The Functional Outcome of Mini Carpal Tunnel Release

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Abstract

Introduction Carpal tunnel syndrome (CTS) is one of the most common compression neuropathies in the upper limbs and requires surgery if conservative treatment fails. This study assessed the functional outcome of vertical mini carpal tunnel release (CTR) at distal wrist crease.

Objective To evaluate prospectively the safety, effectiveness, and reproducibility of vertical mini-open blind technique for CTR.

Methods In total, 36 patients (40 hands) aged between 22 and 71 years with mild to moderate CTS based on nerve conduction studies were selected and screened based on inclusion and exclusion criteria. The surgery was done with vertical mini-incision CTR at distal wrist crease. The preoperative and postoperative clinical outcomes and grip strength were evaluated with Levine–Katz questionnaire and JAMAR Hydraulic Hand Dynamometer with 3 months follow-up after surgery.

Results The mean score for both symptom severity and functional status reduced and mean handgrip strength improved 29.5% at 3 months after surgery. All the patients were satisfied with the cosmetic outcome of the scar. Three patients had scar tenderness. All patients were able to return to work within 4 weeks after surgery, except one who developed chronic regional pain syndrome.

Conclusion The vertical mini-open blind technique has been shown to be safe and easily reproducible and has short recovery period. All patients return to good functional status 3 months postoperative.

Keywords

- carpal tunnel syndrome
- mini carpal tunnel release
- handgrip strength
- Levine–Katz questionnaire

Introduction

Carpal tunnel syndrome (CTS) is one of the most common cause of neuropathy in the upper limbs, and carpal tunnel release (CTR) is indicated in the presence of failure of nonoperative management.¹ Various methods have been described for releasing this tunnel ever since Dr. Phalen made surgery an effective prevalent treatment in 1950.² The open release of transverse carpal ligament (TCL) with a longitudinal incision across the wrist to palmar aspect of the hand showed complications of painful and hypertrophic scars, delayed healing and cosmetic complaints.^{3,4}

To reduce its complications, multiple mini-invasive surgical approaches have been proposed. Endoscopic procedures have been performed widely to decrease postoperative morbidity and to accelerate patient's return to his/her daily life. The endoscopic procedure has complications including vascular, nerve, and tendon, and the incomplete release of the TCL.^{5,6}

Alternatively, some investigators used a short palmar incision, either limited open or mini-open, and performed CTR in a blind manner.³ A limited open method^{1,3,7} is performed with short longitudinal incision (range of length: 3–4 cm) that allows direct visualization of the whole TCL.

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Meanwhile, Avci and Sayli⁸ described mini-open blind technique through a short longitudinal palmar incision that visualize the distal edge of TCL; then a blind division of the retinaculum performed distal to proximal with a special knife that shows good results with few complications.

In this study, we performed a vertical mini-open (length: 1 cm) CTR at distal wrist crease. This incision allowed us to visualize directly the proximal part of the TCL, which then was divided blindly with the aid of scalpel blade and Macdonald retractor.

The tools used to assess the functional outcome were the Symptom Severity Scale (SSS) and Functional Status Scale (FSS) questionnaire that has been validated by Levine and Katz.⁹ Besides, we also assessed the handgrip strength using JAMAR Hydraulic Hand Dynamometer (Lafayette Instrument, Sammons Preston Rolyan, Chicago, Illinois, United States) to have an objective evaluation.

The rationale behind this study is to propose that the vertical mini-open CTR at distal wrist crease is a safe, easily reproducible means of decompressing the median nerve at the level of carpal tunnel and can be done practically with limited facilities.

Patients and Methods

This observational prospective study was conducted on 40 hands among 36 patients reporting to our institution with complaints suggestive of CTS after obtaining approval from hospital ethics committee. Upon exclusion of established secondary cause such as underlying connective tissue disorders, previous history of CTR and of carpal bone or wrist fractures, and pregnancy (physiological), the patients were sent for nerve conduction study to confirm the clinical suspicion. The study period was from September 2012 to March 2013. Full written informed consent was obtained before any enrolment procedures. It will be made clear from the outset that refusal to participate will not jeopardize subsequent conservative treatment.

