



ASSESSMENT OF THE FUNCTIONAL OUTCOME AFTER SPLIT FLEXOR CARPI RADIALIS TENDON TRANSFER IN PATIENTS WITH ULNAR CLAW HAND

General Surgery

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ABSTRACT

Introduction: Ulnar nerve paralysis has an impact on major life areas like employment and community, social and civic life. 1. Procedures for correction of claw deformity of fingers, involve tendon transfers with or without tendon grafting. 2. The aim of these surgeries is stabilization of the metacarpophalangeal joint in flexion, to prevent it from going into hyperextension. This study compared the functional outcome after split flexor carpi radialis tendon transfer in patients with ulnar claw hand.

Material and methods: A total of 30 patients with claw hand deformity, who underwent split FCR tendon transfer were selected after meeting the inclusion and exclusion criteria.

Results: During this study, it was found that most patients had improvement of parameters of hand functions like cylinder grasp, opening and closing of big and small buttons, opening and closing of lid of a cylinder jar, picking up marbles, and counting paper.

Conclusion: split flexor carpi radialis tendon transfer is quite adequate for the treatment in ulnar claw hand

KEYWORDS

Split flexor carpi radialis tendon transfer, ulnar claw hand, functional outcome

INTRODUCTION

Ulnar nerve paralysis has an impact on the following areas: carrying, moving and handling objects, cupping of the hands, eating food with hands, self-care, domestic life, major life areas like employment and community, social and civic life. Clawing of the fingers in ulnar nerve palsy is due to the combined paralysis of the interosseous muscles of all the fingers and the lumbricals of the ring and little fingers. These intrinsic muscles flex the MP and extend the PIP and DIP joints of the fingers, and loss of their resting tone results in the "intrinsic-minus" posture of hyperextension at the MP joints and flexion of IP joints. Clawing due to isolated ulnar nerve disease is most marked in the ring and little fingers, whose interosseous and lumbrical muscles are all paralyzed, but it occurs in all four fingers in 63% of cases due to Hansen's disease, even though the index and middle finger lumbricals are innervated by the median nerve.

Procedures for correction of claw deformity of fingers, involve tendon transfers with or without tendon grafting. The aim of these surgeries is stabilization of the metacarpophalangeal joint in flexion, to prevent it from going into hyperextension. The ultimate result of a combined surgical and rehabilitation program depends on the following factors: Presence of other secondary impairments before surgery, duration of paralysis, age of patient, skill and experience of surgeon, experience, motivation and perseverance of therapist, and motivation and perseverance of patient.

All of the following have been described as the donor muscle-tendon unit in tendon transfers to correct clawing in ulnar nerve palsy:

- Flexor digitorum superficialis
- Extensor carpi radialis brevis
- Extensor indicis proprius and extensor digiti minimi
- Flexor carpi radialis
- Extensor carpi radialis longus
- Palmaris longus

Pre-operative appearance and function were recorded as per established protocols. Results of the surgeries were assessed comparing the preoperative and postoperative position and function parameters.

In the present study we intend to assess the functional activities of daily

living like buttoning and unbuttoning, holding a cylindrical object, opening the threaded lid of a jar, and making a fist after split flexor carpi radialis tendon transfer.

For the assessment of the function of hand, the following parameters will be studied

- Assessment of function of fingers by buttoning, unbuttoning, cylindrical grasp and making a fist.
- Assessment of long flexor tightness in attempted passive IP extension, with the wrist and MCP joint extended, of all the fingers
- Intrinsic tightness test with the MCP joint blocked in extension, attempting to passively flex the IP joint, of all the fingers.

