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ORIGINAL RESEARCH

Tendon Transfer surgery for claw hand: Our Experience

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ABSTRACT

Introduction- The main motor abnormalities commonly seen after ulnar nerve palsy are claw finger deformity, asynchronous finger motion, loss of lateral movement of the fingers, and decreased grasp and pinch strength. The present case series of 10 patients was done to share our experience on tendon transfer surgery for claw hands. **Material and methods-** The present prospective study was conducted at department of plastic and reconstructive surgery during the study period of one year. Through convenience sampling a total of 10 patients were selected. Age, gender, level, palsy time, follow-up time, grip strength, preoperative and post-operative active extension lag, and percent of improvement were assessed and results were analyzed using SPSS version 25.0. **Results-** The mean age of patients was 31.23±3.8 years. Out of 10 patients 6 were male and 4 were female. Mean paralysis time was 46.54±3.8. level of injury was high in 7 patients and low in 3 patients. Mean follow up time was 44.12±5.6 months. The mean value of extension lag was 27º ±9 preoperatively which changed to 9º±6 post operatively. Mean patients were 20% active at the time before surgery while improvement was seen in 75% of patients condition post operatively. Both of the results were significant with p value <0.05. No complication was found in 7 patients while 2 patients developed swan-neck deformity and 1 patient had PIP joint contracture of less than 30°. **Conclusion-** In protracted instances, the application of the FDS 4-tail approach is a highly effective method for achieving favourable prognoses. Preoperative rehabilitation is essential for equilibrating the strength of the donor and antagonist muscles of the recipient.

Keywords- claw, fingers, surgery, tendon transfer, ulnar palsy

INTRODUCTION

Claw finger deformity, asynchronous finger motion, loss of lateral movement of the fingers, and diminished grasp and pinch strength are the principal motor impairments typically observed following ulnar nerve palsy. Tendon transfers are indicated for the care of this type of paralysis; nevertheless, they do not rectify all of these disabilities. The selection of the surgical procedure to be employed typically depends on the availability of donor muscles, joint mobility, the patient's daily activity level, and the surgeon's expertise. [1]

A variety of tendon transfer methods exist that offer dynamic correction of clawing, facilitate MCPJ and IPJ flexion, and in certain instances enhance grip strength. These can be categorised into superficial transfers and transfers facilitated by wrist motors. In the altered Stiles-Bunnell technique, the superficialis tendon of the middle finger is transected distally and extracted into the palm. It is thereafter divided into four slips. [2,3] Each slip is thereafter conveyed along the trajectory of the lumbrical, positioned volar to the deep transverse metacarpal ligament, and reintroduced into the finger, where it is affixed to the lateral band. A disadvantage of this technique is the potential for PIPJ hyperextension, especially in those with flexible joints. This occurs due to the removal of the primary flexor of the proximal phalanx, the superficialis tendon, while concurrently enhancing the extensor apparatus's potency.[4]

Effective management necessitates interdisciplinary collaboration, adherence to precautions, and postoperative rehabilitation to attain favourable outcomes. There is a paucity of information concerning the systematically organised postoperative management of patients following flexor digitorum superficialis (FDS) tendon transfer surgery for the correction of claw hand.

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Hence the present case series of 10 patients was done to share our experience on tendon transfer surgery for claw hands.

MATERIAL AND METHODS

The present prospective study was conducted at department of plastic and reconstructive surgery during the study period of one year. Ethical clearance was taken from institutional ethics committee of hospital and patients were asked to sign an informed consent form before commencement of study.

Through convenience sampling a total of 10 patients were selected for the study on the basis of selection criteria. All patients were old case of nerve injury so nerve restoration was not feasible. Cases where effective reinnervation was deemed unlikely or unattainable despite initial nerve restoration were classified as irreparable and chosen for tendon transfer surgery. [5] (figure 1-3)

Figure 1

Figure 2

Figure 3

The surgical technique used in our cases was FDS 4-tail procedure (Modified Stiles-Bunnell Transfer). A mid-lateral incision was performed next to the radial aspect of the PIP joint of the middle finger for the Stiles-Bunnell transfer. The radial slip of the FDS tendon was severed at its attachment to the middle phalanx. A second transverse incision was executed across the palm as shown in figure (4), and the FDS tendon of the middle finger was mobilised into the palm.

