ORIGINAL ARTICLE

Burkhalter opponensplasty; role in isolated median nerve injury

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Abstract

Objective: To report the outcome of Burkhalter opponensplasty using Extensor Indicis Proprius with isolated traumatic low median nerve palsy.

Methods: The prospective study was conducted at the Mayo Hospital, Lahore, from June 2010 to June 2013, and comprised cases of Burkhalter opponensplasty using the Extensor Indicis Proprius to restore thumb opposition in isolated median nerve palsies. All patients had the condition for 16 to 20 months. The tendon was harvested just proximal to the extensor expansion and the insertion was to the distal attachment of abductor pollicis brevis.

Results: Of the 11 patients in the study, 6(54.5%) were females and 5(45.5%) were males, with overall ages ranging between 19 years and 51 years. There were no postoperative complications. Nine (82%) patients had excellent results, while the remaining 2(18%) had good result.

Conclusion: In patients with isolated traumatic median nerve palsy, Burkhalter opponensplasty yielded excellent and satisfactory results.

Keywords: Extensor Indicis Proprius, Median nerve, Tendon transfer, Opponensplasty, Hand injury.

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Introduction

Opposition of the thumb is the most important component of normal hand function. Action of several muscles are required in opposition of thumb, some responsible for positioning of thumb while other provide compressive forces for pinch. Function of median nerve is to mainly provide the positioning of thumb via abductor pollicis brevis, opponenspollicis and superficial head of flexor pollicis brevis. Injury to median nerve either above elbow or below elbow leads to the loss of ability to oppose the thumb to the fingers. There are a number of causes resulting in median nerve damage, including trauma, tumour, chronic compression, synovitis and neuropathy.

The first tendon transfer was performed in 1894 on a four-year-old child suffering from polio.[1,2] Indications of tendon transfer include traumatic injuries and peripheral nerve injury either awaiting nerve repair or following its failure.[3,4] Opponensplasty is a procedure that restores thumb opposition to the fingers to achieve fine prehension. Steindler in 1917 did opponensplasty for the first time.[5] A number of methods are used now-a-days for opponensplasty. Camitz in 1929 used palmarislongus for opponensplasty.[2,3,6] Short tendon of Abductor DigitiMinimi was used in 1963 and is known as Huber technique, used mainly in thumb hypoplasia.[7,8] In a variety of techniques, including the Royal-Thompson, Bunnell and Fritschi methods, Flexor Digitorum Superficialis is used mostly.[9-11] Burkhalter used Extensor Indicis Proprius for opponensplasty and reported in 1973 that 57 out of 65 patients had regained excellent thumb function.[12] In 1991, Anderson et al. showed good and excellent results in 35 out of 39 patients using Extensor Indicis Proprius.[13]

The purpose of the current study was to evaluate thumb function after opponensplasty using Extensor Indicis Proprius.

Material and Methods

The prospective study was conducted at the Department of Orthopaedic Surgery and Traumatology Unit-I, Mayo Hospital, Lahore, from June 2010 to June 2013, and comprised patients regardless of age and gender. All the patients had median nerve injury due to trauma and 16-20 months had passed after trauma, including road traffic accidents, self-harm and blunt trauma to forearm or wrist. The minimum follow-up was of 6 months.

The procedure was carried out in an operation theatre (OT) as a day case. The patient was placed in supine position. The entire procedure was done under Bier Block. Burkhalter operative technique was used. Initially, a 1cm longitudinal incision was made on the dorsum of hand over the index meta carpophalangeal joint (MCP) to harvest the Extensor Indicis Proprius which lies ulnar to

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Extensor Digitorum Communis slip to index. A second incision was made in the fourth compartment and Extensor Indicis Proprius was separated from other tendons and delivered. Then an incision was made on the ulnar side of the wrist. A subcutaneous tunnel was made from the incision to the fourth compartment on the dorsum of hand, and tendon was delivered and passed around on the ulnar side of the wrist. Another subcutaneous tunnel was made to the radio-lateral border of the MCP joint of thumb. Tendon was then passed through the tunnel and weaved through the base of abductor pollicis brevis tendon using Pulvertaft technique and was secured with proline 4/0 round body. It was important that the tension was kept be tight with the thumb in full palmar abduction with the wrist in neutral position. Patient was given cast for four weeks postoperatively and then advised physiotherapy.

For the response each patient was examined two weeks after the surgery, and then followed up monthly for six months. Treatment efficacy was assessed at final follow-upusing Sundararaj-Mani criteria.[14] As such, the outcome was considered Excellent when opposition to the ring or little finger tip with the interphalangeal joint of the thumb extended; Good when opposition to the index or middle finger tip with the interphalangeal joint of the thumb extended; Fair when the interphalangeal joint of the thumb flexes for opposition; and Poor when there was no opposition.

Testing of opposition was performed with the wrist in 10° of extension to eliminate any element of wrist tenodesis that could aid opposition.

