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ORIGINAL ARTICLE

The Outcomes of Opponensplasty in the Restoration of Thumb Function for Adults with Late Median Nerve Palsy: A Comparison between Two Techniques

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ABSTRACT

Background: Opponensplasty is a salvage tendon transfer procedure to restore thumb opposition function, tip and key pinch in median nerve palsy. The present work aimed to compare between two techniques ofOpponensplasty (using flexor digitorum superficialis (FDS) tendon versusextensor indicis (EI) proprius tendon) to know which one is better in improving the thumb function.

Methods: Twenty-four patients with late median nerve palsy ofthumb who were admitted to the emergency unit of the Plastic and Reconstructive Surgery Department in Zagazig University Hospitals were enrolled in this prospective comparative study, they were categorized into 2 groups (n=12 patients in each group): Group I: was operated using flexor digitorum superficialis tendon and Group II was operated using extensor indicis proprius tendon.The functional assessment of thumb was done 6 months after surgery using Kapandji scoring system.

Results: We found that 25% of the cases in Group I had complications (thumb hyperflexion, wound infection and donor site morbidity) while 16.7% in Group II had complications (all had donor site morbidity%). The mean Kapandj scoring system in Group I pre & post operative respectively were 0.5±0.80 & 7.46±2.5 and in Group II 0.33±0.49 & 7±1.98.Regarding differences between pre & post in each group a statistical significance increase was found in Kapandj scoring post operative compared to pre in both groups with percent of increase 565.3% and 541.67% in Group I & II respectively with non-statistically significant difference between both groups.

Conclusion: The use of opponensplasty is an effective surgical intervention to restore thumb functions among patients with median nerve palsy. The choice between FDS and EI tendon transfers were almost comparable with no upper hand of any one on the other, it should be individualized based on the patient's clinical presentation, with consideration given to the potential complications and long-term functional outcomes.

Keywords: Thumb Function, Median Nerve Palsy, Opponensplasty

INTRODUCTION

One of the most crucial parts of a thumb's regular function is its opposition. In this motion, the thumb pulp crosses over and opposes the pulps of the other fingers in a diagonal fashion. The thenar intrinsic muscles apart from the ulnar head of the lexor Pollicis Brevis Muscle (FPB) are contracted to bring the thumb into this posture, which is not actually a grab but rather a position that is prepared for it [1]. So, loss of thumb opposition can significantly affect 40% of the hand function [2].

The radial half of the hand relies on the median nerve for both intrinsic and extrinsic sensory and motor function. Possible causes of numbness or tingling in the fingers include birth defects or injuries sustained in childhood, such as a laceration to the median nerve or trauma, or long-term compression of the nerve due to conditions like carpal tunnel, pronator, or cervical radiculopathy [2]. Good history and clinical examination are important tools in the detection of the late median nerve palsy and after that comes the imaging role. Tendon transfers are the solution when nerve repair or grafting doesn't achieve a functional recovery or to support the repaired nerve function in early trauma [3].

Opponenoplasty is a salvage tendon transfer procedure to restore thumb opposition function, tip and key pinch in median nerve palsy and it was done for the first time by Steindler in 1917 and soon after that many contributions by other surgeons were there. One of the numerous methods that have been detailed for restoring thumb opposition is the employment of the abductor digiti minimi (ADM), flexor digitorum superfecialis (FDS), palmaris longus (PL), and extensor indicis proprius (EIP) [4]. Before deciding on a donor and procedure, it is important to take into account the patient's unique anatomy, underlying disease, impairments, and functional priorities in addition to the surgeon's personal taste and level of expertise [5-9]. So, we aimed at this study to compare between two techniques of Opponenslasty (using flexor digitorum superficialis (FDS) tendon versus extensor indicis (EI) proprius tendon) to know which one is better in improving the thumb function.

