

Opponensplasty in Cases with Low Median Nerve Injury

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Abstract

Thumb resistance is a basic activity of thumb. Middle nerve paralysis meddles with an enormous number of customary exercises like resistance. This investigation planned to survey the result of ligament move for reclamation of resistance in instances of low middle nerve injury in regards to hand grasp and scope of movement and useful result. Thirty patients, 19 guys and 11 females with a mean time of was 29 years, with a standard deviation of 11 years were remembered for this examination. The interim between wounds to a medical procedure was 17 months, with a standard deviation of 3 months. All patients experienced segregated low middle nerve injury with lost resistance were incorporated for and flexor digitorum superficialis (FDS) opponensplasty. Evaluation of resistance by Kapandji score and appraisal of level of agony by VAS and hand grasp by QuickDASH score. Every one of the patients will have nerve conduction and electromyogram, clinically assessment following fourteen days and evacuation of the skin stitch then at about a month expulsion of the piece and consider controlled scope of movement, and at 3, 4 months postoperatively FDS opponensplasty give better outcomes in low middle nerve paralysis. The volar slanted cut offers clear perception while isolating the FDS ligament, diminishing the frequency of flexion distortion of the ring finger.

Keyword: Opponensplasty, Median Nerve, Injury.

1. Introduction

Resistance is the situation of the thumb inverse the fingers into a situation from which it can work. This movement requires thumb palmar kidnapping, flexion, and pronation, which are given by the abductor pollicis brevis, flexor pollicis brevis, and opponens pollicis.[1].

There are seven moves in the hand to perform the majority of the hand work. For the hand work, the resistance is the main capacity in the thumb. The pivot of the thumb has its establishment at the TM joint and rests in a pronated and flexed position around 80° comparative with the plane of different metacarpals. This exceptional position permits resistance of the thumb to digits. [2].

For resistance (a blend of snatching, flexion, and pronation) to be viable, the thenar inherent muscles, including the APB, spiral top of the FPB, and opponens pollicis, should work. The APB is the main muscle for resistance. It snatches, flexes, and pivots the metacarpal; steals and flexes the proximal phalanx; and broadens the IP joint. The outspread top of the FPB is a frail abductor that isn't close to as viable as the APB, and the opponens pollicis is even less successful. The opponens pollicis steals, flexes, and pivots the metacarpal like the APB however has no impact distal to the MP joint since its inclusion is exclusively on the main metacarpal. The opponens pollicis is the most un-significant inherent muscle for thumb resistance [3].

There are numerous likely reasons for middle nerve paralysis, and consequently an absence of resistance. These incorporate intense middle nerve gash or harm from injury just as constant middle nerve pressure from carpal passage disorder, pronator condition, or cervical radiculopathy. Additionally, innate shortfall of thenar musculature is normal with outspread longitudinal lack and thumb hypoplasia. Numerous neurologic conditions, like Charcot-Marie-Tooth, constant incendiary demyelinating polyneuropathy, and disease, every now and again bring about thenar muscle decay too. More

uncommon etiologies would incorporate tumor or brachial plexopathies. [4].

In a low middle nerve paralysis, the thumb rests in consistent unopposed outer pivot and supination. Over the long haul, without aloof extending works out, this may bring about reformist shortening and contracture of the dorsal first web space skin and belt with resultant solidness. On the off chance that present, medical procedure to reestablish resistance should incorporate extension of the primary web space skin and sash with either z-plasty or skin unite. Contracture of the main web space will additionally put the MCP joint of the thumb at a biomechanical hindrance and further incline it to hyperextension deformation [5].

Actual assessment is the main apparatus of the diagnostician in the finding of middle nerve paralyses. In the setting of intense cracks or injury, x-beams ought to be utilized to survey for associative bony wounds, which may make injury or pressure the nerve however will have minimal utility in the appraisal of nerve injury. Ultrasound is a valuable device and may uncover the etiology of nerve pressure. Electromyography is another regularly utilized device in the conclusion of pressure neuropathies and muscle denervation. Compressive neuropathies bring about expanded distal inactivity and diminished conduction speed when assessed by EMG. Fasciculations inside the innervated musculature are an indication of denervation and warrant a more earnest careful decompression. have been found to give just restricted outcomes [6].