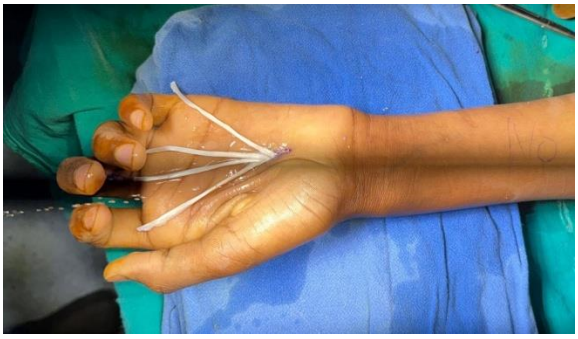

Figure 4 Second transverse incision on palm

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The tendon was longitudinally divided into four equal slips. Dorsilateral incisions were subsequently performed on the proximal radial aspect of the ring, middle and small fingers, as well as the ulnar aspect of the index finger. Each slip was tunnelled through the lumbrical canal of every finger. The slips were inserted into the radial lateral bands of the middle, ring, and little fingers, as well as the ulnar lateral band of the index finger.Then limb is immobilised by plaster splint for four weeks. (figure 5)

Figure 5

Variables like gender, age, level of injury, palsy time and follow up time were assessed quantitatively for all patients undergoing tendon transfer. Follow up methods of assessment included 3 categories: extensor lag measurements, grip strength measurements, and hand function assessment (open hand, closed fit and mechanism of closing).

Age, gender, level, palsy time, follow-up time, grip strength, preoperative and post-operative active extension lag, and percent of improvement were assessed and expressed as frequency and Mean±SD. Chi-square test was used to compare preoperative and postoperative. Level of significance was considered as $p<0.05$.

RESULTS

The mean age of patients was 31.23±3.8 years. Out of 10 patients 6 were male and 4 were female. Mean paralysis time was 46.54±3.8. level of injury was high in 7 patients and low in 3 patients. Mean follow up time was 44.12±5.6 months as shown in table 1.

Table 1 Basic details of patients

Variable	Values
Mean age (years]	31.23±3.8
Male/female	6/4
Mean Paralysis time (months)	46.54±3.8
Level of injury (high/low)	7/3
Mean follow up time (months)	44.12±5.6

The mean value of extension lag was 27º ±9 preoperatively which changed to 9º±6 post operatively. Mean patients were 20% active at the time before surgery while improvement was seen in 75% of patients condition post operatively. Both of the results were significant with p value <0.05 as shown in table 2. The Grip strength pre operatively as compared to post operative results were improved in all patients. (figure 6)

Table 2 Comparison of extension lag pre and post operatively

Variable	Pre-operative	Post- operative	P value
Extension lag	27º ±9	9º±6	0.003
Percent improvement	20%	75%	0.002

Figure 6 Improved Grip Strength of pa>ent

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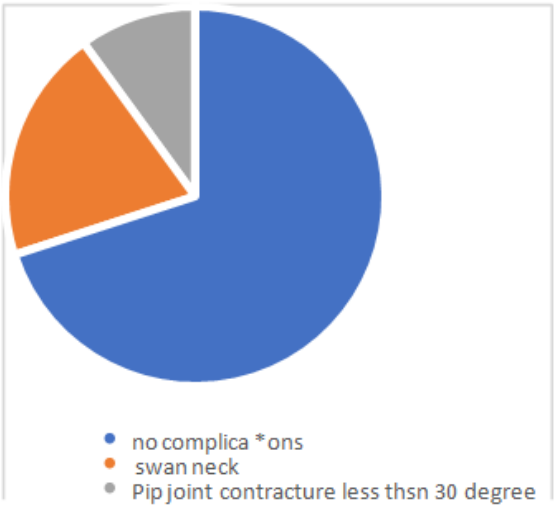
No complication was found in 7 patients while 2 patients developed swan-neck deformity and 1 patient had PIP joint contracture of less than 30° as shown in Graph 1.