Results

Of the 11 patients in the study, 6(54.5%) were females and 5(45.5%) were males, with overall ages ranging between 19 years and 51 years. Functional opposition was initially obtained in 6-8 weeks of postoperative physiotherapy, but continued to improve over some time before hitting a plateau. At final follow-up, 9(82%) patients had Excellent results, while the remaining 2(18%) had Good result. There were no postoperative complications. Six (54.5%) patients experienced pain after the procedure which was cured with analgesics during the hospital stay and oral non-steroidal anti-inflammatory drugs (NSAIDs)at the time of discharge. Pain was relieved in a few days.

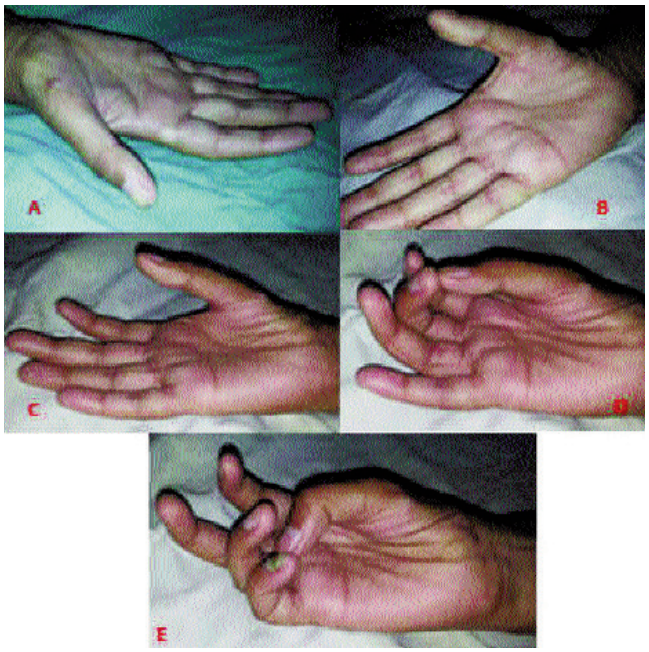

Figure: A: Pre-op picture of 46-year-oldfemale with median nerve injury and unable to abduct the thumb. B and C: 4 weeks post-op picture showing abduction. D and E: 6 months post-op showing full opposition of thumb.

Discussion

Though the current study had its weakness like not assessing the power of opposition and the working with a

Table: Patient characteristic.

Sr. No.	Age	Sex	Mode of Trauma	Time passed since injury
i.	35 years	Male	Road Traffic Injury at elbow	16 months
ii.	46 years	Female	Knife injury at wrist	18 months
iii.	29 years	Female	Road traffic injury at forearm	16 months
iv.	48 years	Male	Machine injury	17 months
v.	26 years	Male	Road traffic accident	19 months
vi.	44 years	Female	Road traffic accident	16 months
vii.	31 years	Female	Self-harm	20 months
viii.	19 years	Female	Glass injury	19 months
ix.	22 years	Male	Toka injury	16 months
x.	51 years	Male	Assault	19 months
xi.	26 years	Female	Fire arm injury wrist	20 months

small sample, it had two strengths: uniform aetiology and technique having been performed by a single surgeon. As for the power of opposition, the intact ulnar nerve, which in some patients anomalously innervates the ulnar muscle, means many patients with traumatic median nerve injury do not lose opposition, as noted in literature.[15]

One study used a modified Bunnell opponensplasty on 86 patients with leprous neuritis resulting in paralysis of intrinsic muscles of hand. It reported 18 Good results, 63 Fair, and 5 Poor results.[16] A series of 24 cases showed 15 patients with Excellent results, 6 with Good and 3 with Fair result.[14] A case series of 23 patients reported 13 Excellent results, 6 Good, 3 Fair, and 1 Poor. Another grading was used to assess the power of pinch which was Good in14 hands, Fair in 7 hands and Poor in 2.[17]

We applied Burkhalter opponensplasty using Extensor Indicis Proprius, and Excellent and Good results were obtained. However, we did not assess the degree of abduction, opposition and power of pinch.

The basic physics underlying the system needs to be assessed in order to optimise the force exerted by a pulley system to increase the function of tendon. The length of the lever and the angle at the fulcrum are the two variable quantities upon which the torque which is produced by the motor is dependent. Also when the angle of the fulcrum is closer to a straight line, less force is required to overcome friction at pulley. In opponensplasty using Flexor Figitorum Superficialis, tendon performs more work to produce the same force at its insertion compared to Extensor Indicis Proprius because of the fact that Flexor Digitorum Superficialishas smaller angle and potentially greater distance than Extensor Indicis Proprius having larger angle and shorter distance. Maximum abduction is seen in Extensor Indicis Proprius because Extensor Indicis Proprius has direct line of action to pisiform than that of Flexor Digitorum Superficialis.[18,19] Hence, the circumduction achieved with Extensor Indicis Proprius is greater than Flexor Digitorum Superficialis.

Burkhalter Opponensplasty shows good functional results with minimal donor-site morbidity and limited increase to index extension. Not only is Extensor Indicis Proprius largely expendable, it is of sufficient length and line of pull provides a favourable torque and superior mechanical advantage.

Conclusion

Burkhalter opponensplasty using Extensor Indicis Proprius gave excellent results in median nerve injury.

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