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Original Article

Factors affecting functional outcome of surgical correction of claw hand in leprosy

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The objective of this paper is to study the results and the factors that impact the results of claw hand surgery in leprosy. 110 patients who underwent claw hand correction between 2002 and 2006 were followed up and studied. Brand's criteria for objective assessment and a visual analog scale for subjective assessment were used. The factors studied were age, sex, clinical, duration of paralysis, long flexor tightness, degree of contracture and type of surgery. Objective assessment showed Excellent or Good results in 76.6%, Fair in 20% and Poor in 3.4%. Subjective assessment showed that 80.8% were fully satisfied or satisfied. Regression analysis showed that age, degree of contracture,duration of paralysis and long flexor contracture were seen as significant factors impacting results of claw hand correction.

Key words : Leprosy, Claw hand, Surgical correction, Flexor digitorum

Introduction

Claw hand from involvement of the ulnar nerve is the commonest paralysis in leprosy. The muscle imbalance that results from ulnar nerve paralysis creates the characteristic claw hand, consisting chiefly of hyperextension at the metacarpo-phalangeal (MCP) joints and flexion at the proximal interphalangeal (PIP) joints. Dysfunction of intrinsic muscles of the hand of ulnar and median paralysis leads to impaired grip and pinch strength (Dell and Sforzo 2005). The weakness of tripod pinch strength is the most important problem in Basic Activities of Daily Living (BADL) (Rajkumar et al 2002).

Correction of deformity and grip strength (Ozkan et al 2003) can be restored in a claw hand only by reconstructive surgery. For more than 50 years tendon transfer procedures have been used to restore the muscle balance and intrinsic muscle function of the hand damaged by leprosy (Antia 1969, Brand 1958).

The aim of reconstructive surgery on the hand is to augment its capabilities for the Activities of Daily Living (ADL) and for safe vocations, and to restore adequately in order to accelerate the patient's integration into society.

For claw hand correction, (Bunnell 1956) popularized the Stiles' Flexor digitorum superficialis

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tendon transfer by using all superficialis tendons to lateral bands of the dorsal extensor expansion (Bunnell 1956). Littler in 1949 proposed an important modification of the Stiles-Bunnell procedure by using only the Flexor Digitorum Sublimes Middle (FDSM) tendon (Littler 2005). Brand in 1952 described a technique to transfer Extensor Carpi Radialis Brevis (ECRB) to the lateral band of the extensor expansion. Use of ECRB as motor is known as EF4T (Brand 1961). Lennox in 1960 performed a new procedure very much similar to EF4T using a wrist flexor motor – palmaris longus. Fritschi in 1971 described and popularized palmaris four tail transfer (Antia 1969).

In 1979, Zancolli used Flexor Digitorum Sublimus (FDS) for intrinsic replacement but used the A1 pulley as the insertion for the transferred tendon. In 2008, Narayanakumar used half of the FDS for Lasso procedure and reported comparable results to the conventional procedures (Narayanakumar 2008). The aim of this paper is to study the results of tendon transfer for claw hand correction in ulnar paralysis in leprosy and to identify the pre-operative factors that affect the outcome of surgery.

Methodology

This is a interventional retrospective study done in Schieffelin Leprosy Research and Training Centre, Karigiri, Tamil Nadu of patients who under went claw hand correction during the period from 1st January 2002 to 31st December 2006. A total of 110 patients representing 120 hands underwent claw hand correction during this period.

Data of these patients was collected from the Physiotherapy assessment and Occupational therapy assessment records maintained at the hospital. Pre-operative physiotherapy assessment included angle measurements at Proximal Inter Phalangeal joint, ability of hand to actively assume open hand, lumbrical position and close fist positions. The mechanism of closure of hand was also recorded.

Three weeks after surgery re-education of the transferred muscle, maintenance of corrected digit positions and Inter Phalangeal joint flexion were practiced. At discharge hand assessments were recorded. All patients whose records have been analyzed for this study were called for a follow up and the hands were reassessed in year 2008.

Brand's evaluation criteria were used for Objective grading of results.

Patients satisfaction was also assessed through a visual analog self rating scale of 0 – 7, developed at our center. Assessment was graded as Excellent – 6 and 7, Good- 5, Fair- 4 and Poor- 3 and below.

The surgical procedures done for correction claw hand deformity at Karigiri are Palmaris longus four tailed (PL4T), Extensor to flexor four tailed transfer (EF4T- ECRL), Lasso procedure and Stiles Bunnel transfers which use Flexor Digitorum Sublimus.

Post-operative results were analyzed objectively and subjectively in relation to the age of the patient, sex, duration of paralysis, two fingers or four finger clawing, long flexor tightness, contracture, duration of pre operative physiotherapy and method of intrinsic correction.

