

## Abductor Digiti Minimi Muscle Flap for Coverage the Median Nerve in Recurrent Carpal Tunnel Syndrome

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### ABSTRACT

**Introduction:** Median nerve is the commonest peripheral nerve to be entrapped under the transverse carpal ligament necessitating Surgical release. Perineural fibrosis considered the commonest pathological cause for the recurrent CTS. The use of local muscle flaps to cover the median nerve in recurrent CTS acts as a mechanical barrier to prevent fibrous adhesion around the nerve because of its rich blood supply.

**Patients and Methods:** 16 female patients had recurrent carpal tunnel syndrome were operated once before for decompression of the median nerve showing recurrence of symptoms. Abductor digiti minimi muscle flap used to cover median nerve in all patients.

**Results:** 16 female patients were included in this study, their age ranged between 25 and 47 years. The involved hand was the dominant in all cases. Accurate diagnosis was done either by subjective and objective ways before surgical consideration. There were no abnormal events during the operation. There was a mild post operative edema in 5 cases. This edema resolved by limb elevation for 3 days. Topical corticosteroids and bandages were used for 3 months postoperatively to soften the scars. The follow-up period continued for 6 months. During this period, the subjective expression about nocturnal pain, tingling, numbness and paraesthesia was absent. 4 cases complained of tender scars for about 3 months which improved at the end of the 6 months follow-up period. The sensory and motor median nerve terminal latency were done at the end of the follow-up period and showed marked improvement to nearly normal levels 4.3 to 4.8ms. opposition grip was examined as an elective test for median nerve motor examination which was nicely good at post operative follow-up.

**Conclusion:** Abductor digiti minimi muscle flap turning it over the median nerve after its surgical decompression is a good solution for the recurrent and severe cases of CTS.

**Key Words:** *Abductor digiti minimi – Muscle flap – Median nerve – Recurrent – Carpal tunnel syndrome.*

### INTRODUCTION

The commonest peripheral nerve to be entrapped under the transverse carpal ligament is the median nerve. What is called carpal tunnel syn-

drome (CTS). It affects up to 10% of the general population. Surgical decompression is successful in returning sensation, abolishing numbness, paraesthesia and improving manual dexterity. However, 14-32% of patients may have persistent symptoms [1].

There are many causes for the recurrent symptoms after surgical decompression as: Incomplete release of the transverse carpal ligament, fibrous proliferation and intrinsic fibrosis between nerve fascicles [2]. The perineural fibrosis considered the commonest pathological cause for the recurrent CTS [3].

Re-exploration is the method of choice to those cases of recurrent CTS. Adequate neurolysis is the key step of this operation. But the results are not promising for complete relief of symptoms [4]. The fear from recurrent fibrosis for the second postoperative time pushed surgeons to seek for suitable procedures to overcome such fibrosis. Fat grafts or flaps, silicone sheath, vein graft wrapping and muscle flaps, all are procedures used to prevent recurrent fibrosis around the nerve [1,5]. Decreased blood flow to the median nerve secondary to transverse carpal ligament compression, produces a circle of nerve damage. Edema of the nerve is the first pathologic change. Inflammatory mediators release leads to inflammation that inevitably leads to a variable degree of nerve fibrosis [6,7,8].

The use of local muscle flaps to cover the median nerve in recurrent CTS has many advantages; it acts as a mechanical barrier to prevent fibrous adhesion around the nerve because of its rich blood supply. Good nerve vascularization prevents edema and prevents inflammatory mediators' release. So prevents massive nerve fibrosis [9,10].

This study was designed to evaluate the outcome of the use of local abductor digiti minimi muscle flap as an option to treat recurrent CTS.

### PATIENTS AND METHODS

16 female patients were admitted to Burn and Plastic Surgery Centre and neurosurgery department, Mansoura University between January 2012 to September 2015. Patients were within the age of 25-47 years. All of them had recurrent carpal tunnel syndrome. 11 of them were operated once before for decompression of the median nerve. The other 5 patients had previous 2 operations for carpal tunnel release. The involved hand was the dominant in all patients. There was a conservative period of 6 months before our surgical interference. There were subjective and objective evaluations to all patients. The subjective one included: Pain, paraesthesia, numbness and muscle wasting. While the objective one included nerve conduction studies (sensory and motor) to confirm the clinical diagnosis, Tinel's sign and Phalen test. Well detailed informations were discussed with patients including surgical details, the possible donor site morbidity and the other complications related to the surgical procedure.

### Surgical procedure:

All operations were done under general anesthesia. A tourniquet was used after adequate maintained compression from the hand to above the elbow for 5 minutes. The old scar of previous operation(s) was opened to expose the median nerve. Meticulous fascicular neurolysis of the median nerve under magnification was the next step.

