

## Factors affecting functional outcome of opponens replacement in median nerve paralysis in leprosy

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In this study, the factors affecting functional outcomes of opponens replacement in median nerve paralysis in leprosy, were investigated. Fifty six patients who underwent opponens transfer between 1995 and 2001 were included in the study. The average duration of follow up is 7.3 years with a range of 4-10 years. Functional assessments were done through assessment of grip strength, pinch strengths and fine manipulation and the results were interpreted using Sundararaj (1984) criteria. 76.6% had excellent or good results, 13.3 % fair and 10.1% poor results. Pinch strength, grip strength and fine manipulation showed improvement after surgery. Logistic regression analysis showed that duration of paralysis had a significant independent effect on the outcome.

**Key words :** Opponens, Leprosy, Median nerve

### Introduction

Peripheral nerve paralysis occurs in 20% to 25% of patients with Hansen's disease. In Hansen's disease often, more than one nerve is involved. The ulnar nerve is the most common nerve involved. The median nerve is also involved but usually together with the ulnar nerve. The median nerve is usually involved at the wrist (low paralysis) and rarely it enters the forearm between the two heads of pronator teres (high paralysis).

Ape thumb deformity occurs in median nerve paralysis with the thumb losing its ability to oppose and abduct. In addition, the thumb also

loses the power to flex at the MP joint. These losses render the thumb to lie next to the palm and unable to position itself with the rest of the fingers for the purpose of grip function. In order to restore this function tendon transfers using muscles that can be spared are performed. Royles (1938) used the Flexor digitorum sublimus tendon through the carpal tunnel and inserted it into Flexor pollicis brevis and opponens pollicis tendons. Thomson (1942) modified Royles technique by routing the Flexor digitorum sublimus tendon subcutaneously to the thumb inserting one slip into the distal aspect of thumb metacarpal and the other slip into the periosteum

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of the base of the proximal phalanx. These modifications led to better rotation of the thumb. Aguirre and Caplan (1956) described the extensor indicis proprius opponensplasty.

The classical tendon transfer to restore opposition of the thumb currently is done using the flexor digitorum superficialis of the ring finger.

In this study, the factors affecting the functional outcomes of opponens replacement in median nerve paralysis due to leprosy were assessed.

### Materials and Methods

This study was done at Schieffelin Leprosy Research and Training Centre at Karigiri among the leprosy patients who underwent opponens transfer for paralytic hand deformities of ulnar and median nerves or isolated median nerve during the period 1995-2001.

The records of these patients were analyzed to gather the basic demographic information and clinical details such as disease classification, duration of paralysis, pre and postoperative assessments of the hand. Then, the patients were called for a follow up and an assessment of the operated hand was done.

Evaluation of the hand included the patient's ability to perform maximum active opposition and abduction and measurement of pinch strength and fine manipulation. The data at the follow up was, compared with that recorded pre-operatively. The post-operative satisfaction of the patient was also analyzed.

The patient with ulnar median paralysis underwent either single stage correction of claw hand with opponens transfer or two staged procedure where correction of claw hand was followed by opponens transfer as second stage. One of the standard procedures like PL4T or EF4T or Sublimus transfer was done for correction of claw hand. Opponensplasty was done using ring finger sublimus.

The data was collected from medical, physiotherapy and occupational therapy assessment records follow-up proforma of follow up clinical assessment of hand.

The results were analyzed by grading system adopted by Sundararaj and Mani (1984) on the study based on reconstructive surgery of hand in Hansens disease with nerve paralysis. The grading is as follows:

Excellent - Opposition to ring or little finger tip with IP joint extended

Good - Opposition to index or middle finger tip with IP joint extended

Fair - Thumb IP joint flexes during opposition

Poor - No opposition restored

Post-operative outcome was analyzed in relation to the age of the patient, sex, duration of paralysis, clinical type, nerve involvement, and method of intrinsic correction, single/two stage correction of opponens, pinch strength, and fine manipulation. The data were analyzed by using SPSS and Epi Info 2000 statistical softwares.

### Results

The study population consisted of 56 patients who underwent opponens transfer for either combined ulnar median or isolated median nerve paralysis, during the period 1995-2001. The patients underwent reconstructive surgery for both claw hand and opponens paralysis in single stage or claw hand correction followed by opponens transfer in two-stage procedure. The average duration of follow up is 7.3 years with a range of 4-10 years.

Out of 56 patients, 46 (82.1%) were men and 10 (17.9%) were women. In the 46 male patients, three had bilateral hand paralysis and one woman out of 10 had bilateral hand paralysis; thus making a total of sixty hands for reconstructive surgery. The age distribution is shown in table 1.