Statistical Methods

The results were analysed by using SPSS statistical software. The significance of the variables was calculated by Chi-square test and Logistic Regression analysis. The variables considered significant if p is less than .05.

Results

The average duration of follow up was 2.8 years with a range of 1 – 5 years

The overall results for objective outcome were

excellent or good in 92 (76.6%) hands, fair in 24 (20%) hands and poor in 4 (3.4%) (Table 1). In subjective assessment, 97 (80.8%) scored fully satisfied or satisfied, 17 (14.2%) hands scored partly satisfied and 6 (5%) scored unsatisfied Children had 88.9% excellent or good results and no poor results in objective assessment. In the age group from 16 to 35 years, 84% had excellent or good results and no poor result. The results in the next two groups above 35 years of age have not been as good. Age was a statistically significant factor (p=0.001) for a better outcome (Table 1).

Patients with Pure neural leprosy (100%) and Borderline Tuberculoid leprosy (76.4%) showed excellent or good results (Table 2).

Statistical analysis showed that duration of paralysis has a statistically significant (p=0.003) bearing on the objective outcome (Table 3).

Hands with PIP joint contractures fared significantly worse (p=0.000) than those without contractures under objective assessment (Table 4).

Table 1 : Objective outcome on Age distribution - percentages within the age group

Age in years	Excellent %	Good %	Fair %	Poor %	Total %
1-15	7(87.8)	1 (1.1)	1(11.1)	0	9 (100)
16-35	29 (38.7)	34 (45.3)	12 (16.0)	0	75(100)
36-45	3 (10.7)	15 (53.6)	7 (25.0)	3 (10.7)	28 (100)
56 and above	1(12.5)	2 (25.0)	4 (50.0)	1 (12.5)	8 (100)
Total for the whole group	40(33.3)	52(43.3)	24(20.0)	4(3.4)	120(100)

Pearson Chi-square value : 29.134(a) df: 9 p= 0.001

Table 2 : Objective outcome on clinical classification

Type of Leprosy	Excellent (%)	Good %	Fair %	Poor %	Total
BorderlineTuberculoid	29 (31.2)	42 (45.2)	21(22.6)	1(1.1)	93(100)
BorderlineLepormatous	4 (26.7)	7(46.7)	3(20.0)	1(6.7)	15(100)
Lepromatous Leprosy	1(25.0)	1(25.0)	0	2(50.0)	4(100)
Pure neuritic	6(75)	2(25)	0	0	8 (100)
Total	40 (33.3)	52(43.3)	24(20)	34(3.3)	120(100)

Pearson Chi-square value: 36.652 (a) df: 9 p= 0.000

Table 3 : Objective outcome on duration of paralysis

Duration of paralysis	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Total (%)
0-12 mths	16 (61.5%)	7 (26.9%)	3 (11.5%)	0	26 (100%)
13-24 mths	20 (37.7%)	24 (45.3%)	8 (15.1%)	1 (1.9%)	53 (100%)
25-36 mths	1 (7.7%)	9 (69.2%)	2 (15.4%)	1 (7.7%)	13 (100%)
37-48 mths	0 (0%)	4 (66.7%)	2 (33.3%)	0 (0%)	6 (100%)
>48 mths	3 (13.6%)	8 (36.4%)	9 (40.9%)	2 (9.1%)	22 (100%)
Total	40 (33.3%)	52 (43.3%)	24 (20%)	4 (3.3%)	120 (100%)

Pearson Chi-square value: 29.690 (a) df:12 p= 0.003

Table 4 : Objective outcome on contracture angle

Contracture angle	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Total (%)
00 degrees	40 (43.5)	41 (44.6)	10(10.9)	1(1.1)	92(100)
01-20 degrees	0 (0)	10(47.6)	9(42.9)	2(9.5)	21(100)
21-30degrees	0(0)	1(16.7)	4 (66.7)	1(16.7)	6(100)
>30 degrees	0(0)	0(0)	1(100%)	0	1(100)
Total	40 (33.3)	52(43.3)	24(20)	34(3.3)	120(100)

Pearson Chi-square value: 39.807 (a) df:9 p= 0.000

Table 5 : Objective outcome on type of Surgery

Type of surgery	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Total (%)
PL4T	25 (41.7	24 (40.0)	10(16.7)	1(1.7)	60(100)
EF4T	11(40.7)	13(48.1)	2(7.4)	1(3.7)	27(100)
Sublimus	0(0)	9(47.4)	8 (42.1)	2(10.5)	19(100)
Lasso	4(28.6%)	6(42.9%)	4(28.6%)	0	14(100)
Total	40 (33.3)	52(43.3)	24(20)	34(3.3)	120(100)

