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Research Article

Functional Outcome by Evaluation of DASH Score on Drop Hand Patient Treated with Jones' Tendon Transfer: A Retrospective Study

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ABSTRACT

Background: Drop hands due to radial nerve injuries cause functional and structural disabilities. Tendon transfer became the last option when nerve repair could not give patients restoration. The most popular method was Jones' Tendon transfer to restore wrist dorsiflexion, extending the thumb and the fingers. The Disabilities of Arm, Shoulder, and Hand (DASH) score measures functional outcomes in patients with upper extremities injuries. This study was to acknowledge the functional outcome and evaluate the DASH score in drop hand patients who undergone surgery by Jones' Tendon Transfer in Prof. Dr. R. Soeharso Orthopaedic Hospital Surakarta from January 2014 to June 2016.
Methods: The collected data from the medical record was evaluated based on functional outcome and DASH score. Eleven patients were included, ten male patients (90.9%) and one female patient (9.1%). The mean age of patients was 27.4 years old, with the most frequently injured arm was the right arm, counted to be eight patients (72.7%), and the left arm was three patients (27.3%).
Results: The result from the evaluation of the DASH score indicated ten patients (90.9%) were minimal disability, and one patient (9.1%) was moderate disability. The average score was 12.48, which means that most patients could cope with most daily living activities post-operatively.
Conclusions: Surgery for drop hand due to radial nerve palsy by Jones' Tendon Transfer gave a satisfactory functional outcome based on the DASH score.

Keywords: Drop hand; Jones' tendon transfer; DASH score; Traffic accidents; Retrospective study

INTRODUCTION

Injury to the radial nerve will significantly affect the patient's daily activities (ADL) because it substantially impairs hand function. Drop hand due to radial nerve injury can ensue as a clinical manifestation in humeral diaphysis fracture. The radial nerve is located near the periosteum of the middle third humeral bone, makes it susceptible to injury when the fracture occurs.[1–3] Around 10 to 17% of humeral fracture cases are accompanied by radial nerve injury.[4,5] When this kind of injury happens in humeral diaphysis closed fracture, the nerve injury can manifest as *neuropraxia* and heal immediately to be treated non-surgery.[6] Delays in the recovery process can occur due to nerve crush or transection during the injury; hence nerve exploration is conducted in nerve injury cases where spontaneous recovery did not appear within three months. In other nerve injury cases where contusion, laceration, or *neurotmesis* are found, the healing process does

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not follow even after surgical intervention is carried out in the form of radial nerve reconstruction. In such cases, tendon transfer is a considered option aiming to maintain wrist and fingers extensions.[6,7] Tendon transfer must follow several principles and requirements, involving a multidisciplinary team such as the orthopedic surgeon, medical rehabilitation physician, physiotherapist, and patients themselves. One of the most popular and commonly used tendon transfer techniques is Jones' Tendon Transfer. This technique was used to restore wrist dorsiflexion, an extension of the thumb and the fingers.[7]

A scoring system becomes an important necessity to measure extremity function after therapeutic intervention, discover the influence of modality therapies given to the patient, and determine how the injury progresses. The Disability of Arm, Shoulder, and Hand (DASH) score is a scoring system frequently used to assess functional outcome range of motion of the upper extremity, especially in patients with radial nerve injuries.[8]

MATERIAL AND METHODS

This study was conducted retrospectively by evaluating functional outcomes using DASH score (Table 1) in patients diagnosed with humeral fracture associated with drop hand and had undergone Jones' Tendon Transfer in Prof. Dr. R. Soeharso Orthopedic Hospital Surakarta from January 2014 to June 2016.

Table 1. Interpretation of DASH score

Score (%)	Category	Interpretation
0 - 20	minimal disability	Patients can cope with most living activities; usually, no treatment is indicated apart from advice on lifting sitting exercise.
21 - 40	moderate ability	Patient experiences more pain and difficulty with sitting, lifting, and standing; travel and social life are more difficult. They may be disabled from work; personal care, sexual activity, and sleeping are not affected and can usually be managed conservatively.
41 - 60	severe disability	Pain remains the main problem, and activities of daily living are affected; these patients require a detailed investigation.
61 - 80	crippled	Back pain impinges on all aspects of the patient's life, positive intervention is required.
81 - 100		Patients either bed-bound or exaggerating their symptoms

Surgery was done under general anesthesia, with incisions in the volar and dorsal aspect of the forearm (Figure 1) and using a tourniquet. Three tendons were used as donors and several tendons as recipients as follows: pronator teres (PT) for extensor carpi radialis brevis (ECRB) + longus (ECRL) to dorsiflex of the wrist, flexor carpi radialis (FCR) for extensor digitorum communis (EDC) to extend the fingers, and palmaris longus (PL) tendon for extensor pollicis longus (EPL) to extend the thumb. Another technique to extend the wrist and fingers simultaneously was FCR → ECRL + ECRB + EDC (+ EIP), performed in three patients. Flexor carpi radialis (FCR)-based tendon transfer was done in all patients in this research.

