

## Functional Outcomes of 300 Carpal Tunnel Release: 1.5 cm Longitudinal Mini-incision

### Abstract

**Objective:** There is an opportunity for median nerve decompression by open surgery in carpal tunnel syndrome which is the most common surgical procedure in neurosurgical practice. The aim of this study is to evaluate the long-term outcomes of carpal tunnel release with 1.5 cm longitudinal mini-incision technique with regarding the effectiveness and safety. **Methods:** For this prospective study, 300 hands for 188 patients with advanced carpal tunnel syndrome who had indication for neurolysis underwent carpal tunnel release through a 1.5 cm longitudinal mini-incision between March 2011 and 2015. There were 132 (70%) females and 56 (30%) males with a mean age of  $40 \pm 29.5$  years (ranging from 24 to 73) and female to male: About 256.178 operations were performed for the right hand and 122 for the left hand. Preoperatively, all patients were evaluated with clinical examination and nerve conduction studies. The clinical effects of the patients assessed with the Global Symptom Score (GSS) and Visual Analog Patient Satisfaction Scale. **Results:** The mean follow-up period was  $18.6 \pm 9.3$  months (12–30 months). Postoperatively, 2% (six hands) complained of residual mild pain with tenderness of scar and only 1% (three hands) complained of median nerve damage (neuropraxy) with tingling and numbness but was temporary which improved after 1 week. Five patients (seven hands) loosed strength of their wrists, but muscle force of abductor pollicis brevis reinforced after 1 month. There is no evidence of local infection, stiffness, loss of some wrist strength, or recurrence of the disorder. Postoperative GSS scoring obviously improved than preoperative ( $P < 0.002$ ). There is no patient who underwent reoperation. The mean time recovery appeared almost 2 weeks. **Conclusion:** 1.5 cm longitudinal mini-incision method in carpal tunnel syndrome decompression showed satisfactory pain relief, wound healing, and nontender scar with good functional outcomes. The technique was performed safely without major complication.

**Keywords:** Carpal tunnel syndrome, mini-incision, outcome

### Introduction

Carpal tunnel syndrome (CTS) is the most frequently encountered entrapment neuropathy.<sup>[1]</sup> The etiology of CTS is largely structural, genetic, and biological, with environmental and occupational factors.<sup>[2]</sup> The main symptom of CTS is intermittent numbness of the thumb, index, long fingers, and radial half of the ring finger.<sup>[3]</sup> Because of CTS is one of the most frequent conditions that lead to work disability; therefore, many numbers of conservative and surgical treatments have been performed. Patients who had severe, advanced CTS who are unresponsive to conservative management candidate faced to open surgeries with different approach. After comparing all techniques, there are some advantages and disadvantages for all.<sup>[4,5]</sup> The important goals for patients on each surgery treatment are relief of

symptoms, earlier rehabilitation, cosmetic satisfaction, and cost-effectiveness of procedure. Many of those approaches on carpal tunnel release reach the patients to these goals.<sup>[6,7]</sup> For this purpose, our study performed carpal tunnel decompression using 1.5 cm longitudinal mini-incision procedure. The outcomes obtained to introduce the advantages and disadvantages of this technique. Various limited skin incisions and endoscopic techniques have been proposed as a minimally invasive and effective for preventing of the excessive scar formation and the achieving of a better cosmetic results.<sup>[8]</sup> Physical therapy following surgery has been done which is very helpful to restore wrist strength.

### Methods

For this prospective, randomized clinical study, carpal tunnel release was performed on 300 hands (188 patients), between

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March 2011 and 2015. Each patient was diagnosed to be having carpal tunnel compression neuropathy based on clinical symptoms, signs, and nerve conduction studies. Initially, conservative treatment, including rest, bracing, and nonsteroidal anti-inflammatory medications, was administered. Patients who diagnosing for CTS within 3 years, being in good general health, having very slow nerve conduction results but good muscle strength, and finally having symptoms that are worse at night than during the day included in this study. Those patients who having very severe symptoms such as continual numbness, muscle weakness and wasting, and very poor nerve conduction results with other upper extremity problems and chronic underlying medical condition were excluded from this study. Because all patients faced to full criterion for surgical neurolysis, the ethical approval was not required in accordance with the policy of our institution. Patients were received surgical treatment using 1.5 cm longitudinal mini-incision procedure. A total of 300 hands for 188 patients with severe, advanced CTS underwent carpal tunnel release through a 1.5 cm longitudinal mini-incision between March 2011 and 2015. There were 132 (70%) females and 56 (30%) males with a mean age of  $40 \pm 29.5$  years (ranging from 24 to 73) and female to male: 2.36. A total of 178 operations were performed for the right hand and 122 for the left hand. The operations were done in two experimental university hospitals (Emam Reza Hospital and Taleghani Hospital). Before surgery, all patients were evaluated for physical examination and electromyography (EMG). Persistent night pain and numbness associated with EMG study which showed moderate and severe CTS in all patients. The pain status of the patients was pre- and post-operatively assessed with the Global Symptom Score (GSS).<sup>[9]</sup> Clinical results and patients' satisfaction were evaluated with the Visual Analog Patient Satisfaction Scale (VAPSS) postoperatively.<sup>[10,11]</sup>