METHODS

This prospective comparative study was conducted on 24 patients with late median nerve palsy of thumb who were admitted to the emergency unit of the Plastic and Reconstructive Surgery Department in Zagazig University Hospitals. During the study period between August 2023 till August 2024; Consent was collected from all patients. The approval for the study was obtained from Zagazig University Hospitals after obtaining approval from the Institutional Review Board (IRB#10989) and the research was conducted in accordance with the Helsinki Declaration.

We included patients between 18 and 60 years of age from both sexes with late median nerve palsy not less than one year, who had flexor digitorum superfacialis score 5, Kapandji score of 0-2 who were fit for surgery. We excluded patients who were less than 18 or older than 60 years of age, all patients who had weak donor muscles or myopathy or early median nerve trauma.

All patients were subjected to the following: entire history taking, history about the trauma was carefully taken. Patients were asked about the mode and time of trauma. Examination of the thumb function and

assessment of kapandji score [10]. Assessment of extent of injury was done by clinical examination. Electromyography (EMG) was done to the patients for median nerve for assessment of muscle response or electrical activity in response to a nerve's stimulation of the muscle. Laboratory investigations included: complete blood count (CBC), Coagulation Profile, liver and kidney functions and virology tests.

Operative Treatment:

The patient was on supine position. General or regional anesthesia were given to the patient. Choice of the method was determined by the anesthesiologist. Tourniquet was used in all cases in this study. Marking was done to identify the tendon used. Patients were categorized into 2 groups (n=12 patients in each group): Group I: was operated using flexor digitorum superficialis tendon and Group II was operated using extensor indicis proprius tendon. The tendon of flexor Carpi ulnaris was used as a pulley.

Post Operative Protocol: Cast was used for the 1 months and in a slap at night 3 weeks later with physiotherapy.

Study Outcome Evaluation:

For evaluating the outcomes of opponenplasty the functional assessment of thumb will be done 6 months after surgery using kapindaji scoring system where 10 means the contact of the thumb with the little finger [10]. In order to complete the intricate motion of the opposition, the following muscles must work together: abduction, flexion, pronation, deviation of the proximal phalanges to the radial side, and thumb movement toward the fingers. In the event of a tendon transfer to the thumb, this muscle should be taken into account due to its primary function in opposition [11].

Statistical Analysis:

Data was analyzed statistically using SPSS version 28 (IBM Co., Armonk, NY, USA). Mean, standard deviation, and range were used to display quantitative parametric data. A Chi-square test or independent t-test was used to assess categorical variables, which were shown as percentages and frequencies; a P-value less than 0.05 was deemed statistically significant.

RESULTS

This study included 24 cases, the mean age of Group I was 32.17±11.37 years while that of Group II 37.33±16.72 years, ll cases of Group I were male while in Group II there was 2 females (16.7%) with non-statistical significant variations between the both studied groups as regards age, or sex distribution (Table 1).

The most frequent occupation in both groups was manual worker (58.3% in Group I and 50% in Group II) with non-statistically significant variations between the both studied groups as regards occupation (Table 2).

The most frequent cause of injury in both groups was RTA (41.7% in Group I and 50% in Group II) and there was no statistical significance difference between the studied groups in cause, 66.7% of the cases in Group I had lesion in right side and 75% in Group II with non-statistically significant variations between the both studied groups as regards side of lesion (Table 3).

Table 4 shows that 25% of the cases in Group I had complications (thumb hyperflexion, wound infection & donor site morbidity) while 16.7% in Group II had complications

(all had donor site morbidity%) with non-statistically significant variations between the both studied groups as regards frequency and type of complications.

The mean kapandji scoring system in Group I pre & post operative respectively were 0.5±0.80 & 7.46±2.5 and in Group II 0.33±0.49 & 7±1.98 with non-statistically significant variations between the both studied groups as regards kapandji scoring pre operative or post operative. Regarding differences between pre & post in each group a statistical significance increase in kapandji scoring post operative compared to pre in both groups with percent of increase 565.3% and 541.67% in Group I & II respectively (Table 5).