Opponensplasty is an ordinarily utilized ligament move to reestablish thumb resistance. The flexor digitorum superficialis (FDS) of the ring finger is the most ordinarily utilized benefactor engine unit in instances of low middle nerve paralysis. In the event that the FDS isn't accessible, the extensor indicis proprius is generally picked for the exchange. In patients with extreme carpal passage disorder and loss of thumb resistance, synchronous carpal passage discharge and

palmaris longus opponensplasty are habitually performed. At last, the abductor digiti minimi opponensplasty is regularly done in inherent hypoplasia of the thenar muscles since it has the upside of adding thenar mass. [7].

The thumb is immobilized in resistance for 3 weeks after most opponensplasties, and the wrist ought to likewise be immobilized if the ligament move crosses the flexor surface of this joint. Moves of muscles with moderately short journeys, like the EIP, ought to be loose by immobilizing the wrist in 30 levels of flexion and the thumb in full resistance. In any case, after move of muscles with bigger outings, for example, the superficialis, the wrist can be immobilized in impartial with the thumb in full resistance. In the event that the exchange is appended to either the extensor component or the APB inclusion, the IP joint of the thumb ought to presumably be immobilized in full augmentation. Some think that its helpful to keep up thumb resistance postoperatively by utilizing cyanoacrylate paste to stick the skin of the thumb tip to the little finger toward the finish of the activity, before the exchange's pressure is set. With desquamation, the thumb is precipitously delivered from the little finger following 2 to 3 weeks. Following 3 weeks, everything supports can typically be disposed of, and most patients rapidly recover thumb control. The accentuation ought to be on early reclamation of wrist development, which will then again unwind and fix the opponensplasty. [8].

This investigation expected to evaluate the result of ligament move for reclamation of resistance in instances of low middle nerve injury with respect to hand grasp and scope of movement and practical result.

2. Patients and methods

This study has been conducted at the orthopedic department, faculty of medicine, Benha university hospitals in the period from between December 2019 to April 2021.

Thirty patients, 19 males and 11 females. With chronic low median nerve injury with lost opposition.

Inclusion criteria

To be included in the study, the patient must fulfill all the following criteria:

- Consecutive patients have evidence of low median nerve injury
- Isolated median nerve injury
- Traumatic nerve injury more than one year
- Associated with inefficiency in daily activities

Exclusion criteria

The patients with any of the following criteria were excluded from the study:

- Incomplete documentation
- Unavailable healthy tendon for transfer
- Injury less than one year
- Neuropathic condition as leprosy
- Anticipated poor co-operation of the patient
- Combined nerve injury

Preoperative Management and Evaluation:

Patient's history

- Clinical history was taken from the patient in the sort of name, sex, age, job, address and smoking habits.
- Associated illness like diabetes, hypertension and cardiac condition.
- Patients were asked about the mechanism of injury and if there is any associated injuries.

Clinical examination

Standard hand examination was performed in the form of:

- Tenderness
- Swelling
- Range of motion of hand
- Skin condition
- Neurovascular examination
- Also examination of associated injuries was performed.

Opposition evaluation

- Assessment of opposition by Kapandji score and assessment of degree of pain by VAS and hand grip by QuickDASH score.
- All the patients will have nerve conduction and electromyogram.
- We used the Kapandji score used to measure opposition of the thumb (/10). The contact between the top of the thumb pulp and the other fingers is used to calculate this score. We used the visual analog scale (VAS) is a pain rating scale first used by Hayes and Patterson in 1921. Scores are based on self-reported measures of symptoms that are recorded with a single handwritten mark placed at one point along the length of a 10-cm line that represents a continuum between the two ends of the scale—"no pain" on the left end (0 cm) of the scale and the "worst pain" on the right end of the scale (10 cm). Measurements from the starting point (left end) of the scale to the patients' marks are recorded in centimeters and are interpreted as their pain.