Pearson Chi-square value: 20.051 (a) df:9 p= 0.018

Table 6 : Objective outcome on long flexor tightness

Long flexor tightness	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Total (%)
Absent	37 (62.7%)	19 (32.2%)	3 (5.1%)	0 (0%)	59 (100%)
Present	3 (4.9%)	33 (54.1%)	21 (34.4%)	4 (6.6%)	61 (100%)
Total	40 (33.3%)	52 (43.3%)	24 (20%)	4 (3.3%)	120 (100%)

Pearson Chi-square value: 50.150 (a) df:3 p= 0.000

Table 7 : Variables significantly contributing to Objective Assessment

Variable	B	S.E	Wald	df	Sig	Odds ratio
Age group				3	0.034	
1-15	3.576	1.774	8.650	1	0.044	35.746
16-35	0.625	1.360	4.065	1	0.646	1.867
36-55	0.509	1.482	0.211	1	0.731	0.601
			0.118			
LFT	2.557	0.915	7.808	1	0.005	12.898
Duration of physiotherapy	1.761	0.831	4.496	1	0.034	5.821
Constant	-4.081	1.443	8.000	1	0.005	0.017

Under objective assessment type of surgery showed significant difference (p=0.018) between PL4T/EF4T and other surgeries (Table 5).

Long flexor tightness had a statistically significant (p=0.000) impact on the objective outcome with those without the tightness doing much better (Table 6).

Logistic regression analysis was done to find out the independent effect of various variables on the objective outcome (Table 7). The significant variables that had independent effect on "excellent objective outcome" are Age Group 1-15 years (p=0.044), Long flexor contracture (p=0.005) and duration of pre operative physiotherapy lasting for less than a week (p=0.034). Other variables do not have any independent effect on the objective outcome. The age group "up to 15" has 35.7 times chance of achieving excellent result compared to the oldest group. Patients with no long flexor tightness have 13 times chance of achieving excellent result to those with long flexor tightness. Similarly when the duration of physiotherapy was of 1 week duration or less, the patient has 5.8 times chance of achieving excellent result compared to those who had physiotherapy for more than one week.

Discussion

The purpose of the study is to assess the objective and subjective evaluation of the results of claw hand correction and to identify the factors that impact the surgical outcome.

Overall results objectively assessed according to Brand's criteria showed, excellent or good results in 76.6%, fair in 26% and poor in 3.3%. These results are comparable with similar studies published by Gaisne et al using the same criteria (Gaisne and Palande 1986). Malaviya reported excellent or good results in 57.6% using Palande's criteria when FDS II or FDS III was used for claw correction (Malaviya 2004).

Subjectively assessed, 80.9% were fully satisfied or satisfied, 17% were partly satisfied and 5% unsatisfied. These results are similar to those in the study done by (John et al 2005).

Three major factors influenced the outcome of surgical correction of claw hand in this study. Age was a significant factor, with children faring better than the adults. Among the adults, those who are less than 35 years of age did better those who are older. The nature of the tissues and easier postoperative re-education among the younger age group may have influenced the outcome.

The second major factor which influenced the surgical outcome was the duration of paralysis prior to surgery. If the duration of paralysis was long, secondary changes in the dorsal expansion, contractures and mal habit usage of the hand may have contributed to the outcome.

The third major factor influencing outcome was long flexor contracture. Presence of long flexor tightness was a highly significant factor in the outcome of claw hand corrective surgery. Tendency to keep the wrist in flexion to decrease clawing, leads to myostatic contracture of the long finger flexors. If this is not corrected prior to surgery by adequate physiotherapy the hand will re claw.

Other important indirect factor that influenced the outcome was presence of contractures requiring long duration of pre operative physiotherapy. Mobile hands did better than stiff hands. Even among the stiff hands the degree of stiffness and the duration and effort required to release the stiffness influenced outcome.

Even though PL4T and EF4T did better than Sublimus or Lasso transfers it is possible that patient selection criteria, patient age, occupation and secondary deformities of the hand among the four groups may have affected the outcome.

In patient satisfaction assessment, in general, older patients were better satisfied probably

because of a lower expectation. The expectation after a claw hand correction includes in addition to a better function is a near normal looking sensate hand. This expectation among those who were partially satisfied and unsatisfied also may have influenced subjective assessment.

From the study the critical success factors for a favorable outcome seem to be age of the patient, degree of contracture in the hand both PIP, long flexor tightness and duration of paralysis

A limitation of this study is that it is a retrospective study. A prospective study where other factors such as choice of procedures, experience of surgeons and functional assessment can be studied will be very useful.

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