

# Evaluation of Results after Flexor Digitorum Superficialis Tendon Transfer to Provide Fingers and Thumb Extension in Radial Nerve Lesions

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## ABSTRACT

**Purpose:** Objective and subjective evaluation of the results of flexor digitorum superficialis tendon transfer for the restoration of finger extension in irreparable radial nerve lesions.

**Methods:** Restoration of finger extension, thumb extension, was done in 10 patients (seven with radial nerve and three with posterior interosseous nerve injury; age range: 5-60 years).

We used tendon transfer technique using the flexor digitorum superficialis (FDS) 3 [to extensor pollicis longus (EPL)] and FDS 4 [to extensor digitorum communis (EDC)] as donors for the reconstruction of fingers and thumb extension (all patients) and pronator teres (PT) for wrist extension.

**Results:** Eight patients (out of 10) yielded 'Excellent to good' results: These patients showed marked improvement to the motor power scoring M4-M5 on the MRC grading system while 2 patients (out of 10) yielded 'Fair' results: Moderate improvement to the motor power scoring M3 on the MRC grading system.

**Conclusions:** The FDS transfer provides thumb extension independent from the fingers and wrist extension, because the FDS control for each finger is independent from the other fingers.

**Key Words:** Flexor digitorum superficialis – Tendon transfer – Radial nerve.

## INTRODUCTION

Tendon transfers follow a basic concept that nothing new is created but functional parts are rearranged into the best possible working combination so it is the relocation of a tendon from a functioning muscle to replace an injured or non-functional muscle-tendon unit [1].

Several factors are considered when choosing an appropriate tendon transfer to restore hand muscle function: The tendon transfer route and the tendon insertion site. Other factors such as tissue equilibrium, timing of the tendon transfer, joint mobility, the relative power and amplitude of the transferred muscle tendon unit, and synergism. Principles and rules must be followed in tendon transfer [2].

The aim of this study is to evaluate the results after the use of flexor digitorum superficialis in tendon transfer after radial nerve palsy.

## PATIENTS AND METHODS

Ten patients were included in this study. Those patients presented to the outpatient clinics of plastic surgery at Al-Azhar University (Al-Hussin and Bab Al-Sheeryia) Hospitals. They initially presented during the period starting May 2014 to May 2017.

Ten patients with radial nerve palsy were included in the study, of which three patients had posterior interosseous nerve (PIN) affection, leading to loss of thumb and fingers extension.

The other seven patients had high radial nerve affection, leading to wrist drop in addition to the lost extension of the thumb and fingers. The loss of wrist extension in those patients further impaired the thumb and fingers function, due to frailer flexion; and thus weakened the hand power grip. Six patients were injured in their right hand (dominant), while four were injured in their left hand (all non-dominant). patients were assessed by the range of motion of wrist, thumb, and Fingers (Tables 1,2).

Table (1): Criteria for range of motion of wrist, thumb, and fingers [3].

	Excellent	Good	Fair	Poor
Wrist extension	0-80	0	45 extension lag	70 extension lag
Finger extension	0-10	0	45 extension lag	90 extension lag
Thumb extension	100-80	80-60	60-30	30-0
Wrist flexion	Full	0-20	0	Dorsiflexion

Table (2): Subjective evaluation scale [4].

0	Not improved in comparison to pre-operative state.
1	Slightly improved; does not help in everyday activities.
2	Slightly improved; helps in everyday activities, but cannot tolerate work load.
3	Moderately improved; can be burdened with workload for 1-2 hours.
4	Greatly improved; can be burdened with workload for more than 2 hours.
5	Greatly improved; uses hand normally in all muscular activities with usual intensity; does not notice weakness.

**Objective evaluation:****Subjective evaluation:****Post-operative management and rehabilitation:**

The splint was removed after 4-5 weeks post-operatively, Physiotherapy program was carried out by a therapist experienced in hand therapy. Range of motion exercises started at 5-6 weeks post-operatively. All exercises were passive at first, and then attempts for active motion started about two weeks later. Reeducation exercises started concomitantly for the FDS powered transfers,

patients were taught to fire the transfer by trying to independently flex his ring and middle fingers.