We used the Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH) score (in which a score of 0 means no disability and a score of 100 means complete disability).

Surgical Technique

Fitness to surgery

The patients were assessed for fitness for surgery by clinical history, examination and routine pre-operative laboratory investigations.

Consent

Standard consent was taken from the patients

Surgical procedure

Anesthesia

Patients were anaesthetized by general anaesthesia or brachial block.

Position

Patients were operated on a standard orthopedic table, in supine position.

The patient was placed supine given intravenous antibiotic The FDS of the ring finger is harvested through an incision overlying the A1 pulley of the ring finger. Once the FDS is isolated, the finger is fully flexed, proximal traction on the FDS allows for visualization of the bifurcation of FDS, and the FDS is transected at this level concurrent incision at carpal tunnel. The FDS is then passed through a subcutaneous tunnel to the radial aspect of the thumb MCP, where a third incision is made and the FDS is either inserted into the ulnar base of the proximal phalanx or directly attached to the APB tendon. The transfer is tensioned such that passive wrist extension will result in full thumb opposition. Then suturing the skin and slap is done.

Postoperative care

The patients receive intravenous antibiotics for at least 48 hours, pain medication as required discharging after 24 hours

Follow up care

Clinically examination after 2 weeks and removal of the skin suture then at 4 weeks removal of the slap and allow for controlled range of motion, and at 3, 4 months postoperatively.

2.1 Statistical methods

Data management and statistical analysis were done using SPSS version 25. (IBM, Armonk, New York, United States). Normality of numerical data was assessed using Shapiro-Wilk test and direct visualization methods.

Then, numerical data were summarized as means and standard deviations or medians and ranges. Categorical data was summarized as numbers and percentages. Kapandji and VAS scores were compared prior to surgery, at 3 months, and at 6 months using Friedman’s test, while QuickDash score was compared using repeated measures ANOVA. Post-hoc analysis was done using Bonferroni method. All P values were two sided. P values less than 0.05 were considered significant.

3. Results

This study was conducted in Orthopedic surgery department, faculty of medicine, Benha university hospitals on thirty (30) cases with chronic low median nerve injury with lost opposition., The mean time between injuries to surgery was 17 months, with a standard deviation of 3 months. The mean age of the studied patients was 29 years, with a standard deviation of 11 years. Regarding gender, 63.3% were males, and 36.7% were females Table (1).

Kapandji score before surgery, after 3 months and 6 months in the studied patients

There was an overall significant difference between Kapandji score before surgery, after 3 months, and after 6 months, P value was <0.001. Post-hoc analysis revealed that median Kapandji score was significantly lower before surgery (1) than after 3 months (5) and after 6 months (6). No significant difference was noted regarding Kapandji score between 3 months and 6 months Table (2).

Table (1) Demographic characteristics in study population.

General characteristics		
Age (years)	Mean ±SD	29 ±11
Gender	Male n (%)	19 (63.3)
	Female n (%)	11 (36.7)

The most frequent mode of injury was traumatic(66.7%), followed by iatrogenic and self-injuries(16.7% for each) fig. (1)

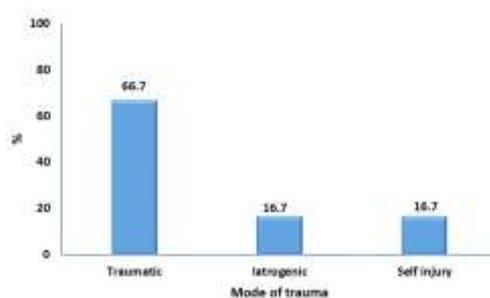


Fig. (1) Mode of injury in the studied patients.

Table (2) Kapandji score before, after 3 & 6 months in the studied patients.

