thumb in full extension (Fig 1&2&3).



Fig 1: preoperative case of radial palsy.



Fig 2: preoperative case of radial palsy.



Fig 3: intraoperative.

After transfer the tendon, tension was checked by passive movements of the wrist, using the tenodesis effect. With the wrist in extension, the tension was set such that it was possible to flex the fingers to within 2 cm of the palm. At the end of the operation, the wrist was immobilized in 40° of extension, the MCP joints in 10° of hyperextension and the thumb in maximum extension and abduction using a forearm splint. The proximal and distal interphalangeal joints of the fingers were left free.

Postoperative Follow-up;

In all cases, an exercise program was started one day after operation with active flexion and extension of the interphalangeal joints of the fingers every 3 hours. The splint was removed on the 25th day postoperatively, it was particularly useful to instruct the patient to carry out gentle synergic movements in a warm bath twice daily, we never used dynamic splints postoperatively but in 20 % of cases when recovery was not progressing satisfactorily at 5 weeks, the patients were referred to physiotherapy for exercise treatment. All the patients were examined every 4 weeks during the first six months and usually every six months during the next two years. The ranges of wrist movement, extension of the MCP joints of the middle finger and abduction and extension of the thumb were measured by goniometry at each follow-up, and compared the results with normal side. The patient already asked about their return or not to normal daily activities and work.

RESULTS

Period of postoperative follow-up was ranged (12–24) months. After 45days, 80 % of the patients were able to do the normal non heavy daily work. In 20% of cases recovery was not progressing satisfactorily at 5 weeks. These were referred to physiotherapy for planned exercise program, which the two patients achieved the functional level we expected after 8 week (Table 1, 2&3).

Table 1: Rang of motion of hand after six months.

	Wrist joint				Middle Finger (MCP)				Thumb
	flexion	extension	Radial deviation	Ulnar deviation	flexion	extension	Finger ⁽¹⁾	Finger ⁽²⁾	Abduction
1	50 ⁰	32 ⁰	18 ⁰	24 ⁰	18 ⁰	7 ⁰	8 ⁰	15 ⁰	40 ⁰
2	53 ⁰	35 ⁰	16 ⁰	23 ⁰	20 ⁰	8 ⁰	10 ⁰	9 ⁰	44 ⁰
3	48 ⁰	38 ⁰	19 ⁰	22 ⁰	20 ⁰	12 ⁰	5 ⁰	16 ⁰	35 ⁰
4	46 ⁰	37 ⁰	17 ⁰	20 ⁰	18 ⁰	10 ⁰	8 ⁰	14 ⁰	36 ⁰
5	55 ⁰	38 ⁰	16 ⁰	24 ⁰	19 ⁰	12 ⁰	10 ⁰	15 ⁰	42 ⁰
6	48 ⁰	30 ⁰	16 ⁰	18 ⁰	17 ⁰	11 ⁰	9 ⁰	12 ⁰	40 ⁰
7	56 ⁰	36 ⁰	17 ⁰	24 ⁰	19 ⁰	9 ⁰	10 ⁰	10 ⁰	43 ⁰
8	50 ⁰	35 ⁰	20 ⁰	23 ⁰	18 ⁰	12 ⁰	8 ⁰	13 ⁰	39 ⁰
9	49 ⁰	32 ⁰	19 ⁰	22 ⁰	20 ⁰	10 ⁰	10 ⁰	16 ⁰	40 ⁰
10	47 ⁰	38 ⁰	18 ⁰	24 ⁰	20 ⁰	11 ⁰	9 ⁰	15 ⁰	41 ⁰

(1);Finger extension with wrist extension, (2); Finger extension with wrist in natural position

Table 2: Range of movements of normal side hand joints by Geniometer.

Wrist joint				Middle Finger (MCP)				Thumb	
extension	flexion	Radial deviation	Ulnar deviation	flexion	extension	Finger ⁽¹⁾	Finger ⁽²⁾	Extension	Abduction
50 ⁰	60 ⁰	20 ⁰	30 ⁰	20 ⁰	20 ⁰	5>8 ⁰	>12 ⁰	0-5 ⁰	>50 ⁰

(1);Finger extension with wrist extension, (2); Finger extension with wrist in natural position

Table 3: Range of movement in affected side.