### Surgery procedure

Before surgery, the affected hand, wrist, and forearm were cleaned with povidone-iodine solution. The area to be operated was covered with a sterile compress. Pneumatic tourniquet was used. An ideal hand position is obtained with a wrist extension of 30 degrees, the handheld in place by a cushion placed under the wrist joint and with the thumb abducted. Local anesthesia, using 2% xylocain 5 cc and isotonic SF 5 cc as performed. In our study, the mini-open carpal tunnel release is a relatively new technique that consists of a longitudinal incision that varies from 1.5 cm placed in the radial border of the ring finger line which is beginning about 2 cm to the distal flexure wrist crease [Figure 1a]. The incised skin was retracted with the help of a miniretractor and subcutaneous fat tissue was dissected laterally. A small opening done in the carpal ligament with a fine scissors or surgical blade and a dissector was introduced beneath the carpal ligament, and then, the ligament was cut with surgical blade. After



**Figure 1:** It showed a longitudinal incision that varies from 1.5 cm placed in the radial border of the ring finger line which is beginning about 2 cm to the distal flexure wrist crease (flexor carpi radialis, flexor carpi ulnaris, kaplan cardinal line, radial side ring finger line, red line is incisional site) (a) The incised skin was retracted with the help of a miniretractor and subcutaneous fat tissue was dissected laterally (b) The ligament was cut with surgical blade (c) The skin was sutured with 4/0 sutures mattress

the homeostasis, the skin was sutured with 4/0 sutures mattress [Figure 1].

A postoperative elastic bandage was applied to all patients, allowing early active motion. The stitches were removed after 7 days. Patients underwent physical therapy after surgery to restore wrist strength. The mean of operation duration time was  $12 \pm 3.5$  min (ranging between 8 and 15 min). The mean hospital stay was 2.5 h (ranging between 3 and 5 h). All patients were evaluated the clinical effects using the GSS that in which points are given on a 1–10 scale for pain, numbness, paresthesias, weakness, and nocturnal awakening, and a Visual Analog Patient Satisfaction Scale described by Kilincer and Zileli evaluated the patients for cosmetic results (0–3), return to daily activities (0–3), palmar tenderness (0–3), and scar sensitivity (0–3).<sup>[6,10,11]</sup>

### Results

In this group, 300 carpal tunnel release operations were done on 188 patients using 1.5 cm longitudinal mini-incision. During surgery procedure, there is no evidence of local hematoma or nerve injury. There are no procedure-related complications such as skin infection, tenderness of scar, excessive scar formation, and stiffness during the follow-up period. All symptoms have been relieved immediately after surgery and full recovery after surgery took average 2 months for all patients. The mean preoperative GSS score was  $7 \pm 2.5$  which decreased to  $1.3 \pm 0.34$  postoperatively ( $P < 0.002$ ). Postoperatively, the mean VAPSS score has been improved to  $8.3 \pm 1.5$  during the follow-up period. In this study, six hands complained of residual mild pain with tenderness of scar and three hands had temporary median nerve neuropraxy

which improved 2 weeks after surgery and muscle force of abductor pollicis brevis reinforced. We did not have incomplete release of the ligament and extensive scarring in site of incision [Table 1]. Therefore, there are no reasons for procedure failure. In our study, no patient required repeat operations. Five patients (seven hands) loosed strength of their wrist because the carpal ligament was cut completely. These patients underwent physical therapy after surgery and restore their wrist strength after 1 month. There is no patient underwent reoperation because there is no recurrence of symptoms. The mean time recovery appeared to be fast and generally stay out of work for at least 2 weeks return to daily activities and all patients recover completely.

## Discussion

The CTS is the most common compressive neuropathy in clinical practice. It is caused by the compression of the median nerve at the wrist, more precisely at the carpal tunnel. It effects mainly middle-aged population and mostly females.<sup>[12-16]</sup> In our study, CTS was more frequent in women (female/male: 1.47) and in the right hand with a mean age of  $40 \pm 29.5$  years. The general clinical presentation is of painful paresthesias and/or burning pain in the lateral half of the hand, predominantly in the three first fingers. Typically, the paresthesias are predominantly nocturnal. The patients may also complain of anesthesia, loss of dexterity, weakness, and in more advanced cases loss of motor function and thenar atrophy.<sup>[17,18]</sup> Surgical treatment of CTS consists of the division of the transverse carpal ligament which reduces the pressure on the median nerve by increasing the space in the carpal tunnel.<sup>[14]</sup> Many surgical techniques have been used to treat CTS such as the classical open carpal tunnel release technique, the “mini-open” or limited visualization techniques, and the endoscopic carpal tunnel release methods. Other studies reported that endoscopic release results in less pain in the early postoperative period and a quicker return to work and less wound complications but showed a higher risk of median nerve injury.<sup>[19-21]</sup> Mini-incision release

is a less invasive technique, lower rate of complications, shorter operative time, and more cost-effective. Although each technique has advantages and disadvantages. A few studies reported that the mini-incision release technique decreases the pathologic swelling of the median nerve and scar formation at the inlet of the carpal tunnel.<sup>[22,23]</sup> Likewise, several publications on endoscopic release have also reported possibly higher cost and higher risk of nerve injury.<sup>[24]</sup> The advantages and disadvantages of the above techniques are a matter of debate, but their common goal is to release the median nerve by completely transecting the flexor retinaculum.