Graph 1 Post operative complications

DISCUSSION

Tendon transfer surgery is a surgical procedure of the hand aimed at restoring impaired hand function. A functional tendon is relocated from its original attachment to a new one to restore the lost action. Tendon transfer surgery can address many issues. Tendon transfer surgery is required when a certain muscle function is compromised due to a nerve injury. If a nerve is damaged beyond repair, it ceases to transmit impulses to certain muscles. The muscles are paralyzed, resulting in the loss of their function. Tendon transfer surgery may be employed to restore that function. Common nerve injuries addressed with tendon transfer surgery include spinal cord, radial nerve, ulnar nerve, and median nerve injuries. [6,7]

The current research presents a review of 10 patients with ulnar nerve palsy who underwent reconstruction using FDS 4 tail tendon transfer technique. The cohort of patients examined in this study exhibits a diverse range of concomitant injuries, as well as variations in age, duration of paralysis, and follow-up intervals among the groups. The current study's results indicated that all tendon transplants successfully restored grip strength post-surgery. Among the two donor muscle units, FDS 4-tail demonstrated greater efficacy. The FDS 4-tail technique is the most effective method for rectifying claw hand deformity.

Before surgery, the mean extension lag was 27º ±9, while after surgery, it was 9º ±6. The average patient was 20% active prior to surgery, and 75% of patients' conditions improved after the procedure. With p values less than 0.05, both findings were significant. Before undergoing tendon transfer surgery, several researchers advise correcting the extensor lag through serial splinting, extensor shortening, or Littler type boutonniere repair. [8] Unlike previous studies, we conducted tendon transfer surgery at the beginning instead of using these therapy techniques. We exclusively employed the FDS 4-tail techniques for lateral band attachment.

The patients' extensor lag was satisfactorily corrected, according to the results. This observation could be explained by the fact that the PIP joint can be extended by drawing and absorbing the length of the stretched central slip via sagittal bands using the contraction force and excursion of the transferred muscle unit attached to the lateral bands. The lateral band attachment does not usually allow for full proximal interphalangeal joint extension. The central slip's elongation and the degree of preoperative active extension lag are probably going to increase with the length of paralysis. [9,10]

One of the most notable impairments in ulnar nerve palsy is weakness of grasp, which can be decreased by 38% in low ulnar nerve palsy and 60% to 80% in high ulnar nerve palsy.[10,11]

In our study the mean grip strength of the patients got improved in at the follow ups.

However, in the Hastings and Davidson investigation, the FDS was only applied to the clawed fingers and not always to the second or third digit. This could have an impact on the synchronized action of the fingers as a whole, leading to a weaker grasp. [12]

The state of the wrist joint is another crucial factor to take into account in chronic instances. Repeated attempts to extend clawed fingers in patients with long-standing ulnar palsy may result in a volar flexion posture at the wrist joint. This frequently results in wrist contracture as well as extensor system elongation. [9] The capacity of the patients to extend their wrists by at least 30 degrees before to surgery was linked to satisfactory results in our study. Therefore, the degree of wrist contracture prior to therapy had no bearing on the outcome.

In our study 2 patients developed swan-neck deformity and 1 patient had PIP joint contracture of less than 30° after the surgery. Three primary factors

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contribute to the development of this deformity: the excision of the principal flexor of the proximal interphalangeal (PIP) joint (for donor fingers), the attachment of the transfer to the lateral slip (for recipient fingers), and the laxity of the volar plate of the proximal interphalangeal joint (for both donor and recipient fingers). Consequently, in this study, either the augmented extension force at the PIP joint or the laxity of the volar plate is considered to be pivotal in the etiology of this deformity. [13] Bunnell asserted that an elongated superficialis stump following harvesting may attach to the damaged tendon sheath, resulting in a contracture. Consequently, certain researchers advocated for the excision of the flexor superficialis tendon at its insertion on the middle phalanx to avert adhesions between the tendon stump and the flexor sheath.[2] North and Little, conversely, advocated for the excision of the tendon between the A1 and A2 pulleys to reduce hemorrhage and surgical trauma, potentially preventing adhesions. All FDS tendons in this investigation were collected around their insertion to the middle phalanx. [8,14] The patients who developed deformity were those who had not followed rehabilitation program completely.

CONCLUSION

In protracted instances, the application of the FDS4-tail approach is a highly effective method for achieving favourable prognoses. Preoperative rehabilitation is essential for equilibrating the strength of the donor and antagonist muscles of the recipient. Although deformity repair is achieved, full restoration of function in ulnar nerve palsy remains challenging.

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