Motion	Wrist flexion	Wrist extension	Wrist extension with extension finger	UD	RD	Finger extension with wrist extension	Finger extension with natural wrist	Thumb Abduction
Range	46 ⁰ -56 ⁰	30 ⁰ -38 ⁰	5 ⁰ -10 ⁰	18 ⁰ -24 ⁰	16 ⁰ -20 ⁰	5 ⁰ -10 ⁰	9 ⁰ -16 ⁰	35 ⁰ -44 ⁰
Mean value	50 ⁰	34 ⁰	7 ⁰	21 ⁰	18 ⁰	7 ⁰	12 ⁰	40 ⁰

Six months after surgery, the average ranges of wrist movements were as the follows: the mean wrist flexion was 50° (range 46° – 56°), the mean wrist extension was 34° (range 30° – 38°), radial deviation 18° (range 16° – 20°), and ulnar deviation 21° (range 18° – 23°). The mean extension of the fingers in wrist extension was 7° (range 5 – 10) and in wrist neutral position was 12° (range 9° – 16°).

The mean abduction of the thumb was 40° (range 35 – 44°) .Long-term follow up of the patients showed no regression and none of the patients underwent additional related surgical interventions.

In comparison to the measure of joints in the contralateral hand final extension of the wrist was less, but extension of the fingers and MCP joints was similar to that of the normal hand (Fig 4 & 5). All of the patients in our study were able to extend their fingers with the wrist in the neutral position. Thumb abduction and extension was sufficient to deal with daily activities and, even, heavy jobs in most of the patients.



Fig 4: postoperative case



Fig 5: postoperative case

DISCUSSION

Most authors believe that the tendon transfers not good outcomes in cases of radial nerve palsy with irreversible damage or reconstruction failure (Kruft et al., 1997; Lowe et al., 2002; Reid, 1988; Tsuge, 1980). Sunderland recommended carrying out tendon transfers if radial nerve recovery did not occur within 1 year (Sunderland, 1991) [11]. At present, there is continuing dispute as to the best is triple tendon transfers in patients with radial nerve palsy [6, 7, 8].

Burkhalter believed that the greatest functional loss in the patient with radial nerve injury is weakness in grip and recommended an early PT to ECRB transfer to eliminate the need for an external splint (Burkhalter, 1974) [2]. Some other authors also support the use of this tendon transfer and point out that this type of tendon transfer does not interfere with recovery of the radial nerve (Omer, 1974) [9]. Thinking along the same lines and to obtain better extension of the fingers and a better ability to grasp large objects, in our study we performed the same tendons. This was intended as a substitute for a lively dynamic splint during regeneration of the nerve after repair. Surprisingly, we observed quite acceptable

functional results in the first weeks after removing the plaster splint and the patients were able to do their routine works after 45 days, long before nerve regeneration could have occurred with high nerve injuries. The results were comparable to the results of the standard technique of transferring three tendons, which was our normal approach for permanent radial nerve palsies at that time. This experience persuaded us to use the same technique in patients with permanent, or irreparable, radial nerve injuries.

There is concern about loss of some functions in the hand and wrist after transfer of three tendons. However some authors believe that a single flexor carpi ulnaris tendon (FCU) cannot provide simultaneous wrist dorsiflexion and fingers extension (Brand, 1974) [1]. Our experience has shown that transfer of flexor carpi ulnaris tendon (FCU) and palmaris longus (PL) tendons provides good restoration of wrist and finger extension and thumb abduction and extension without further transfers.

Presented two studies of patients by two different methods of triple tendon transfer. The mean wrist extensions were reported in his series as 36° and 32° in his two groups and 34° in our patients and the mean wrist flexion in his two groups were 13° and 38° and 52 in our patients.

The means of thumb abduction in his two groups were 55° and 56° and 41° in our patients. All the patients in our study were able to extend the fingers, not only in wrist flexion, but also in the neutral wrist position and even when the wrist was in extension (Fig 6). Also they were able to flex their fingers to make a full fist. Although this technique could be criticized for not providing enough power of thumb abduction, we have not noticed major functional drawbacks in our patients. Probably if the median nerve is intact, abductor pollicis brevis can provide strong enough abduction of the thumb to tackle routine work.

Transfer of a flexor carpi ulnaris tendon (FCU) and palmaris longus(PL) has some advantages, including simplicity, shorter operation time, less morbidity due to transfer of two tendon, and, not least, less surgical scars, which is important in some patients, particularly women. In respect of the use of two tendon instead of three, this may have particular value in war victims, such as many of our patients, who often do not have single injuries to the limb. In addition, the most advantage of our study, we can performed our minimal transfer of flexor carpi ulnaris tendon (FCU) and palmaris longus (PL) early at the same time with radial nerve repair.

Table 5: Return of patients to work.

Return to job without difficulty	70%
Return to job with difficulty	20%
Not return	10%

There is only one important contraindication to use of this technique, if the flexor carpi ulnaris tendon (FCU) tendon was not sufficiently strong, we added the PT transfer to ECRB for restoration of wrist extension. This situation had been encountered in some patients with brachial plexus injury, simultaneous injury to the radial and ulnar nerves in the arm, cubital tunnel syndrome and partial damage to the flexor carpi ulnaris tendon (FCU) muscle itself.

