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Treatment of persistent radial nerve palsy through "tendon minimal transfer" technique

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SUMMARY: **Treatment of persistent radial nerve palsy through "tendon minimal transfer" technique.**

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Palliative tendon transfer procedures for radial nerve palsy are continuing to evolve. This paper reports outcomes of 10 patients with isolated and traumatic radial nerve palsy underwent "minimal transfer". All patients improved functionally and could attend their routine activities.

The flexor carpi ulnaris and palmaris longus tendon transfer has some advantages in terms of simplicity, shorter operative time, less morbidity, better wrist and finger extension and thumb extension and abduction.

RIASSUNTO: **Trattamento della paralisi persistente del nervo radiale con tecnica di "minimo trasferimento tendineo".**

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Le procedure palliative di trasferimento tendineo per la paralisi del nervo radiale sono in continua evoluzione. Il presente lavoro riporta i risultati ottenuti mediante "minimo trasferimento" in 10 pazienti con paralisi del nervo radiale traumatica ed isolata. Tutti i pazienti hanno mostrato un miglioramento funzionale e sono tornati alle loro attività.

Il trasferimento dei tendini flessore ulnare del carpo e palmare lungo presenta diversi vantaggi in termini di semplicità tecnica, ridotto tempo operatorio, morbilità, migliori estensione del polso e delle dita ed estensione ed abduzione del pollice.

KEY WORDS: Radial nerve palsy - Tendon transfer - Flexor carpi ulnaris - Palmaris longus.
Paralisi del nervo radiale - Trasferimento tendineo - Flessore ulnare del carpo - Palmare lungo.

Introduction

Complete radial nerve palsy results in a lack of extrinsic extensors of the wrist, fingers and thumb (Fig. 1). Patients have great difficulty in picking up heavy, large objects. Palliative tendon transfer procedures for radial nerve palsy are continuing to evolve. The main modifications have concerned the operative techniques and the choice of procedures to adapt surgery to the needs of the patient.

One of the earliest descriptions of tendon transfer for radial nerve palsy was by Franke, in 1898. He transferred flexor carpi ulnaris (FCU) to extensor digitorum communis (EDC) through the interosseous membrane. Successively, flexor carpi radialis (FCR) transfer to extensor pollicis longus (EPL) is described; nevertheless Zachary in 1946 recommended that FCR should be preserved for wrist control (1). In 2002, Tubiana presented a study of all the elements of tendon transfer has been undertaken and has gradually led us to describe two basic methods of transfer either using or not using the FCU for transfer. The essential consideration is the avoidance of radial deviation of the wrist by centralizing the insertion of the extensor carpi radialis longus (ECRL) (2).

Over 50 variations of tendon transfer for this problem have been described. The most widely accepted combination is the triple transfer of: 1) pronator teres (PT) to ECRL; 2) FCU to EDC; 3) palmaris longus (PL) to EPL.

This paper reports the results of "tendon minimal transfer" consisting of the FCU and PL in 10 such patients, to restore wrist and finger extension and thumb extension and abduction.

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Fig. 1 - Radial nerve palsy and exposition tendons of EDC, EIP, and EPL (see text for abbreviations).

Patients and methods

Ten patients with isolated and traumatic radial nerve palsy underwent transfer of the FCU tendon alone to EDC and extensor indicis proprius (EIP) and PL transfer to EPL. All of the patients were suffering from complete loss of radial nerve function, resulted in a dropped wrist and inability to extend the fingers. Seven of these patients were expected to recover radial nerve function as the nerve had either been irreparably damaged or had failed to recover after nerve repair at least 15–18 months previously, three from over 18 months. Nine men and one woman with the average age of 30.6 (range 21–68) years were treated. In 8 patients (80%), the radial nerve was injured at the arm level by humeral fracture, direct wounds, bullet or shell fragment injuries or iatrogenic injury during fixation of humeral fractures (2 patients). In other 2 patients (20%), the nerve had been injured at antibrachial level, the motor branch such that radial nerve function was lost. Ulnar nerve and median nerve functions were intact. In 9 patients, the problem affected the dominant hand (Table 1).

Surgical technique - A longitudinal incision was made in the distal third of the flexor aspect of the forearm over the FCU muscle and tendon. The FCU tendon was transected just proximal to the pisiform and freed up proximally under direct vision. The neurovascular pedicle from the main ulnar artery and nerve entering the proximal part of the distal third of the FCU was sacrificed to allow easier transfer of the tendon as the main neurovascular pedicle is located more proximally, about 6 cm from the FCU origin from the medial epicondyle. Through a Z incision on the dorsum of the distal forearm, the tendons of EDC, EIP and EPL were exposed (Fig. 1). The FCU tendon was then passed around the ulnar border of the forearm to the dorsal incision. With an assistant block the wrist at 30°, the metacarpophalangeal joints at 20° and interphalangeal joints in full extension, the FCU tendon was passed through the EDC and EIP tendons as far distally as possible. It was then sutured to each, separately, with non-absorbable 2-0 Nylon sutures. Then with a further incision we prepare the PL for 10 cm and trough the radial border was then passed through the EPL tendon and sutured to it with the thumb in full extension. After completing the transfers, tension was checked by movement, using the tenodesis effect. With the extension wrist, the tension was set such that it was possible to flex the fingers near the palm (2-3 cm).