**Table 1 : Age and Sex distribution (n=56)**

Age Group	Male (%)	Female (%)
< 20	1 (2.2)	1 (10.0)
21-40	30 (65.2)	3 (30.0)
41-60	14 (30.4)	5 (50.0)
> 60	1 (2.2)	1 (10.0)
<b>Total</b>	<b>46 (100)</b>	<b>10 (100)</b>

**Table 2 : Post-operative outcome by age**

Results	Age 0-40	Age 41-60	Age >60
Excellent	28 (75.6%)	8 (38%)	0 (0%)
Good	4 (10.8%)	6 (28.6%)	0 (0%)
Fair	5 (13.5%)	2 (9.52%)	1 (50%)
Poor	0 (0%)	5 (23.8%)	1 (50%)
<b>Total</b>	<b>37</b>	<b>21</b>	<b>2</b>

**Table 3 : Post- operative outcome by gender**

Results	Male (%)	Female (%)
Excellent	30 (61.2)	6 (54.5)
Good	8 (16.3)	2 (18.2)
Fair	6 (12.3)	2 (18.2)
Poor	5 (10.2)	1 (9.1)
<b>Total</b>	<b>49 (100%)</b>	<b>11 (100%)</b>

**Table 4 : Post- operative outcome by classification**

Result	TT	BT	BB	BL	LL
Excellent	1	28	1	6	0
Good	0	6	2	1	1
Fair	0	5	1	0	2
Poor	0	4	0	1	1
<b>Total</b>	<b>1</b>	<b>43</b>	<b>4</b>	<b>8</b>	<b>4</b>

**Table 5 : Post- operative outcome by side of hand involved**

Result	Right hand (%)	Left hand (%)
Excellent	15 (60)	21 (60)
Good	5 (20)	5 (14.3)
Fair	3 (12)	5 (14.3)
Poor	2 (8)	4 (11.4)
<b>Total</b>	<b>25</b>	<b>35</b>

Overall, assessment showed that 36 (60%) hands had excellent result, 10 (16.6%) good result, 8 (13.3%) fair result and 6 (10.1%) poor results (Table 2). In the age group below 40 years, 86.5% of hands had excellent or good outcome, and 13.5% had fair outcome. In the age group above 40 years 60.9% of the hands had excellent or good outcome, 13% had fair outcome and 26.1% had poor outcome. Analysis showed that patients aged less than 40 years had better outcome than patients above 40 years and this is statistically significant. ( $\chi^2 = 9.93$ ,  $p = 0.007$ ).

There was no statistical significant association between gender and outcome ( $\chi^2 = 0.17$ ,  $p = 0.916$ ) (Table 3).

Ridley Jopling classification showed that borderline tuberculoid leprosy patients contributed the major proportion and most cases of borderline tuberculoid hand had excellent or good results (Table 4). However the association between the classification and the outcome was not statistically significant ( $\chi^2 = 2.46$ ,  $p = 0.292$ ).

In 35 (58.3%) left hands, 74.3% had excellent or good results and 25.7% had fair or poor results (Table 5). In 25 (41.6%) right hands, 80% had excellent or good results and 20% fair or poor results. Statistical analysis showed that hand involvement was not significantly associated with post operative outcome ( $\chi^2 = 0.49$ ,  $p = 0.782$ ).

The duration of paralysis ranged from 0.3 years to 25 years. 100% of patients whose duration of paralysis was less than 3 years of paralysis had excellent or good results (Table 6). It is seen that as the duration of the paralysis increases the results tend to be fair or poor. Analysis showed that lower duration of paralysis had a significant favorable effect on the final post-operative outcome ( $\chi^2 = 36.68$ ,  $p = 0.000$ ).

Outcomes of single stage surgery and two stage surgery are presented in table 7 and 8 respectively. Of the 60 hands, 31 hands underwent single

**Table 6 : Post- operative outcome by duration of paralysis**

Results	0–3 yrs (%)	3.1–5 yrs (%)	5.1–10 yrs (%)	>10 yrs (%)
Excellent	33 (89.2)	3 (30)	0	0
Good	4 (10.8)	4 (40)	2 (33.3)	0
Fair	0	3 (30)	4 (66.7)	1 (14.3)
Poor	0	0	0	6 (85.7)
Total	37	10	6	7

**Table 7 : Post-operative outcome in single stage by type of claw surgery**

Result	PL4T (%)	EF4T (%)	FDS (%)
Excellent	12 (80)	7 (70)	4 (25)
Good	2 (13.3)	1 (10)	5 (31.3)
Fair	0	2 (20)	4 (25)
Poor	1 (6.7)	0	3 (18.8)
Total	15	10	16

**Table 8 : Post- operative outcome in two staged surgery**

Results	PL4T (%)	EF4T (%)	FDS (%)	LASSO (%)
Excellent	1 (100)	2 (50)	0	4 (80)
Good	0	1 (25)	1 (100)	0
Fair	0	0	0	1 (20)
Poor	0	1 (25)	0	0
Total	1	4	1	5

stage surgical reconstruction for ulnar and median paralysis. In all cases, the FDS of the ring finger was used as motor in opponens transfer and for ulnar paralysis; palmaris longus 15 (36.6%), extensor carpi radialis longus 10 (24.4%). In 16 (39.1%) hands FDS of middle finger was used as motor tendon. PL4T and EF4T resulted in more excellent outcome when compared to FDS ( $\chi^2=10.48$ ,  $p=0.014$ ). Totally 11 hands were operated on two stages; first stage, claw hand correction by PL4T, EF4T, FDS & LASSO. The outcome was excellent or good in 81.8% and fair or poor in 18.2%.

