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Original Article

# Recurrence rate of the Paine retinaculotome carpal tunnel release in diabetic and non-diabetic patients at long-term follow-up

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**Abstract**

*Background*: Carpal tunnel release (CTR) is considered effective in treating carpal tunnel syndrome (CTS), and diabetes is considered to complicate the outcome and recovery. However, the difference in recurrence rate between diabetic and non-diabetic patients after mini-open CTR in the long-term has not yet determined.
*Methods*: This study enrolled 1251 wrists (1091 patients), with 841 (67%) females and 480 (33%) males at a mean age of 58.5 years at operation. Patients were followed for a mean duration of 10.5 years. We retrospectively compared the recurrence rates of the Paine retinaculotome for mini-open CTR at wrist in diabetic and non-diabetic patients.
*Results*: In our study, a total of 161 wrists (13%) were in the diabetic patients and 1090 wrists (87%) were in the non-diabetic patients. Two wrists (1.24%) in the diabetic group and seven (0.6%) in the non-diabetic group exhibited recurrence ($p = 0.325$).
*Conclusion*: The mini-open CTR with the Paine retinaculotome in diabetic patients didn't show significantly higher recurrence rate than that in non-diabetic patients in the long term.


*Keywords:* Carpal tunnel syndrome; Diabetes mellitus; Median nerve; Paine retinaculotome; Recurrence

## 1. Introduction

Carpal tunnel syndrome (CTS) is very common in clinical practice. Surgical treatment is indicated if non-operative treatment fails. Surgical treatment mainly including endoscopic, mini-open and open carpal tunnel release (CTR) have been reported to have excellent outcomes.[1–4] The Paine retinaculotome was used for mini-open incision over the palmar side to release carpal tunnel previously. It is an efficient and safe method.[4] We have used the Paine retinaculotome as the main method for CTR at our institute for about twenty years. Although there are many benefits of surgical treatment, recurrence is still a concern for any method.

Diabetes is considered a possible risk factor of CTS.[5–8] Due to the hyperglycemia status, endoneurial hypoxia and deficiency of several neurotrophic factor, the diabetic patient might have worse recovery than the non-diabetic patient,[9,10] and higher recurrence after traditional open CTR.[11] But the recurrence rate after mini-open CTR in the long term between

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diabetic and non-diabetic patients was not yet determined. The purpose of this retrospective study was to compare the recurrence rate between diabetic and non-diabetic patients after mini-open CTR with the Paine retinaculotome in the long-term.

## 2. Methods

Our study was based on chart review, and informed consent was waived due to its retrospective nature. Between 1999 and 2012, 1681 patients who underwent primary CTR at our institute were reviewed. All patients had at least one of the symptoms of numbness, pain, tingling, sensitivity, cramping, and weakness. They also had failure of non-operative management, consisting of the use of a wrist splint and/or nonsteroidal anti-inflammatory drugs (NSAIDs). The enrolled patients had to have had an electromyographic study and distal sensory latency of >3.5 ms and/or distal motor latency of >4.5 ms.[12] The stage of the carpal tunnel syndrome was defined according to the severity of electromyographic study. Patients who underwent endoscopic and traditional open CTR were excluded. In addition, patients with (1) a neurologic deficit involving the same upper extremity, (2) previous wrist trauma or surgery, (3) history of wrist trauma, (4) immunological disease, e.g. rheumatoid arthritis, or (5) renal failure under dialysis were also excluded. Diabetes was confirmed and defined as type 1 or type 2 according to the American Diabetes Association (ADA) criteria and was treated with diet, oral diabetic medications, or insulin. Patients without at least a 2-year medical record for follow-up were excluded. A total of 1251 wrists (1091 patients) met the inclusion/exclusion criteria. The demographic variables and important outcomes were reviewed.

### 2.1. Surgical technique

Patients underwent the surgery on an outpatient basis. All surgeries were performed by four hand surgeons whose expertise level was graded as Level III (experienced specialist) according to Tang's grading.[13] The patient was positioned in the supine position and anesthetized with general or regional anesthesia, or local anesthesia with heavy sedation. The procedure was performed with or without an arm pneumatic tourniquet (depending on the surgeon) that was inflated to 250 mmHg if used. The landmarks of palmaris longus tendon (if existing), pisiform bone, hook of Hamate, Kaplan's cardinal line, and the radial border of the ring finger were identified. A 1.0−1.5 cm transverse incision was made at the distal wrist crease ulnar to the flexor carpi radialis (Fig. 1). Blunt dissection was performed deep into the flexor retinaculum with palmaris longus retracted radially. The route of release was checked and dilated with a freer elevator. In addition, the distal edge was felt using the freer elevator and marked. The Paine retinaculotome was placed above the median nerve.