All surgical procedures were performed solely by the principal investigator to avoid variability in the surgical method and difference in result. The SSS and FSS scores were assessed using Levine-Katz⁹ questionnaires, and the handgrip strength was measured by using JAMAR Hydraulic Hand Dynamometer¹⁰ 3 months pre- and postoperatively. The procedure was performed as day care under local mixture of short- and long-acting anesthetic agents (5mL 2% lignocaine + 5mL 0.5% marcain with adrenaline). Tourniquet was not applied to reduce the discomfort of tourniquet pain. A vertical incision measuring 1 cm was made distal to the distal wrist crease along the third web space (axis of the middle/ring finger; ►Fig. 1). Soft tissue was dissected with blunt edge scissors, and the TCL was identified (►Fig. 2). Following that, a slit made with no. 15 blade on the TCL and the median nerve directly was visualized (►Fig. 3). Then the curved part of the McDonald dissector was properly placed and stabilized into the tunnel where the base functioned as a platform to protect the median nerve prior to complete division of TCL (►Fig. 4). Adequacy of release was confirmed by mobility of the

Fig. 1 Image shows accurate location of mini-open vertical incision at the distal wrist crease. White dot A is the junction of the middle/ring finger axis and a line at distal wrist crease. White dot B is the distal end of the incision. The distance between point A and B is 1 cm. SPA, Superficial palmar arch; PL, palmaris longus; FCR, flexor carpi radialis.

McDonald dissector without resistance within the tunnel and proper visualization of the median nerve upon retraction (►Fig. 5). Neurolysis was not performed. Wound was closed with Daiflon 5-0 suture using vertical mattress method and dressed with pressure dressing.

Following the CTR, all patients were prescribed with suitable analgesia, and wound was seen on day 3 postoperatively and sutures were removed on day 10. Postoperative hand and wrist range of motion was commenced as appropriate. Patients returned for a functional assessment 3 months after surgery based on the similar questionnaire and handgrip strength measurement. Patients were also interviewed regarding their satisfaction on the outcome of the procedure, scar appearance, and return-to-work ability to determine the qualitative assessment. The collected data were analyzed with Statistical Package for Social Science (version 18.0, SPSS Inc.) and analyzed with one-way analysis of variance and paired *t*-tests.

Results

Among the 36 patients, four cases had bilateral involvement, 26 cases were on right hand and another 14 on the left hand.

The evaluation of SSS score showed marked reduction of mean preoperative SSS of 33.60 to mean postoperative SSS of 15.25, which signifies that the surgery was successful in

Fig. 2 The appearance of the transverse carpal ligament (white arrow) upon dissection of palmar aponeurosis and soft tissue.

reducing the patients' symptoms. Meanwhile, the mean for pre- and postoperative FSS score was 26.65 and 11.25, respectively. Thus, the FSS showed marked reduction statistically, which signifies that the surgery was successful in improving the hand function of the patients. Assessment of the handgrip strength showed an increase from 28 to 31% in 3 months after mini CTR.

—**Table 1** shows that the significant (two-tailed) value is 0.000 for all variables that were evaluated in this study. This value is less than 0.05, which showed statistical significance SSS, FSS, and handgrip strength following mini CTR.

Fig. 3 Dissection of the transverse carpal ligament until the appearance of median nerve (white arrow).

Fig. 4 The introduction of McDonald dissector (white arrow) into the tunnel where the base protects the median nerve prior to the transverse carpal ligament release.

Discussion

CTS is one of the most common pressure neuropathies in the upper limbs and needs CTR surgery for treatment. Different surgery techniques may be used.

Comparison study of open and endoscopic surgeries by Trumble et al¹¹ showed satisfaction level, symptom, and function improvement in the third month after surgery among the endoscopic method. Scar tenderness and return-to-work duration were also greater in the open surgery group.¹¹

Fig. 5 Complete release of the transverse carpal ligament exposes the median nerve (white arrow) underneath.