MATERIALS AND METHODS

Study area: Department of Plastic and Reconstructive Surgery, R.G Kar Medical College and Hospital, Kolkata

Study population

Inclusion criteria

- Clinically low ulnar nerve palsy
- Patients more than 12 years of age
- Traumatic low ulnar nerve palsy
- Hansen disease

Exclusion criteria

- Patients with fixed contracture of finger/ fingers prior to surgery.
- Clinically high ulnar nerve palsy- patients less than 12 years of age.
- Clinically combined high ulnar and median nerve palsy
- Clinically cut FCR / & FCU

Study period

From November, 2017 to October, 2019

Sample size

- All cases of ulnar claw hand (approx. 30 cases) within the study period as per exclusion criteria in both tendon transfer group

Sample design

It is a cross sectional observational study and 30 consecutive patients of ulnar claw hand undergoing tendon transfer surgery were recruited

for study following the inclusion and exclusion criteria. Written informed consent was taken from all cases. Approval was taken from institutional ethical committee.

Study tools

shirt with button, jar with screw lid and cylindrical tumbler and predesigned proforma.

Study technique

Pre operative Claw hand appearance and function were recorded. Results of the surgeries were assessed comparing the preoperative and postoperative position and function parameters.

1. For the assessment of the function of hand, the following parameters will be studied
- iv. Assessment of function of fingers by buttoning, unbuttoning, cylindrical grasp and making a fist.
- v. Assessment of long flexor tightness in attempted passive IP extension, with the wrist and MCP joint extended, of all the fingers
- vi. Intrinsic tightness test with the MCP joint blocked in extension, attempting to passively flex the IP joint, of all the fingers.

Statistical Analysis

Statistical analysis was performed with the help of Epi Info (TM) 7.2.2.2. EPI INFO is the trademark of the Centers for Disease Control and Prevention (CDC)

RESULTS

Functional assessment

Forming a fist:



Plate 1- Pre operative



Plate 2- Post operative

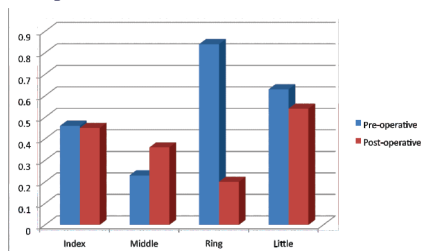


Chart (1)

Here, when attempting to make a fist the distance between the tips of the little and ring finger and the distal palmar crease, and tips of middle and index fingers and proximal palmar crease were measured.

Table (1)

Index finger:-

Distance in cms.	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	24	79.2%	26	85.8%
0.1-1	2	6.6%	0	0%
1.1-2	1	3.3%	3	6.6%
2.1-3	1	3.3%	0	0%
>3	2	6.6%	2	6.6%

The pre-operative mean was 0.46, and the range was 0—5. Post-operative, the mean was 0.45, and the range was 0—4.2.

Table (2)

Middle Finger:-

Distance in cms.	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	27	89.1%	26	85.8%
0.1-1	1	3.3%	1	3.3%
1.1-2	0	0%	0	0%
2.1-3	1	3.3%	1	3.3%
>3	1	3.3%	2	6.6%

The pre-operative mean was 0.23, and the range was 0—4. Post-operative, the mean was 0.36, and the range was 0—6.

Table (3)

Ring finger:

Distance in cms.	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	27	89.1%	26	85.8%
0.1-1	1	3.3%	3	9.9%
1.1-2	2	6.6%	0	0%
2.1-3	0	0%	0	0%
>3	0	0%	1	2.86%

The pre-operative mean was 0.14, and the range was 0—2. Post-operative, the mean was 0.20, and the range was 0—4.

Table (4)

Little finger:

Distance in cms.	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	26	85.8%	24	79.2%
0.1-1	2	6.6%	2	6.6%
1.1-2	2	6.6%	1	3.3%
2.1-3	0	0	1	3.3%
>3	0	0	2	6.6%

The pre-operative mean was 0.63, and the range was 0—2. Post-operative, the mean was 0.54, and the range was 0—4.

Cylindrical grasp:



Plate 3

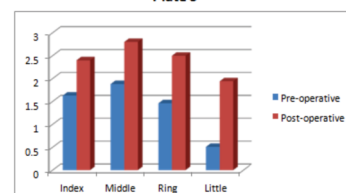


Chart (2)

The skin of the number of phalanges (out of Proximal, Middle and Distal Phalanx) coming in contact with a cylindrical object, on an attempt to grasp it, was noted, as representing the function of the hand.