**RESULTS**

This series included ten patients with radial palsy transfers; seven of whom suffered from high radial palsy, while the other three suffered from posterior interossious nerve (PIN) palsy, Table (3).

- 8 patients (out of 10) yielded 'Excellent to good' results:

Patients who underwent tendon transfers with 'early' timing obtained 'excellent to good' results.

These patients showed marked improvement to the motor power scoring M4-M5 on the MRC grading system, i.e. they obtained full range of thumb extension with reasonable power against resistance.

- 2 patients (out of 10) yielded 'Fair' results:

These patients showed moderate improvement to the motor power scoring M3 on the MRC grading system, i.e. they obtained some thumb extension against gravity.

Table (3): Data about ten patients with radial palsy transfers.

Case	Level of injury	Timing of surgery	Mode of trauma	Subjective evaluation scale	Objective evaluation
1	High radial	Conventional	Cut wound	3	Fair
2	High radial	Early	Cut wound	4	Good
3	PIN	Conventional	Cut wound	5	Excellent
4	High radial	Early	Cut wound	4	Excellent
5	High radial	Early	Fracture mid-shaft humerus	4	Good
6	PIN	Conventional	Radial head dislocation	5	Excellent
7	High radial	Early	Cut wound	4	Excellent
8	High radial	Early	Cut wound	5	Good
9	PIN	Conventional	Cut wound	5	Excellent
10	High radial	Conventional	Bullet injury	2	Fair

**Surgical techniques:**

Fig. (1): The flexor digitorum superficialis to middle and ring, pronator teres are harvested and identified.



Fig. (2): Demonstration of the interossious tunnel.



Fig. (3): A Pulvertaft weave of the flexor digitorum superficialis of the ring and middle to extensor digitorum and extensor pollicis respectively.



Fig.(4): Nerve grafting and tendon transfer done simultaneously.



Fig. (5): Pre-operative wrist and fingers drop of right hand after radial nerve injury.



Fig. (6): Post-operative result with restoration of wrist and fingers extension.



Fig. (7): Pre-operative wrist and fingers drop of left hand after radial nerve injury.



Fig. (8): Post-operative result with restoration of wrist and fingers extension 1 year later.

### DISCUSSION

Non-cooperative, non-compliant patients or those who did not accept the labor-intensive pre- and post-operative physiotherapy program were not considered candidates for tendon transfer procedures.

The selection of patients indicated for tendon transfers, and the decision of the timing of their surgeries, were very meticulously done. It is always borne in mind that a tendon transfer reconstructs a lost function at the expense of a donor motor unit.

Interosseous tunnel make a physiological, biomechanical vector of pull. If this is done, a large window should be created in the interosseous membrane to prevent constriction or tethering of the transfer [5].

Choosing to perform a delayed nerve repair or graft, that was of a clearly poor prognosis from the start, rather than a tendon transfer, would mean wasting 6 more months for the patient, waiting for an unwarranted result.

The FDS transfer set was primarily employed; as it provides thumb extension independent from

the fingers and wrist extension, because the FDS control for each finger is independent from the other fingers, as advocated by Boyes [5].

The FDS of the middle finger was preferred as a motor for the EPL. When the FDS is used as a motor, it provides 7cm of excursion, while the FCR provides only 3cm; therefore, the FDS is more efficient, noting that the EPL normally provides 5cm excursion. The FDS also provides more powerful contraction than that of the PL [7,8].

The FDS tendon was harvested proximal to their bifurcation through a window between the A1 and A2 pulleys as originally recommended by North & Littler, to avoid injury to the vincula or to the flexor sheath, and to leave behind a 3-cm length of superficialis tendon that glides freely within the flexor sheath. Using this method, we did not encounter any case of PIP joint flexion contracture in the donor digit, or any swan neck deformities as in the study conducted by Altintas et al., [9].

89% of patients with radial palsy were able to resume working after tendon transfer. In the study by Gousheh and Arasteh 92% of the patients re-integrated into working life. In the study by Mousavi, et al., 95% of the patients experienced functional improvement [3-10].

The 3-6 months timing for return to work or resumption of everyday life activities achieved by radial palsy patients in this study, is also consistent with the literature [8].

Communication among physician, therapist, and patient is necessary to maximize the outcome and prevent untoward complications.

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