In our study we did not measure the power of the grip because lack of equipment.

Though surly this is limitation of the study, it may be consideration that the power grip different among the individuals and even between the two hands in the same individual, so the grip is not a good parameter for comparison.

CONCLUSION

The purpose of this study was to evaluate function of the hand after transfer of the FCU to EDC and PL to EPL, with persistence high nerve injuries. The FCU & PL tendons transfer has some advantages over the other techniques, short duration of operation time, no morbidity, improve range of motion of hand and less surgical scares. It is a viable option to restore hand function and strength following radial nerve injuries.

REFERENCES

- [1] Brand PW. (1974). Biomechanics of tendon transfer. *Orthopedic Clinics of North America*, 5: 205–230.
- [2] Burkhalter WE. (1974). Early tendon transfer in upper extremity peripheral nerve injury. *Clinical Orthopedics and Related Research*, 104: 68–79.
- [3] Green DP (1999). Radial Nerve Palsy. In: Green DP (Ed.) *Operative Hand Surgery*. 4th edn. New York, Churchill Livingstone, Vol. 2: 1481–1496.
- [4] Green DP (2003). Radial nerve palsy. *Green's operative hand surgery*. 4th ed. vol.1 philadelphia, pennsylvania ; churchil Livingston, 1113-30.
- [5] Gousheh J. Arasteh E. (2006). Transfer of a single flexor carpi ulnaris tendon for treatment of radial nerve palsy. *Journal of hand surgery (British and European volume)*, 231B; 5: 542-546.
- [6] Krufft S., Von Heimburg D., Reill P. (1997). Treatment of irreversible lesion of the radial nerve by tendon transfer: indication and long term results of the Merled' Aubigne procedure. *Plastic and Reconstructive Surgery*, 100: 610–616.
- [7] Lim A., Lahiri A., Pereira B., Kumar V., Tan L. (2004). Independent function in a split flexor carpi radialis transfer. *Journal of hand Surgery*, 29A: 28–31.
- [8] Lowe JB, Sen SK, Mackinnon SE (2002). Current approach to radial nerve paralysis. *Plastic and Reconstructive Surgery*, 110: 1099–1112.
- [9] Omer JR. GE (1974). The technique and timing of tendon transfers. *Orthopedic Clinics of North America*, 5: 243–252.
- [10] Reid RL (1988). Radial nerve palsy. *Hand Clinics*, 4: 179–185.
- [11] Sunderland S. (1991). Decision making in clinical management of nerve injury and repair. In: Sunderland S, ed. *Nerve Injuries and their repair*. Edinburgh, Churchill Livingstone, 413–431. and Suderland S., *Decision making for radial nerve palsy*. *Australian and New Zealand journal of surgery*, 50; 267-272.
- [12] Tsuge K. (1980). Tendon transfers for radial nerve palsy. *Australian and New Zealand Journal of Surgery*, 50: 267–272.
- [13] Tubiana R. (2002). Problem and solution in palliative tendon transfer surgery for radial nerve palsy. *Tech Hand Up Extrem Surg*. 6; 104-13.
- [14] Ustun ME, Ogun TC, Buyukmumcu M (2001). Neurotization as an alternative for restoring finger and wrist extension. *Journal of Neurosurgery*, 94: 795–798.

دراسة فعالية نقل وتر مثنيه الرسغ الزنديه ووتر الراحيه الطويلة في ترميم الشلل التام للعصب الكعبري في بسط اليد

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ملخص

الشلل الكلي للعصب الكعبري نتيجة الحوادث والاصابات اثناء الحروب من المشاكل الشائعة التي تجعل حركة اليد في البسط او الامسك بالأشياء مستحيل وقد قمنا بدراسة التعويض لوظيفة اليد وذلك بنقل الاوتار لعضله مثنيه الرسغ الزنديه ووتر الراحيه الطويلة حتى تستطيع بسط اليد واسترجاع الحركة الطبيعية لليد

لقد تم اجراء عشر عمليات لحالات مصابه بشلل العصب الكعبري وتم مقارنه النتائج الحركية لليد بعد نقل الاوتار ومقارنتها باليد السليمة وتم استخدام جهاز القياس الجينوميتر وتم عمل النتائج في جداول ومقارنتها مع بقيه الطرق المتعارف عليها عالميا ووجدنا ان الطريقة المستخدمة التي استخدمناها طريقه بسيطة وسريعة ولا يوجد لها اثار جانبية كفقدان وظيفه او تأثير على بقيه الوظائف لليد