Table (5)
Cylindrical grasp of index finger:

Number of contacts	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	4	13.2%	0	0%
1	6	19.8%	1	3.3%
2	15	49.5%	16	52.8%
3	5	16.5%	13	42.9%

Table (6)
Cylindrical grasp of middle finger:

Number of contacts	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	5	16.5%	0	0%
1	7	23.1%	1	3.3%
2	4	13.2%	4	13.2%
3	14	46.2%	25	82.5%

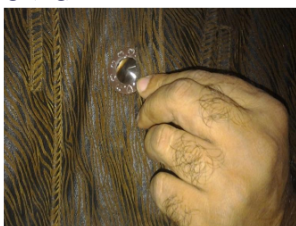
Table (7)
Cylindrical grasp of ring finger:

Number of contacts	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	11	36.5%	0	0%
1	5	16.5%	3	9.9%
2	5	16.5%	6	19.8%
3	9	29.7%	21	69.3%

Table (8)
Cylindrical grasp of little finger:

Number of contacts	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	19	62.7%	1	3.3%
1	7	23.1%	4	13.2%
2	3	9.9%	18	59.4%
3	1	3.3%	7	23.1%

Plate 4- Buttoning: (Big)



The number of buttons of a shirt that a patient could button in a time period of 30 seconds was noted as representing the functional ability of the hand.

Table (9)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—2	18	59.4%	17	56.1%
3—5	10	33%	12	39.6%
6—8	2	6.6%	1	3.3%
>8	0	0%	0	0%

Unbuttoning: (Big)

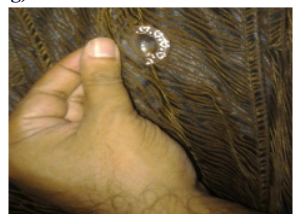


Plate (5)

The number of buttons of a shirt that a patient could unbutton in a time period of 30 seconds was noted as representing the functional ability of the hand.

Table (10)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—2	17	56.1%	15	49.5%
3—5	11	36.3%	14	46.2%
6—8	2	6.6%	1	3.3%
>8	0	0%	0	0%

Buttoning: (Small)



Plate (6)

The number of buttons of a shirt that a patient could button in a time period of 30 seconds was noted as representing the functional ability of the hand.

Table (11)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—2	14	46.2%	10	33%
3—5	14	46.2%	14	46.2%
6—8	2	6.6%	5	16.5%
>8	0	0%	1	3.3%

Unbuttoning: (Small)



Plate (7)

The number of buttons of a shirt that a patient could unbutton in a time period of 30 seconds was noted as representing the functional ability of the hand.

Table (12)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—2	11	36.3%	7	23.1%
3—5	14	46.2%	14	46.2%
6—8	4	13.2%	7	23.1%
>8	1	3.3%	2	6.6%

As per pre-operative records, the mean value for big button opening was 2.46, big button closing was 1.94, small button opening was 3.51, and small button closing was 2.71.

During this study, the mean value for big button opening was 2.96, big button closing was 2.98, small button opening was 4.40, and small button closing was 3.71.

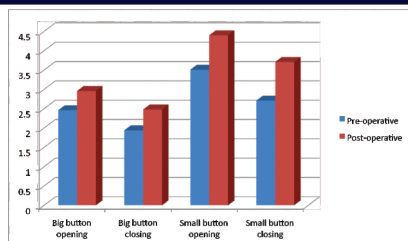


Chart 3: Buttoning and Unbuttoning

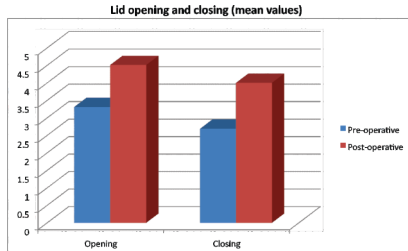


Chart (4)

Opening a lid:

Plate (8)

The number of lids of a threaded cylindrical bottle that a patient could open in a time period of 30 seconds was noted as a representation of the functional ability of the hand.