A 18 years old student with history of median nerve palsy since a year and half presented with kapandji score of 1, Marking was done to identify FDS tendon and the the base of thumb proximal phalanx,the result after 8 months with kapandji score of 6 (Figure 1).

A 54 years old male manual worker presented with median nerve palsy a year ago with failed nerve repair, the patient was kapandji score 2, Marking was done to identify Extensor indices proprious tendon, the result after 8 months with kapandji score of 6 (Figure 2).

Table (1): Age and gender of the studied groups

Variable		**Group I (*n*=12)**		**Group II (n=12)**		**t**	**P**
Age: (years)	*Mean ± Sd* *Range*	32.17±11.37 18-51		37.33±16.72 19-56		0.89	
Variable		**Group I (*n*=12)**		**Group II (n=12)**		**χ^2**	**P**
		No	**%**	**No**	**%**		
Sex:	*Female* *Male*	0 12	0 100	2 10	16.7 83.3	2.18	0.14 NS

SD: Standard deviation **t:** Independent t test, **χ2:**Chi square test **NS:** Non significant (P>0.05)

Table (2): Occupation among the studied groups

Variable		**Group I (*n*=12)**		**Group II (n=12)**		**χ^2**	**P**
		No	**%**	**No**	**%**		
Occupation:	*House wife* *Students* *Manual worker* *Specialized (Accountant-Teacher)*	0 3 7 2	0 25 58.3 16.7	2 0 6 4	16.7 0 50 33.3	5.74	0.12 NS

χ^2: Chi square test **NS:** Non significant (P>0.05)

Table (3): Cause and side of injury among the studied groups

Variable		Group I (*n*=12)		Group II (n=12)		χ^2	P
		No	%	No	%		
Cause of lesions	RTA	5	41.7	6	50	4.20	0.24 NS
	Cut wrist	0	0	2	16.7		
	Machine injury	5	41.7	4	33.3		
	Gun shot	2	16.7	0	0		
Variable		**Group I (*n*=12)**		**Group II (n=12)**		χ^2	P
		No	**%**	**No**	**%**		
Side	*Right*	8	66.7	9	75	0.20	0.65 NS
	Left	4	33.3	3	25		

χ^2**:** Chi square test **NS:** Non significant (P>0.05)

Table (4): Complication among the studied groups

Variable		Group I (*n*=12)		Group II (n=12)		χ^2	P
		No	%	No	%		
complication	*No*	9	75	10	83.3	0.25	0.62 NS
	Yes	3	25	2	16.7		
Type	*Thumb hyperflexion*	1	8.3	0	0	2.22	0.33 NS
	Wound infection	1	8.3	0	0		
	Donor site morbidity	1	8.3	2	16.7		

χ^2: Chi square test **NS:** Non significant (P>0.05)

Table (5): kapandji scoring system among the studied groups pre & 6 months post-operative

Variable		Group I (*n*=12)	Group II (n=12)	MW	P
Pre: (%)	*Mean ± Sd*	0.5±0.80	0.33±0.49	0.28	0.78 NS
	Median	0	0		
	Range	0-2	0-1		
Post: (%)	*Mean ± Sd*	7.46±2.5	7±1.98	1.86	0.06 NS
	Median	8	7.25		
	Range	0-9	1-8.5		
W^		**2.95**	**2.94**		
P		**0.003****	**0.003****		
% of increase		**565.3%**	**541.67%**		

SD: Standard deviation **MW:** Mann Whitney test **W^:** Wilcoxon t test
NS: Non significant (P>0.05) *: Significant (P<0.00)

(A)

(B)

(C)