A separate incision on the ulnar side of the palm was done to elevate the abductor digiti minimi muscle. Dissection of this muscle was carefully done to avoid injury of ulnar nerve branches. Abductor digiti minimi muscle elevation began from distal to proximal taking care not to injure its blood supply. Subcutaneous tunnel between the two incisions was done; through it the muscle was turned to cover the nerve. Wound closure was the final surgical step. The hand was immobilized for 7 days (see Fig. 1). Patients were instructed to use their hands actively from the first post operative day. Six months follow-up was done and subjective evaluation was the main parameter to evaluate the results. Patients were asked about symptoms relief or persistence. Nerve conduction velocity was done 6 months post operatively to compare it with that previously done before the operation.



Fig. (1): (A) Incision of previous release. (B) Exploration of median nerve. (C) Incision for abductor digiti minimi elevation. (D) Muscle flap turned to cover median nerve. (E) Post operative slap.

## RESULTS

16 female patients were included in this study. Their age ranged between 25 and 47 years. The involved hand was the dominant in all cases. The last operation before this interference was at least 6 months. Accurate diagnosis was done by subjective and objective ways before surgical consideration. There were no abnormal events during the operation such as excessive bleeding or iatrogenic injury to the nerve. Dissection around the muscular pedicle passed well. There was a smooth post operative period. There was no bleeding, seromas, hematoma, severe edema or agonizing pain. There was a mild post operative edema in 5 cases this edema resolved by limb elevation for 3 days. Topical corticosteroids and bandages were used for 3 months postoperatively to soften the scars. The follow-up period continued for 6 months. During this period, the subjective expression about nocturnal pain, tingling, numbness and paraesthesia was absent. 4 cases complained of tender scars for about 3 months which improved at the end of the 6 months follow-up period. The sensory and motor median nerve terminal latency were done at the end of the follow-up period and showed marked improvement to nearly normal levels (4.3 to 4.8 milli-second). Opposition grip was examined as an elective test for median nerve motor examination which was nicely good at post operative follow-up.

## DISCUSSION

Recurrent carpal tunnel syndrome is a major complication of transverse carpal ligament release [11]. It may be so severe enough to affect patient's life and daily activities. There are many reported causes of nerve recompression after surgical release. Fibrous adhesion is responsible for the recurrent symptoms. Haematoma and infection are contributing factors for fibrous proliferation. Prolonged post operative immobilization and lack of active exercise help in nerve adhesion. Aggressive mechanical stress may lead to development of edema and focal nerve demyelination [12]. The more surgical trials to decompress the nerve, the more the fibrosis and the more segmental nerve devascularization [13]. Enhancement of the nerve vascularity is a goal to improve the nerve function after surgical decompression. Muscles are rich in blood supply. So, their use to cover the nerve helps in its revascularization [13]. The commonest muscles used as flaps to cover the nerve are Palmaris brevis, abductor digiti minimi and pronator quadrates [22,23].

Fusetti and his colleagues [14] used the hypothenar fat pad flap as a mechanical barrier between the skin and subcutaneous tissue and the nerve to prevent recompression of the nerve. This technique leaves an obvious mass on the upper central palm.

Free omental flap had been described as a surgical alternative for the recurrent cases of carpal tunnel syndrome [10]. However, it is a major operation and leaves an abdominal donor site morbidity.

There are many other flaps described for the same target as, free groin, free lateral arm, axial posterior interosseous, axial radial forearm and free lateral thigh flap [15,16].

In our opinion, there many reasons to prevent use of such flaps. They are lengthy operations, technically difficult and their donor site morbidity could not be neglected. Vein wrapping with autogenous vein graft also used to prevent the nerve from adhesion with the surrounding tissues [17-20]. Recurrence may occur because the vein graft itself may be the initiator of fibrous proliferation despite of its mechanical barrier effect [21].

The use of silicon to act as an insulator between the nerve and the surrounding tissues is an effective procedure. However, it carries the risk of foreign body reaction, skin complications and long period of potential cavity formation.

In this work, the abductor digiti minimi muscle was used to pad the nerve. The key step for success of this operation is the meticulous muscular dissection taking care to avoid injury of the vascular pedicle.

Preoperative nerve conduction study was compared with that done 6 months post operatively. This fixed study reflected the excellent improvement. Actually, nerve conduction may be very nice but the patient still expressing symptoms. So that, in this study, patient's satisfaction was the guide to our successful results. Many investigators found a quantitative relation between increased endoneural fluid pressure and decreased nerve blood flow; increased endoneural fluid pressure should exacerbate the neuropathy by diminishing the local blood flow [6,8,12]. The increased blood flow from the turnover muscle flap gives an explanation for the good results of this study.

### *In Conclusion:*

Abductor digiti minimi muscle flap turning it over the median nerve after its surgical decompression is a good solution for the recurrent and severe cases. Meticulous dissection of the muscle and

preserving its blood supply is the key for success. The only drawback of this maneuver is the post operative tender scarring. This complication could be managed by topical application of corticosteroids and pressure bandages for 3 months. Keep the patient's complaint as your first guide about the success of your technique regardless any other elective parameter.

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