In previous studies, some authors have worked on multiple limited mini-open incision approaches on CTS management to decrease the postoperative morbidity.<sup>[25-29]</sup> Mini-open procedures have been introduced in some patterns such as a longitudinal wrist incision, minitransverse wrist incision, midpalmar accurate incision, palmar incision, and double-incision technique. However, those techniques are safe and effective as reported by authors, but it has some complications.<sup>[30]</sup> Those surgical techniques are performed under direct vision, early complications including incomplete release of carpal ligament, artery and nerve injuries, and local hematoma are rare in mini-open median nerve release.<sup>[30]</sup> Furthermore, hypertrophic scar formation, scar tenderness, pillar pain, loss of grip strength, and sympathetic dystrophy led to delay of returning to daily activities or work and emotional distress in different open surgeries.<sup>[31]</sup> In this study, we aimed to analyze the outcome of patients operated for CTS using 1.5 cm longitudinal approach. We reported that the early and late complications including pain, palmer tenderness, scar sensitivity, stiffness, and limited strengthened and cosmetic problems became less. In this study, the mean VAPSS score was 1.8 when the patients were evaluated for cosmetic results, return to daily routine activities, palmer tenderness, and scar sensitivity. A study from Iraq worked on 228 hands with CTS using 1.5 cm palmer skin incision technique for carpal tunnel release. Their results showed better VAPSS score and less complications than other standard techniques and

**Table 1: Pre- and post-operation scores of pain, numbness, paresthesias, weakness and nocturnal awakening, cosmetic results, return to daily activities, palmar tenderness, and scar sensitivity of the patients operated with 1.5 cm longitudinal mini-incision in 300 hands based on Global Symptom Score and visual analog patient satisfaction scale**

Symptoms	GSS				VAGUSS			
	Pain (0-10)	Numbness (0-10)	Paresthesias (0-10)	Weakness and nocturnal awakening (0-10)	Palmar tenderness (0-3)	Scar sensitivity (0-3)	Return to daily activities (0-3)	Cosmetic results (0-3)
Preoperative symptoms (mean)	8.4±1.4	9.0±0.8	9.1±0.5	8.0±1.8				
Postoperative symptoms (mean)	1.2±0.6	1.0±0.8	0.8±0.5	1.1±0.7	2.4±0.4	2.35±0.3	3	3
Preoperative total mean			8.3±1.5			10±1.8		
Postoperative total mean			1.3±0.34					
<i>P</i>	<0.002	<0.002	<0.001	<0.003				
Total <i>P</i>			<0.002					

In this study, we aimed to analyze the outcomes of patients who underwent 1.5 cm longitudinal approach. GSS – Global Symptom Score; VAGUSS – Visual analog patient satisfaction scale

the mean VAPSS score was 8.7 postoperatively.<sup>[32]</sup> In our group, all patients have complete remission of symptoms which is near the results of the literatures those used mini-open incision approaches.<sup>[16,33,34]</sup> However, we did not experience any artery, nerve, or tendon injury during using 1.5 cm longitudinal mini-incision technique which was seen in some previous studies using mini-open surgeries.<sup>[15]</sup> Other study performed to total 93 wrists of 79 patients with CTS and compare minilongitudinal and transverse incision approaches. They reported that longitudinal incision is more effective to relief symptoms and better functional outcomes than transverse incision and there was less scar formation with transverse incision.<sup>[35]</sup> Other study operated 143 carpal tunnel releasing procedures using a limited uniskin incision. There was no complication such as bleeding or nerve injury in the operated patients during average 13-month follow-up period. The mean visual analog scale score was 7.9 preoperatively and 2.8 postoperatively and the mean VAPSS score was 8.1. These results are really similar to our results.<sup>[16]</sup>

## Conclusion

1.5 cm longitudinal mini-incision is a valuable and bearable procedure because it is minimally invasive with shorter operative time. The early and late complications including bleeding, pain, palmer tenderness, scar sensitivity, stiffness, and limited strengthened and cosmetic problems became less. Furthermore, return to daily routine activities was shorter with good patient satisfaction and low need recurrent therapy and rehabilitation costs. However, this approach requires more experience for surgeon to do the best.

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## Conflicts of interest

There are no conflicts of interest.

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