The post operative functional assessments in terms of pinch strength, grip strength and fine manipulation showed improvement compared to pre operative assessments (Table 9). For all the assessments the differences between the excellent and good outcome and fair and poor outcomes are statistically significant.

Logistic regression was done to determine independent effects of the risk factors on the outcome (Table 10). Both Excellent and Good outcome were combined for this purpose. The independent variables assessed were age, classification, sex, side of hand, other surgeries,

**Table 9 : Grip strength, Pinch strength and fine manipulation**

Outcome	Pinch strength Post v Pre		Fine manipulation Pre v Post		Grip strength Post v Pre	
	Mean	SD	Mean	SD	Mean	SD
Excellent	1.63	0.53	113	43	5.03	1.33
Good	0.59	0.19	115	43	3.06	0.71
Fair	0.70	0.35	90	67	3.47	1.38
Poor	0.15	0.06	60	29	1.76	1.25
F ratio	32.90		2.82		16.48	
P value	0.000		0.046		0.000	

**Table 10 : Logistic Regression Analysis**

Variable	B	S.E.	Wald	df	Sig	Odds Ratio
Age	.3202	1.0440	.0941	1	.7590	1.3775
Classification	.9037	1.0781	.7026	1	.4019	2.4687
Sex	.2441	1.3870	.0310	1	.8603	1.2764
Side	.6096	1.0627	.3291	1	.5662	1.8397
Surgery	-.3193	.5705	.3132	1	.5757	.7267
Staging	.6847	1.1461	.3569	1	.5502	1.9831
Dur of paralysis	4.3514	1.0902	15.9294	1	.0001	77.5839
Constant	-2.2404	2.0587	1.1844	1	.2765	

staging of surgery and duration of paralysis. The results showed that only duration of paralysis had independent effect on the outcome ( $p=0.0001$ ). Compared to those with duration of paralysis of more than five years, those with five years or less have 77.58 times higher chance of obtaining excellent or good results. Other factors did not significantly contribute to the outcome.

### Discussion

In this study the excellent and good results were seen in 76.6% which is comparable to the excellent and good results 85% reported by Sundarraj and Mani (1984), and 81.3% Patond et al (1999).

Results were excellent in the age group up to 40 years. As the age increases various asso-

ciated parameters like duration of the paralysis increases, development of joint contracture occurs and difficult post-operative re-education was experienced. These may lead to poor outcomes.

The outcome of opponens transfer was not significantly ( $p=0.916$ ) associated with gender.

Excellent results were obtained in hands where paralysis is less than 3 years. This is similar to the results reported by Ozkan et al (2003). If the duration of paralysis is more the patient has a risk of developing contracture, worsening of deformities and mal habit formation leading to poor outcome in post-operated cases.

The type of leprosy did not have significant effect ( $p=0.292$ ) on the functional outcome post-operatively.

Comparison of Single stage correction of intrinsic paralysis by PL4T and EF4T against FDS shows statistically significant ( $p=0.014$ ) outcomes post-operatively. The possible explanation is when the FDS of ring finger used for opponens transfer and FDS of middle finger used for claw hand correction the grip strength decreases because two sublimes are removed.

The outcome of single stage correction when compared to two-stage correction of thumb had not attained statistical significance ( $p=0.887$ ). But single stage correction of fingers and thumb is desirable as it improves the ability of the patients to resume his occupation early. It allows the working of thumb and finger together and re-education for thumb is easy. It also reduces the hospital stay and cost of surgery so we recommended single stage correction unless it is absolutely needed.

The post-operative outcome was independent of the hand involved. The post-operative rehabilitation period was also comparable with regard to hand involvement.

The functional assessment in terms of pinch strength, grip strength and fine manipulation showed improvement and good correlation with the grading of the outcomes assessed objectively. Logistic regression was done to find out independent effect of the risk factors viz age, classification, sex, side of hand, other surgery and

duration of paralysis on the outcomes. The results showed that only duration of paralysis had an independent effect on outcome ( $p=0.0001$ ). Compared with those with duration of paralysis of more than five years, those with duration of paralysis of 5 years or less have 77.58 times higher chance of obtaining excellent or good outcome. Other risk factors were not significantly affecting the result.

Early reconstructive surgery is recommended for median paralysis as it is likely to give a good result with opponens replacement.

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