Kapandji score	Median (range)	P value
Before	1 (1 - 2) ^a	<0.001
After 3 months	5 (4 - 7) ^b	
After 6 months	6 (4 - 7) ^b	

Friedman’s test was used. Post-hoc analysis was done using Bonferroni method. Different letters indicate significant pair

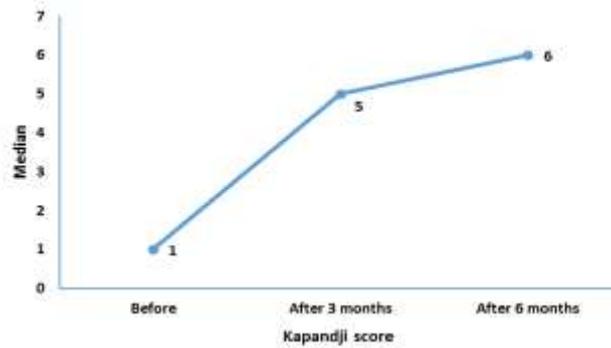


Fig. (2) Kapandji score before, after 3 & 6 months in the studied patients

VAS score before surgery, after 3 months and 6 months in the studied patients

There were no significant differences between VAS score before surgery, after 3 months, and after 6 months. P value was 0.5. Table (3).

Table (3) VAS score before, after 3 & 6 months in the studied patients.

VAS score	Median (range)	P value
Before	1 (0 - 2)	0.5
After 3 months	1 (0 - 2)	
After 6 months	1 (0 - 2)	

Friedman’s test was used.

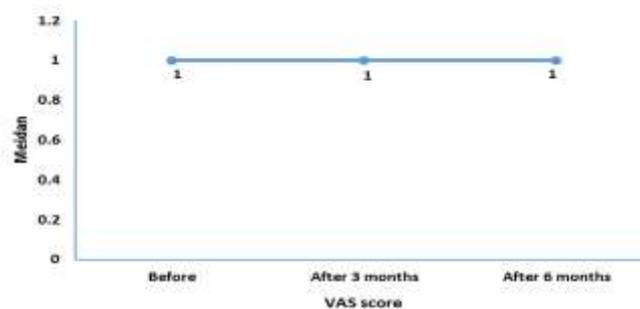


Fig. (3) VAS score before, after 3 & 6 months in the studied patients.

QuickDash score before surgery, after 3 months and 6 months in the studied patients

There was an overall significant difference between QuickDash score before surgery, after 3 months, and after 6 months, P value was <0.001. Post hoc analysis

revealed that mean QuickDash score was significantly higher before surgery (24.7) than after 3 months (16.3) and after 6 months (14). Also, QuickDash score at 3 months was significantly higher (16.3) than after 6 months (14).

Table (4) QuickDASH score before, after 3 & 6 months in the studied patients.

QuickDASH score	Mean ±SD	P value
Before	24.7 ±5.7 ^a	<0.001
After 3 months	16.3 ±4.1 ^b	
After 6 months	14 ±4.4 ^c	

Repeated measures ANOVA was used. Post-hoc analysis was done using Bonferroni method. Different letters indicate significant pair

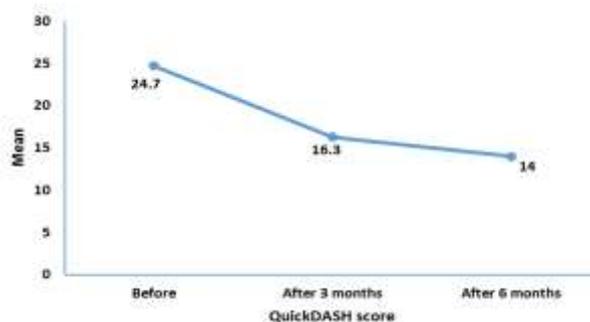


Fig. (4) QuickDASH score before, after 3 & 6 months in the studied patients

4. Discussion

The thumb is a significant piece of the hand that is liable for most day by day exercises. The significance of the activities of this finger becomes more clear when we realize that the standard day by day exercises are altogether lost without resistance. In this manner, patients who lose their capacity to Pronation, Abduction, and Flexion because of horrible thumb injury are altogether restricted in their every day activities.[9].