Table (13)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	5	16.5%	0	0%
1—2	6	19.8%	4	13.2%
3—4	8	26.4%	8	26.4%
5—6	10	33%	17	56.1%
7—8	1	3.3%	1	3.3%

The average number of lids opened by a patient in 30 seconds rose from 3.31 preoperatively to 4.51 postoperatively at follow up in this study.

Closing a lid:

Plate (9)

The number of lids of a cylindrical jar that a patient could close in a time period of 30 seconds was noted as a representation of the functional ability of the hand.

Table (14)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0	5	16.5%	0	0%
1—2	6	19.8%	4	13.2%
3—4	8	26.4%	8	26.4%
5—6	10	33%	17	56.1%
7—8	1	3.3%	1	3.3%

0	7	23.1%	1	3.3%
1—2	7	23.1%	5	16.5%
3—4	8	26.4%	11	36.3%
5—6	7	23.1%	11	36.3%
7—8	1	3.3%	2	6.6%

The average number of lids closed pre-operatively was 2.69 per 30 seconds and this rose to an average of 4.0 per 30 seconds in each patient, post-operatively, during this study.

Picking up marbles

Plate (10)

The number of marbles a patient was able to pick up in 30 seconds was noted as a representation of the functional ability of the hand.

Table (15)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—10	12	39.6%	9	29.7%
11—20	5	16.5%	5	16.5%
21—30	8	26.4%	10	33%
31—40	4	13.2%	5	16.5%
>40	1	3.3%	1	3.3%

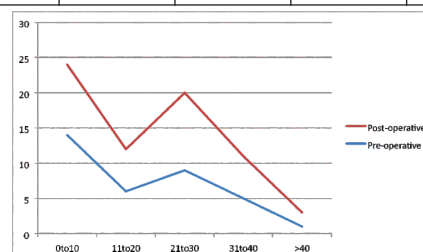


Chart (5)

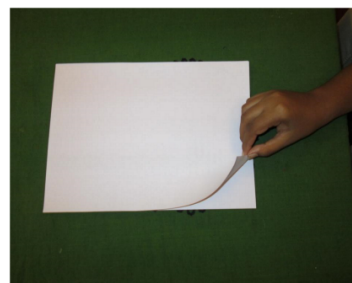
Counting papers

Plate (11)

The number of papers a patient was able to count in 30 seconds was noted as a representation of the functional ability of the hand.

Table (16)

Number	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
0—10	15	49.5%	10	33%
11—20	7	23.1%	7	23.1%
21—30	3	9.9%	7	23.1%
31—40	4	13.2%	2	6.6%
>40	1	3.3%	4	13.2%

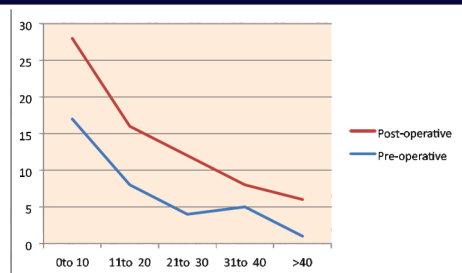
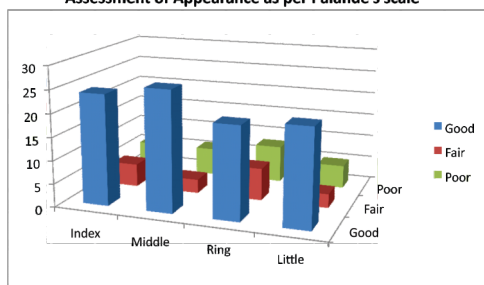


Chart (6)

Assessment of Appearance as per Palande's scale



The patients were graded as good, fair, and poor, by plotting the P.I.P joint angle against the M.P. joint angle of hyper extension (details given in Materials and Methods) in a graph chart.