The wrist was immobilized in 40° of extension, the metacarpalphalangeal joints in 10° of hyperextension and the thumb in maximum extension and abduction using a forearm splint at the end of the operation. The proximal and distal interphalangeal joints of the fingers were left free. In all cases, an exercise programmed was started on the day after operation with active flexion and extension of the interphalangeal joints of the fingers. The splint was removed on the 30th day postoperatively. We used dynamic splints postoperatively, only when recovery was not progressing satisfactorily at 5 weeks for other 3 weeks.

After surgery, patients were examined every 3 weeks during the first 5 months and usually every 6 months during the next 18 months. The ranges of movement of the wrist, MCP joints of the middle finger and abduction and extension of the thumb were evaluated preoperatively and at each follow-up. Patients were asked about their return, or not, to normal activities of daily living and return to work, where appropriate. The mean postoperative follow-up was 12 (3–18) months.

Results

After 45 days, 6 patients (60%) were able to do their daily work. In 2 cases, recovery was not progressing satisfactorily at 6 weeks. These were satisfactory a functional level considered in the following 8 weeks. Six months after surgery (Tab. 2), the average ranges of wrist move-

TABLE 1 - PERSONAL SERIES.

	Dominant hand	*Male/Female*	*Etiology*			*Level of injury*	
			Humeral fractures	Iatrogenic	Wound	In the arm	Antibrachial
Cases	65%	9:1	6	2	2	8 (80%)	2 (20%)

TABLE 2 - ANALYSIS OF HAND FUNCTION 6 MONTHS AFTER SURGERY (GRIP STRENGTH BY JAMAR DYNAMOMETER)

	Movements								
	Wrist					Finger extension		Thumb abduction	Grip strength (kg force)
	Flexion	Extension	Extension with extended fingers	Ulnar deviation	Radial deviation	In wrist extension	In neutral position of wrist		
Mean	45°	30°	8°	21°	19°	8°	10°	38°	11
Ranges	40-50°	27-34°	5-10°	18-23°	17-21°	5-10°	8-12°	35-45°	8-14

ments were as follows: the mean flexion was 45° (range 40–50°), the mean extension was 30° (range 27–34°). The mean extension of the fingers in wrist extension was 8° (range 5–10°) and in wrist neutral position was 10° (range 8–12°). The mean abduction of the thumb was 38° (range 35–45°). The mean of recovery period was 40 days. Able to return to original job were 9 patients (90%). Two of 7 heavy manual laborers and all of those who did not have heavy manual occupations were able to return to their previous jobs.

Discussion

Most authors believe that tendon transfers will result in good outcomes in cases of radial nerve palsy with irreparable damage or reconstruction failure; however, there is continuing dispute as to the best combination of tendon transfers in patients with radial nerve palsy, although the standard transfers are commonly performed with success (1, 2). Burkhalter believed that the greatest functional loss in the patient with radial nerve injury is weakness in grip and recommended an early PT to ECRL transfer to eliminate the need for an external splint (3). In radial nerve palsy, the PT is the most common motor donor used to restore wrist extension (4). The rationale of our "minimal transfer" technique of FCU and PL tendons is supported in several cases: severe soft tissue injuries and unavailability of the PT; functional deficit after transfer of the PT for radial nerve palsy; lower complexity and aggressiveness of the surgical procedure; advantages in terms of less morbidity and complication, simplicity, shorter operation time. On the other hand, PL can be absent (5, 6), so the choice it is to use the classic transfers. In fact, one of the problems may be the anatomy incidence of PL, but in our experience we always find the tendon and good muscle. Never any treatment had been modified by this problem. There is concern about loss of some functions in the hand and wrist after transfer of three tendons. However, some Authors (7-9) believe that a single FCU cannot provide simultaneous wrist dorsi flexion and fingers extension.

Our experience has shown that transfer of a FCU and PL tendon and provides good restoration of wrist and finger extension and thumb abduction and extension. This technique has given results in our hands, which are comparable to other published series. For example, Tsuge (10) presented two series of patients with 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 33° in our patients and the mean wrist flexions in his two groups were 13° and 38° and 52° in our patients. Extension of the fingers was also favorable in our series, with a mean of 8°, as compared to 4° and

3° in his two groups. The means of thumb abduction in his two groups were 55° and 56° and 41° in our patients. All the patients in our series 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. They were also able to flex their fingers to make a full fist. This indicates an active and dynamic biomechanical result of this transfer, which cannot be explained by a simple tenodesis effect. Not completely satisfaction for the abduction of the thumb not more than 40°.

Conclusions

All patients improved functionally and could attend their routine activities. The FCU and PL tendons transfer has some advantages in terms of simplicity, shorter operation time, less morbidity due to transfer of only two tendons, and, not least, less surgical scars, which can be important in some patients, particularly women. The aim of this study was to restore wrist and finger extension and thumb extension and abduction by transfer of the FCU tendon (alone to EDC, EIP) and PL (to EPL) in 10 such patients. In respect of the wrist and fingers, these goals were achieved nearly completely; thumb extension and abduction were partially restored. The good results witnessed by this "minimal transfer" technique add a significant and valuable experience in the surgery of the persistent radial nerve palsy in which nerve repair is no feasible or has failed.

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