Figure 1. Operative Technique

Stich end to side PT tendon to the ECRB+ECRL at maximum tension (the wrist is fully extended) and FCR to EDC tendons with the fully extended MCP joint and IP joints, using non-absorbable 4/0 surgical suture. PT tendon was harvested with a strip of periosteum. The four EDC tendons should be divided just distal to their musculotendinous junction. The PL tendon was stitched to the EPL tendon, divided proximally, near its musculotendinous junction (Figure 2). All the methods mentioned above are done using the Pulvertaft technique. Allpatients who have undergone Jones' transfer surgery will be placed on a fore slab on the forearm at the end of surgery with full position extension of the thumb and fingers and 60 degrees dorsiflex the wrist. The fore slab is maintained for three weeks.

RESULTS

Eleven patients were included in the criteria (Table 2), with the gender ratio of 10 male patients (90.9%) and one female patient (9.1%). The most affected site was the right arm in 8 patients (72.7%), while the rest three patients were in the left arm (27.3%). Operative treatment for drop hand patients using Jones' Tendon Transfer in Prof. Dr. R. Soeharso Orthopedic Hospital Surakarta from January 2014 to June 2016 showed a good functional outcome.

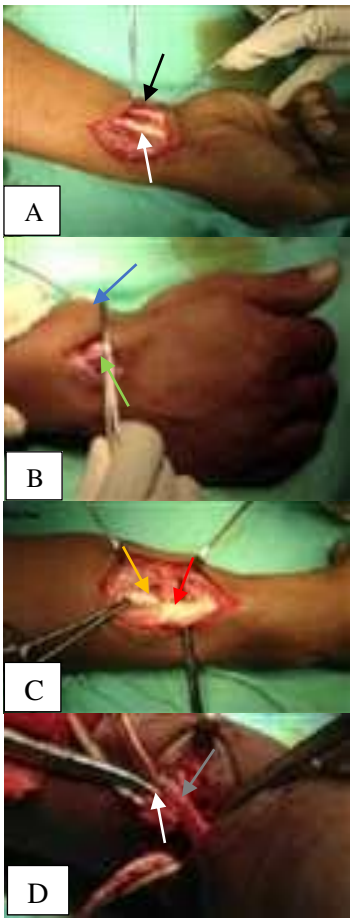

Figure 2. (a) volar approach to explore PL (black arrow) and FCR tendon (white arrow), (b) dorsal approach for exploring ECRL-ECRB (blue arrow) and EPL tendon (green arrow), (c) approach for exploring PT tendon (yellow arrow), and ECRL+ECRB tendon (red arrow) (d) stitch FCR tendon (grey arrow) to EDC tendon (white arrow).

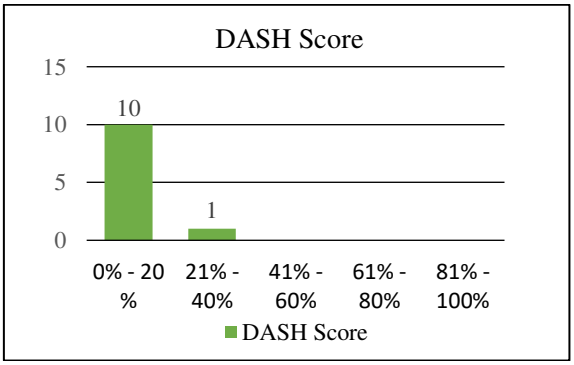

Figure 3. Diagram of the DASH score

The evaluation using the DASH score indicated ten patients (90.9%) were minimal disability and one patient (9.1%) was moderate disability; the average score was 12,48 (minimal disability). The results were presented in the following diagram (Figure 3).