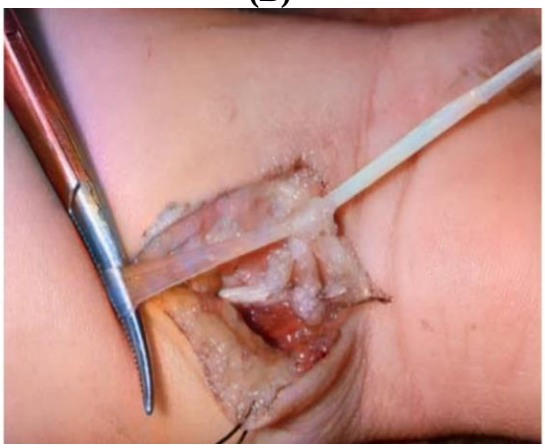
(D)

Figure 1:(A) median nerve injury since 1.5 years with kapandji score of 1 **(B)** The tendon was taken to be transferred**, (C)** FCU tendon was used as a pulley, **(D)** The result after 8 months with kapandji score of 6

(A)

(B)

(C)



(D)

(E)

Figure 2:(A) patient with failed nerve repair, the patient was kapandji score 2, **(B)** Marking was done to identify Extensor indices proprious tendon, (C) The tendon was harvested to be transferred, **(D)** FCU tendon was used as a pulley, **(E)** The result after 8 months with kapandji score of 6

DISCUSSION

Opponensplasty is a critical surgical intervention designed to restore thumb opposition and function in patients with median nerve palsy. By reconstructing the opponens pollicis muscle, this procedure significantly enhances grasp and pinch strength, which are essential for daily activities. Its importance lies in its ability to improve hand function and quality of life for individuals who have lost this vital hand movement due to nerve injury. Studies have shown that opponensplasty can result in substantial functional gains and patient satisfaction [12].

The FDS tendon transfer is a common method for opponensplasty, particularly effective for restoring thumb opposition in patients with median nerve palsy. The procedure involves harvesting the FDS tendon from one of the fingers (often the ring finger) and rerouting it to the opponens pollicis muscle, thus enabling improved thumb function. This technique has shown promising results in improving grasp and pinch strength. [13] The EI tendon transfer is another surgical option for opponensplasty, utilizing the tendon of the extensor indicis muscle. This method involves rerouting the EI tendon to the opponens pollicis muscle to restore thumb opposition. The EI tendon transfer is particularly advantageous in cases where other tendons might be compromised or unavailable. It provides a good balance of functional restoration and minimal donor site morbidity [14].

The Kapandji score, developed to assess thumb opposition in patients with median nerve palsy, is widely recognized for its reliability and applicability in clinical settings. This scoring system evaluates the range of thumb opposition by assessing the ability to touch various points on the palmar surface, offering a quantitative measure of thumb function. Recent studies affirm its reliability, showing consistent results across different clinical settings and among various practitioners. A study by Leung et al. [11] demonstrated that the Kapandji score remains a robust tool for evaluating functional outcomes in thumb reconstruction surgeries, particularly in patients with median nerve injury. Its simplicity and straightforward application make it a valuable tool for both clinical assessment and research, providing clear and actionable data on thumb functionality and aiding in the evaluation of surgical interventions and rehabilitation progress.

This study evaluates the comparative outcomes of opponensplasy in the restoration of thumb opposition and compares between EI and FDS tendon transfers and examines how factors such as age, sex, occupation, and complications influence the success of the surgery. According to the age our study found no significant difference in surgical outcomes based on the age of the patients, suggesting that age is not a critical determinant of success in opponensplasty. In agreement This finding is supported by research showing that as long as patients are in good general health, their age does not significantly affect the success of tendon transfers [12].

For gender discrepancy the study observed no significant sex-related differences in surgical outcomes, which aligns with existing literature indicating that sex does not substantially influence the effectiveness of tendon transfers in hand surgery [12]. Occupation can play a critical role in post-operative outcomes, particularly in patients whose jobs demand high levels of hand function. The study reported no significant

difference between occupational groups, with manual workers showing substantial functional recovery post-surgery. In agreement this observation is consistent with Zarezadeh et al. [12] as they demonstrated successful outcomes in manual laborers due to the high functional demands placed on their hands.