Blunt dissection was done above and below the transverse carpal ligament (TCL) with the dissector before TCL release, so only the TCL would be cut by the knife. Then the Paine retinaculotome was used to release the TCL from the dissected retinaculum edge at wrist level going distally toward the radial border of the ring finger.[14] The force pushing the Paine retinaculotome going forward must be applied very meticulously and should be stopped if no more resistance of the retinaculum is felt. Proximal release of the retinaculum and the antebrachial fascia was then performed with the Paine retinaculotome for a distance of 2−3 cm. The Freer elevator was used to check proximally and distally to confirm the release. A pneumatic tourniquet was deflated if used. Manual compression of the released site for 10 min was applied after the surgery. The wound was sutured (5-0 Nylon) without drainage. Following surgery, Cephalexin 500 mg was given orally four times for one day and gentle activities were allowed for all patients. The removal splint was used until removal of the sutures, which was performed 10−14 days postoperatively.

All patients were followed-up at a clinic visit at two weeks and six months postoperatively, then once every year thereafter at a clinic visit if the CTS symptoms were not totally relieved or recurred. Additional visits were arranged if needed. Each patient was assessed for pain, numbness, and thenar muscle condition at every visit. Patients complaining of recurrence of symptoms underwent repeat electrophysiological studies for evaluation. Recurrent CTS refers to when the primary CTR was successful in relieving symptoms, but similar symptoms recurred after 6 months. All patient charts and operative notes of the four hand surgeons were evaluated by a project investigator, who was not involved in the treatment of CTS.

### 2.2. Statistical analysis

All analyses were performed using SPSS (version 17, SPSS, Inc., Chicago, IL). A $p$-value $< 0.05$ was considered statistically significant. Continuous variables between groups were compared using the Mann−Whitney $U$ test (Table 1). Categorical covariates were assessed individually, with the $\chi^2$ test used to compare the differences in each discrete variable between groups and Fisher's exact test performed for samples with expected values $< 5$ (Table 2).

## 3. Results

A total of 1251 wrists (1091 patients) with a mean age of 58.5 years (range, 30−85 years) were enrolled and analyzed. The mean follow-up duration was 10.5 years (range, 2.2−23.2 years) (Table 1). There were 9 wrists (9 patients; 7 female, 2 male) with recurrence; 2 were in the diabetic group (1.24%) and 7 were in the non-diabetic group (0.6%) ($p$ value $= 0.325$) (Table 2). Three occurred on the right side and six on the left. The average interval between the primary CTR and the revision CTR was 245 days in the diabetic group and 511 days in the non-diabetic group. The nine patients all underwent open CTR for the recurrence CTR to avoid iatrogenic median nerve injury due to scar adhesion in recurrent cases. Most of the operative findings during revision surgery were scarring of the retinaculum and tightening of the transverse carpal ligament. There was no iatrogenic nerve or vessel injury in our study.

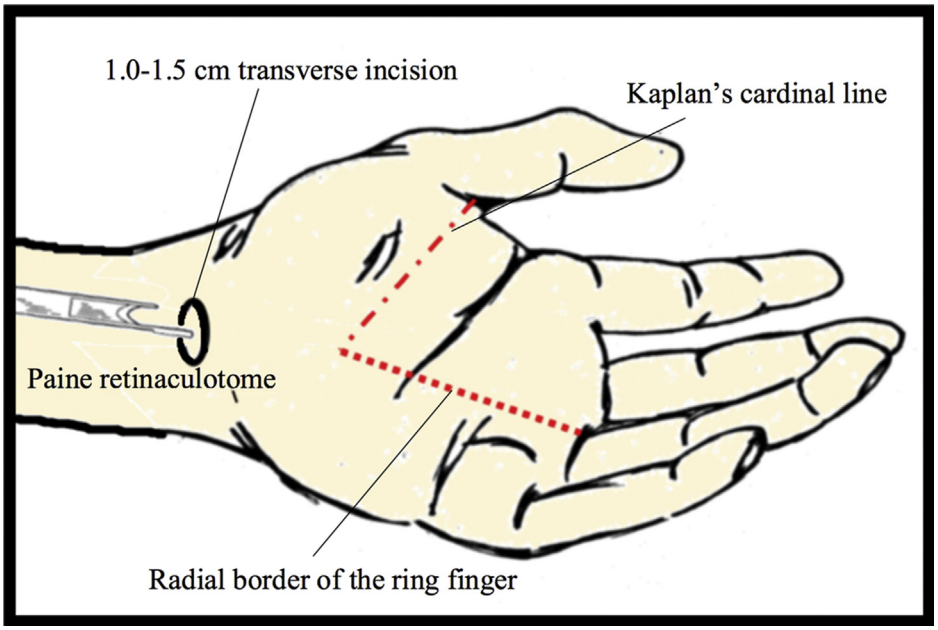


Fig. 1. The landmarks of the Paine retinaculotome carpal tunnel release.