Table 2. The patients' data

No	Name	Sex	Age	Side	Tendon Transfer	DASH Score	Interpretation score	Date
1.	SOD	M	31	R	PT → ECRL+ECRB PL → EPL FCR → EDC	10.8	minimal disability	Feb 2014
2.	AZH	M	30	L	PT → ECRL+ECRB PL → EPL FCR → EDC	8.3	minimal disability	Jun 2014
3.	WID	M	62	R	PT → ECRL+ECRB PL → EPL FCR → EDC	15.8	minimal disability	Jun 2014
4.	AHD	M	21	R	PT → ECRL+ECRB PL → EPL FCR → EDC	9.2	minimal disability	Sep 2014
5.	SUW	M	38	L	PT → ECRL+ECRB PL → EPL FCR → EDC	15	minimal disability	Apr 2015
6.	DES	F	25	R	PT → ECRL+ECRB PL → EPL + APL FCR → EDC	10	minimal disability	May 2015
7.	FRE	M	20	R	FCR → ECRL + ECRB + EDC + EIP PL → EPL	11.6	minimal disability	Oct 2015
8.	IRH	M	23	L	PT → ECRL+ECRB PL → EPL FCR → EDC + EDM	9.1	minimal disability	Nov 2015
9.	MIS	M	20	R	FCR → ECRL + ECRB + EDC PL → APL + EPB	14.2	minimal disability	Jan 2016
10.	MIR	M	16	R	FCR → ECRL + ECRB + EDC PL → EPL	10.8	minimal disability	Feb 2016
11.	ALF	M	15	R	PT → ECRL+ECRB PL → EPL FCR → EDC	22.5	moderate disability	Mar 2016

DISCUSSION

The radial nerve is more vulnerable to injury among upper extremity peripheral nerves accompanying humerus fracture. Drop hand due to radial nerve palsy can ensue as one of the clinical manifestations in humerus fracture.[1]

The treatment method depends on the primary cause and the severity of the damage. There was a tendency of type C and open fractures to be associated with more severe nerve damage. However, fracture type and trauma mechanism had no significant influence on the grade of nerve damage.[9] Most researchers contend that tendon transfer in patients with radial nerve palsy may bring about good results once nerve repair has failed. When no improvement in radial nerve lesions is noticed within a one-year interval, tendon transfer may be recommended.[10]

In 2.5 years period between January 2014 and June 2016, there were eleven patients recorded to have a humeral fracture with a drop hand and had undergone Jones' Tendon Transfer in Prof. Dr. R. Soeharso Orthopedic Hospital Surakarta that matched inclusion criteria. Out of the gender ratio, male patients were found more than females. The average patients' age was 28 years old, with the most vulnerable age to experience humeral fracture associated with radial nerve lesion was 15 to 25 years old. This finding was consistent with the literature which stated that the majority of fractures happened in the age of 12-19 years old due to the high energy trauma in a traffic accident.[11] All of the patients who met the inclusion criteria were right-handed.

In some literature, it is mentioned that the combination of tendon transfers has proven to have good results which have been carried out by experts and have become the standard of drop hand surgery. The recent standard agreed-upon best tendon transfer combinations are:

PT → ECRL + ECRB
PL → EPL
FCU → EDC

In this study, the most frequent techniques used by the amount of 8 times were:

PT → ECRL + ECRB
PL → EPL
FCR → EDC

The tendon transfers technique first described by Sir Robert Jones in his paper in 1916 consisted of the transfer of PT into the radial extensors of the wrist, FCU into the extensors of the third, fourth, and fifth digits, and FCR into EPL and extensor indices. The use of both FCR and FCU decreased the flexion power of the wrist as well as excessive dorsiflexion of the wrist on the extension of the fingers.[12] Controversy shrouds overusing FCU or FCR for transfer to motorize EDC for MCP extension. The author preferred FCR tendon to the FCU as the transfer tendon option for fingers extension based on several factors, which were: [7,11,13]

- FCU tendon owned a bigger power, and the excursion was too short (3 cm) to be placed as finger extensors; the minimum requirement was a 5 cm excursion.
- FCU tendon was the main stabilizer for ulnar in wrist joint that it was too precious to sacrifice, may cause decreasing in grip power and some activities such as hammering and dart throwing.

- FCU tendon could not provide simultaneous movement between dorsi-flexion and finger extension.

Other advantages of using FCR as tendon donor that only one incision is required to perform the two procedures (PT and FCR transfer) were: [7]

- Could be applied using the same incision as PT transfer.
- Less incision is needed compared to the FCU tendon.

Three patients had undergone surgery the combination of:

- FCR → ECRL + ECRB + EDC (+ EIP)
- PL → EPL (+ EPB)

This combination also gave a satisfactory outcome based on the DASH score. This "single tendon" transfer is transferring a single tendon to restore thumb and finger extensions. This technique does not show a superior outcome to other standard techniques. However, the procedure performed in this technique is simpler. The study of Al-Qattan in 2012 demonstrate this technique still allows some independent finger and thumb function.[13] This study concludes that operative treatment using Jones Tendon Transfer for drop hand patients in Prof. Dr. R. Soeharso Orthopedic Hospital Surakarta between January 2014 and June 2016 gave satisfactory functional outcome by evaluation using DASH Score.

CONCLUSIONS

Jones Tendon Transfer surgery gave a satisfactory functional outcome based on the DASH score.

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