Loss of thumb resistance addresses a huge useful shortfall to the hand. Given the significance of reestablishing resistance of the thumb, it isn't astounding that a wide range of ligament sources and move inclusion locales have been portrayed in endeavors to stand up to this issue. To treat this condition we utilized Riordan technique in which FDS ligament of the ring finger is utilized as engine unit giver in instances of low middle nerve paralysis.

Middle nerve injury brings about a genuine utilitarian set back to the patient. Since these nerve wounds happen all the more usually in men who are physiologically dynamic, athletic and in the most profitable age gathering; this may cause extensive bleakness, if not oversaw proficiently.

The mean age of the considered patients was 29 years, with a standard deviation of 11 years. With respect to, 63.3% were guys, and 36.7% were females. The most successive method of injury was awful (66.7%), trailed by iatrogenic and self-wounds (16.7% for each). As to of harmed hand, multiple thirds of patients had right hand injury, and 26.7% had left hand injury. The interim between wounds to a medical procedure was 17 months, with a standard deviation of 3 months. The interim between wounds to a medical procedure was 17 months, with a standard deviation of 3 months.

We utilized the Kapandji score used to quantify resistance of the thumb. There was a by and large critical contrast between Kapandji score before a medical procedure, following 3 months, and following a half year, P esteem was <0.001. Post-hoc examination uncovered that middle Kapandji score was essentially lower before a medical procedure (1) than following 3 months (5) and following a half year (6). No critical distinction was noted with respect to Kapandji score between 3 months and a half year.

Skie et al looked at changed techniques and thought about the qualities and shortcomings of Flexion, Extension, Abduction, and Pulp squeezing. At last, they presumed that the Riordan technique FDS ligament opponensplasty was better than any remaining strategies. These outcomes are some way or another in accordance with our discoveries showing the viability of FDS ligament opponensplasty in patients with low middle nerve paralysis. [10].

Jafari et al analyzed the aftereffects of opponensplasty by Riordan and Burckhalter strategies. They revealed Riordan strategy brought amazing outcomes for 60.4% of patients and the Burckhalter technique was fruitful for all patients and 80.6% of them had great outcomes. [11].

In another investigation by Lemonas et al the achievement of Opponensplasty was evaluated utilizing the EIP technique and it was accounted for that the aftereffects of the Burckhalter strategy satisfactory for FDS ligament Opponensplasty. These outcomes are additionally in accordance with the finding of our investigation however here we utilized FDS ligament for opponensplasty. [12].

Cooney et al announced that flexor digitorum superficialis of the long and ring fingers are appropriate for low middle nerve paralysis when strength was required. He favored EIP move when just thumb versatility was wanted. [13].

A correlation investigation of EIP and flexor digitorum superficialis (FDS) opponensplasty in 166 patients with middle nerve loss of motion of changed etiology was finished by Anderson et al. FDS was utilized for the exchange in 116 patients, though, EIP was utilized in rest 50. They showed that the EIP opponensplasty was best in flexible hands and FDS opponensplasty was more reasonable for less malleable hands. A ulnar nerve injury related with a high middle nerve injury restricts the decision of accessible engines for opponensplasty. The flexor digitorum superficialis, palmaris longus and abductor digiti minimi are for the most part not accessible and EIP is the conspicuous ligament of decision for an opponensplasty. [14].

Middle is a blended nerve answerable for tactile innervation in the spiral three and a half digits which add to the significant squeeze region of the hand. It likewise supplies the characteristic musculature including

complex developments of the thumb, in this manner the anticipation following fix stays unusual. Earthy colored et al. revealed the consequences of medical procedure in 272 furthest point nerve wounds and found that neuroorrhaphy of middle nerve (38 fixes) brought about incomplete useful recuperation in portion of the patients, though, other half had no practical advantage. He likewise recommended that ligament moves for middle nerve paralysis have shown genuinely great outcomes in hopeless injuries of the nerve as 27 out of all out 31 patients showed huge improvement. [15].