Table 1
Patient characteristics.

| | Diabetic patients | Non-diabetic patients | *p* |
|---|---|---|---|
| Wrist number | 161 | 1090 | |
| Patient number | 149 | 942 | |
| Age | 61.4 ± 11.5 | 58.1 ± 12.6 | 0.911 |
| Gender (F/M) | 96/65 | 745/345 | 0.320 |
| Bilateral involvement | 22 (14.7%) | 148 (15.7%) | 0.979 |
| Right/Left | 92/69 | 609/481 | 0.585 |

Table 2
Revision CTR ratio.

| | Diabetic patients | Non-diabetic patients | *p* |
|---|---|---|---|
| Revision CTR/Primary CTR (%) | 2/161 (1.24%) | 7/1090 (0.6%) | 0.325 |

CTR = carpal tunnel release.

Superficial wound infection was observed in one patient of the non-diabetic group, and it subsided after oral antibiotic treatment.

## 4. Discussion

In our 10-year study, the recurrence rate after mini-open CTR with the Paine retinaculotome between diabetic and non-diabetic patients showed no significant difference in the long-term, although the recurrence rate of diabetic patients was higher (Table 2). The average interval between primary mini-open CTR release and revision CTR was less than two years, and our diabetic patients recurred sooner than non-diabetic patients (245 days vs 511 days).

For the outcome after CTR, some internal issues, including the duration of compression, the quality of the nerve, and recovery ability of the nerve may play an important role.[15] These characteristics seem to be less related with either endoscopic, mini-open or open CTR. But for the recurrence, although the physiologic factors play an important role, the extent to which surgical method might affect recurrence to some degree needs to be discussed. A higher percentage of primary open CTR patients required a revision CTR compared with those who had primary mini-open or endoscopic CTR.[7,11] In the literature, the pathological scarring around the median nerve was the common intraoperative findings during revision CTR.[16,17] A more extended wound could possibly cause more inflammation, which may lead to more fibrotic tissue formation and the recurrent CTS possibly occurring.[11]

In the study of Schreiber et al.,[11] there were 81.2% (39/48) of non-diabetic patients among the patients of revision CTR. The recurrence after CTR should be a multifactor result. Diabetic mellitus is a chronic inflammatory condition, and there are more histopathologic changes with fibrocartilaginous metaplasia in diabetic tissue.[18–20] In the study of Schreiber et al.,[11] there were 9 (9/44, 20%) diabetic patients who had revision CTR after primary open CTR. Interestingly, we found no diabetic patient with revision CTR after primary endoscopic CTR in the study of Schreiber et al.[11] Whether the release procedure affects the recurrence of the external anatomic compression should also be considered. A smaller CTR wound for diabetic CTS patients may decrease the recurrence rate. This is also consistent with our result. However, the recurrence interval in the study of Schreiber et al. was 6.6 ± 7.3 years (range 1–28 years), which is longer than our study. The longest interval is up to 28 years, which means these cases were followed up for a longer time than those of our study. We presume that if our cases were followed up for a longer time, the recurrence interval would also increase.

For recurrence, in addition to the internal factors that worsen the symptoms in diabetic patients, how fast and how severe of the externally anatomic compression regained is

another important issue. Our patients in the diabetic group recurred sooner than patients in the non-diabetic group (244.5 days vs 511 days). This was also consistent with the study of Schreiber et al. (4.2 years vs 7.2 years).[11] If the follow-up for the two groups was not long enough, it could have caused bias. Our sample size of recurrent CTS in the two groups was too small to reach statistically significance. Further study with larger sample size to compare recurrent patients in each group is necessary to get this conclusion.

Mini-open CTR with the Paine retinaculotome and endoscopic CTR can both have smaller incision wounds, however, possible oozing and hematoma formation in the carpal tunnel could also cause the formation of scar tissue. All of our nine patients with recurrence had their symptoms relieved after the revision CTR release of external neurolysis. The circumferential scarred retinaculum with a lot of fibrotic tissue which compresses the median nerve can be observed in revision CTR for the recurrence. External compression of the nerve is a reasonable cause that can develop faster than the internal change of the neurologic condition.

The limitation of this study is its retrospective nature. In addition, the multiple surgeons could have caused bias. In conclusion, a mini-open CTR with the Paine retinaculotome in diabetic patients didn't show significantly higher recurrence rate than non-diabetic patients in the long-term. Further studies are needed to evaluate the effects of metabolic condition and wound size on the recurrence.

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