Table (17)
Index finger

Grading	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
Good	2	6.6%	21	69.3%
Fair	5	16.5%	4	13.2%
Poor	23	75.9%	5	16.5%

Table (18)
Middle finger

Grading	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
Good	1	2.86%	23	75.9%
Fair	3	9.9%	2	6.6%
Poor	26	85.8%	5	16.5%

Table (19)
Ring finger

Grading	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
Good	0	0%	17	56.1%
Fair	0	0%	6	19.8%
Poor	30	100%	7	23.1%

Table (20)
Little finger

Grading	Pre-operative Number	Pre-operative Percentage	Post-operative Number	Post-operative Percentage
Good	0	0	19	62.7%
Fair	0	0	2	6.6%
Poor	30	100	9	29.7%

DISCUSSION

The hand is a very versatile part of our body. Not only do we perform various simple activities of daily living, but also we perform multifarious complex activities with our hand. To use our hand meaningfully, we must be able to move the various components of our hand in a sequential and coordinated manner. This aspect is jeopardized by the muscle imbalance caused by leprosy affecting the ulnar and median nerves resulting in the characteristic claw hand.

During the study period between November 2017 to October 2019, 30 patients of ulnar claw hand were operated at R.G. Kar Medical College

and Hospital, and those patients who responded to our summon and reported for follow up were included in this study.. Those patients who reported for follow up more than once, the findings at the last follow up were taken into account. A minimum period of one year was allowed between the date of operation and date of examination.. Patients under 10years and over 60 years of age were excluded, as it is difficult to teach these age groups isolation exercises of the transferred tendons and post-operative re-education.

Of the 30 cases included in this study, the mean age was 31.11 years, and the range was 15 to 55 years. The peak incidence was noted in the 3rd decade of life, followed by the 4th decade. Taylor et al¹ in their study had operated on 65 hands, with a mean age of 26 years and a range of 13 to 53 years. In a study by Ozkan T et al, where 25 patients were operated with a mean age of 36 years and a range of 21 to 57 years. In another study by Ozkan et al, 44 patients had been operated and the average age was 30 years with a range of 16 to 52 years. Palande et al² also reported a series of 48 patients with an age range of 16 to 52 years. Sundararaj et al⁶, reported a study where 200 hands were operated and followed up.

Out of the 30 cases 23 were males and 7 were females. Therefore the male: female ratio was 3.2:1, which is comparable to the 3.33:1 ratio in the study by Taylor et al¹. In a study by Palande et al this ratio was 4.7:1. Out of the 30 cases operated, 14 were right and 16 cases happened to be left. Hence 46.6% of cases were right sided and 53.3% were left sided. A total of 29 cases (82.86%) presented with complaints of both poor appearance and functional compromise. Three cases (8.57%) presented with only loss of function. Three cases (8.57%) presented with poor appearance only. No female patient presented with both loss of function and poor appearance.

The mean duration of deformity in this study was 49.17 months with a range of 9 to 97 months, compared to 44.93 months in a study by Ozkan T et al¹, 94.6 months in another study by Ozkan et al¹, 39 months in the study of Taylor et al¹, and 42 months in the study of Palande et al².

The mean interval of time between the date of operation and date of final followup in this study was 34.34 months with a range of 13 to 57 months.

On asking the patients to evaluate the outcome of their surgery on a Visual Analogue scale of 1 to 10, (1-10), considering 1-3 as poor, 4-6 as satisfactory, 7-8 as good and 9-10 as excellent. 2cases (5.71%)reported as poor, 9 cases(22.86%) reported as satisfactory, 13 cases(42.86%) reported as good, and 6 cases(20%) reported as excellent. So, overall 28 cases (94.28%) were pleased with the outcome of surgery.

The results of this study are comparable to the study by Taylor et al¹ where 85.85% patients were satisfied with their result and only 14.15% were unsatisfied with their result.

During this study, it was found that most patients had improvement of parameters of hand functions like cylinder grasp, opening and closing of big and small buttons, opening and closing of lid of a cylinder jar, picking up marbles, and counting paper.

CONCLUSION

The overall percentage of improved functional outcome is (94.28%) on an Visual Analogue scale. So, split flexor carpi radialis tendon transfer is quite adequate for the treatment in ulnar claw hand.

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