Regarding functional outcomes, our study showed significant improvements in Kapandji scores from pre-operative to 6 months post-operative in both groups ($p<0.001$), with increases of 565.3% and 541.67% respectively. However, no significant difference was observed between the two groups at the 6-month follow-up ($p=0.06$). In agreement these results are consistent with a study by Lee et al. [13] who also demonstrated substantial improvement in Kapandji scores post-opponensplasty, highlighting the effectiveness of the procedure in restoring thumb function. However, Lee's study noted that while improvements are significant, the differences between various surgical techniques might not always translate into clinically significant differences in long-term functional outcomes.

Another study by Coulshed et al. [13] revealed that The average Kapandji score for EIP transfers before surgery was 2.8 (1 research, n = 60), but it improved to 9.1 (2 studies, n = 73) following surgery. After FDS transfers, the average Kapandji score improved from 2.4 (range: 1.5-3.5) before surgery to 8.6 (range: 7.7-8.9) (3 studies, n = 132). Opposition in ADM transfers has only been examined in one study, which found that 89% of the contralateral score was achieved.

In another study by Lemonas et al. [14] It was determined that the strategy's outcomes were satisfactory for FDS ligament Opponensplasty after evaluating the procedure's success using the EIP technique. Although we used FDS ligament for opponensplasty in this case, the results are consistent with those of our studies. Cooney et al. [15] showed that when strength was needed, the flexor digitorum superficialis of the long and ring fingers are suitable for low middle nerve paralysis. When using only his thumb, they preferred the EIP maneuver for its adaptability.

In their evaluation of 166 patients suffering from middle nerve loss of motion of unknown cause, Anderson et al. found a link between EIP and flexor digitorum superficialis (FDS)opponensplasty. [16] 116 individuals underwent the exchange using FDS, while the remaining 50 used EIP. Their results demonstrated that less malleable hands were better candidates for FDS opponensplasty, while more flexible hands were more effectively helped by EIP opponensplasty. Conversely, Patel et al. [17] argued that while Kapandji scores improved significantly post-surgery, the variations between different surgical methods were minimal, which aligns with our findings that no significant difference was observed between groups in our study. This suggests that while the procedure is generally effective, the choice of surgical technique may not dramatically impact functional recovery as measured by the Kapandji score alone.

And regarding complications, the present study revealed that the rates for opponensplasty were 25% in The FDS operated group and 16.7% in EI operated group, with no significant differences between the groups ($p=0.62$). The types of complications included thumb hyperflexion, wound infection, and donor site morbidity. This is consistent with recent literature that also reports varied complication rates but generally indicates that complications are

manageable with proper surgical technique and post-operative care. In agreement, Smith et al. [18] reported a similar range of complications, with donor site morbidity being the most common issue across different surgical approaches. This aligns with our finding that donor site morbidity was prevalent but did not differ significantly between groups.

Also,Yavari et al. [7] evaluated surgical complications and they revealed that: Twenty-four patients (40%) from EI and six patients (10%) from FDS felt some discomfort, ranging from mild to moderate, at the surgical incision. In contrast to individuals undergoing surgery utilizing the EI approach, 12 patients (20%) who received FDS surgery experienced hyperextension in the proximal interphalangeal fourth finger. The incidence of complications was significantly higher in the FDS group (P=0.01). Another study by Jones et al. [19] also highlighted that while complications are not uncommon, they do not significantly affect overall surgical outcomes if managed appropriately.

The current study was limited by small sample size (24 cases), being a single center study and relatively short follow up period, lack of patient inclusion across a large time period, also the non-great significant variations between different parameters however these were the exact results we have found.

CONCLUSION

Overall, our study supports the current literature indicating that opponensplasty is effective in improving thumb function, with manageable complication rates. The absence of significant differences between the two groups in both complications and functional outcomes suggests that variations in surgical technique might not substantially affect the overall success of the procedure. Future research with larger sample sizes and long-term follow-up could provide further insights into optimizing surgical approaches and minimizing complications.

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