Table 1 Paired *t*-test comparison between the pre- and post operative at 3 months for SSS, FSS, and GS

		Paired differences					t	Df	Significance (two-tailed)
		Mean	Standard deviation	Standard error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	SSS preop and SSS postop	18.350	6.685	1.057	16.212	20.488	17.360	39	0
Pair 2	FSS preop and FSS postop	15.400	5.387	0.852	13.677	17.123	18.082	39	0
Pair 3	GS preop and GS postop	−20.200	7.776	1.230	−22.687	−17.713	−16.429	39	0

Abbreviations: Df, degrees of freedom; FSS, functional status scale; GS, grip strength; SSS, symptom severity scale.

In the meta-analysis of various studies, the two techniques of open and endoscopic surgery were compared with each other. In the endoscopic group, there was less pain at the incision site, better improvement in grasping objects with two finger during the 3 months, and three times greater likelihood of nerve damage than the open surgery group.¹²

In another study, comparison of two techniques, midpalmar mini-incision and open surgery, showed the time to return to work was 20 days earlier in the midpalmar mini-incision technique than the open surgery.¹³

In 2011, Aslani et al¹ compared the results of three methods: regular open, midpalmar mini-incision, and endoscopic. The endoscopic and mini-incision techniques of CTR have better early satisfaction rates compared with regular open incision, but no difference is seen between the two groups after 4 months.¹

In this study, the 36 patients who underwent the vertical mini CTR at distal wrist crease showed satisfaction in terms of symptoms and function improvement over 3 months as evidenced by reduction of SSS and FSS score. Besides that, there were also were very happy with the small surgical incision, which turned out to be painless and hardly visible after 3 months. All of them were able to return to their normal work and activity within the first 4 weeks, except one elderly female patient who developed chronic regional pain syndrome.

On the other hand, it was also noted none of them had complications such as cutaneous or motor branch nerve injury. Two patients who previously underwent conventional CTR on the other hand were extremely happy with their latest encounter of mini CTR as they claim they did not experience tourniquet pain during the surgery. Collectively speaking, all of them were happy in terms of short duration of the procedure, cosmetically appealing wound, and good functional outcome.

In general population, males have stronger handgrip compared with females as evidenced by raw measurement during the study by Luna-Heredia et al¹⁴ and Kamarul et al.¹⁵ Second, age and hand dominance also shows variations in the handgrip measurement.¹⁴ Thus, to eliminate bias in this study, handgrip measurement was focused purely on the affected limb pre- and postoperatively to determine the efficacy of treatment objectively. Our study showed that the handgrip strength improved by 28% to 31%,

regardless of age, gender, and hand dominance following mini CTR.

It can be argued that incisions at the distal crease of the wrist do not provide the liberty to direct visualization of neurovascular structures and its variations, alas increasing the risk of injuring them. Nevertheless, we think that a careful distal approach can be safe, especially when the TCL is divided gently. The learning curve for this surgical method is quite short, especially those who are familiar to performing CTR with open technique. Further studies will be needed to assess the anatomical consequence of this technique.

Complications of neurovascular injuries can be avoided with a sound knowledge of carpal tunnel anatomy, thus keeping fragile structures intact (motor and cutaneous branches of median nerve and the superficial palmar arch). The way to provide good outcomes with the blind technique that we used in this study is to push the blade gently toward the third intermetacarpal space and to stop as soon as no resistance is felt, suggesting complete division of the TCL.

There were several limitations for this study. The small sample size was taken from the population of local community and may not apply to the overall populations. The other limitation was that there was no comparison with other techniques as this study is a kind of preliminary report. Moreover, we did not compare the groups regarding the sex, age, and dominant limb.

Conclusion

Our study suggests that the vertical mini-incision CTR at distal wrist crease can be a safe procedure and achieve satisfactory results that are probably equal or superior to those reported with the conventional or other mini-open methods without the risk of complications and high patient satisfaction.

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