Care should be taken to take a little segment of the extensor development alongside the ligament or it could be excessively short. After separation, the extensor development should be fixed cautiously to stay away from extensor slack of the forefinger. In FDS opponensplasty, the analyzation ought not be taken excessively far along the side while disconnecting the giver ligament to evade harm to the horizontal groups of the extensor development prompting lacking expansion of the DIP joint of the ring finger. The volar entry point allows direct perception of the FDS ligament without the need to convey the analyzation horizontally. Separation of FDS diminishes power grasp, however we have not estimated this. The force of the engine ought to be sufficient to reestablish anteposition yet not to forestall adduction.

5. Conclusion

FDS opponensplasty give better results in low median nerve palsy. The volar oblique incision offers clear visualization when detaching the FDS tendon, reducing the incidence of flexion deformity of the ring finger.

References

- [1] R.A.El-Beshbishy ,G.A. Abdel-Hamid . Variations of the abductor pollicis longus tendon: anatomic study. *Folia Morphol (Warsz)*.VOL.72(2),pp.161e166,2013.
- [2] S.F.Duncan ,C.E.Saracevic ,R.Kakinoki. Biomechanics of the hand. *Hand Clin*.vol.29(4),pp.483–92,2013.
- [3] M.A. Posner ,D.Kapila . Restoration of opposition. *Hand Clin*.vol.28(1),pp.27–44,2012.
- [4] N.D.Royle. An operation for paralysis of the intrinsic muscles of the thumb. *JAMA*.vol.111,pp.612–3,1983.
- [5] E.Olave ,J.C. Prates ,M. Del Sol. Distribution patterns of the muscular branch of the median nerve in the thenar region. *J Anat*.vol.186(Pt 2),pp.441–6, 1995.
- [6] B.Elhassan ,S.P. Steinmann. Entrapment neuropathy of the ulnar nerve. *J Am Acad Orthop Surg*. Nov.vol. 15(11),pp.672-81,2007.
- [7] E.R.North ,J.W. Littler . Transferring the flexor superficialis tendon. Technical considerations in the prevention of proximal inter phalangeal joint disability.*J Hand Surg*.vol.5,pp.498–501. ,2011.
- [8] P.H.Kehr.,P. Liverneaux, P. David P. Green, N. Hotschkiss, C. Pederson, W. Scott. Wolfe (eds) (2005): Green's operative hand surgery, 6th edn. Low Median Nerve Palsy Part V chapter.vol.8,pp. 34 page 1093 ,2011.
- [9] S.Rahnamayan ,H.R. Tizhoosh ,M.M. Salama. Opposition-based differential evolution. *IEEE Trans Evol Comput*.vol.12,pp.64–79 ,2008.
- [10] M.C.Skie ,T. Parent ,K. Mudge ,Q. Dai . Kinematic analysis of six different insertion sites for FDS opponensplasty. *Hand*.vol.5,pp.,261–266,2010.
- [11] D.Jafari,A. Yeganeh ,H. Shariatzadeh . Assessment of results of opponensplasty in patients in shafa rehabilitation center between 1974-2005. *Razi J Med Sci*.vol.14,pp.75–80,2007.
- [12] P.Lemonas,T. Laing ,S. Ghorbanian ,M. Malahias ,R. Ragoowansi . Extensor indicis proprius opponensplasty-the burkhalter revisited. *J Hand Microsurg*..vol.4,pp.47–49,2012.
- [13] W.P.Cooney . Tendon transfer for median nerve palsy. *Hand Clin*,vol.4(2),pp.155e165,1988.
- [14] G.A.Anderson,V. Lee ,G.D. Sundararaj . Opponensplasty by extensor indicis and flexor digitorum superficialis tendon transfer. *J Hand Surg Br*.vol.17(6),pp.611e614,1992.
- [15] P.W.Brown . The time factor in surgery of upper-extremity peripheral nerve injury. *Clin Orthop Relat Res*.vol.68,pp.14e21,1970.