

ORIGINAL ARTICLE

Comparison of Minimally Invasive Carpal Tunnel Release with Open Carpal Tunnel Release

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ABSTRACT

Objective: To compare the long-term results of conventional treatment [open carpal tunnel release (OCTR)] with the results of mini-open carpal tunnel release surgery (MCTR), performed through the palmar approach.

Study design: retrospective study

Place and Duration: This study was conducted at Pakistan Institute of Medical Sciences Islamabad from June 2020 to June 2022

Methodology: This research involves a total of 40 patients who were divided into 2 groups. Each group contained 20 patients respectively. One group was treated with mini-open carpal tunnel surgery and the other was treated with conventional treatment. Each patient had to conduct follow-ups for at least one years. The results were evaluated through SSS (Symptom Severity Scale), VAS (Visual Analogue Scale), DASH Score (Disability of arms, shoulder and hand), and FSS (Functional Status Scale). For a statistical analysis, confidence interval of 95% was set and significance was 0.05.

Results: In the long-term follow-up, both groups showed comparable results. The mean follow-up for MCTR and conventional method was 2 years. The DASH score was 4.2 and 8.9, SSS was 1.2 and 1.1, VAS was 0.5 and 0.9, and the FSS was 1.4 and 1.1. The scar sensitivity was lower in MCTR. It was 5 percent in MCTR while 12 percent in conventional treatment. The pain, time taken in surgery, and recovery time were also lower in the MCTR group. Both groups showed less complications and there was not a single recurrence.

Practical implication : To compare the long-term results of conventional treatment [open carpal tunnel release (OCTR)] with the results of mini-open carpal tunnel release surgery (MCTR), performed through the palmar approach. Practically less invasive surgery (minimal invasive) is more beneficial for patient in terms of wound complications

Conclusion: Mini-open carpal tunnel release is a better option than the conventional treatment. It is a fast, reliable, and simple process which relieves the patient from scar sensitivity.

Keywords: Mini-open carpal tunnel release, open carpal tunnel release, carpal tunnel syndrome

INTRODUCTION

The carpal tunnel syndrome (CTS) is one of the most frequently observed neuropathies. Across the world, it is reported to have a prevalence of 3.8%¹. But the prevalence varies in accordance with the criteria that are used for diagnosis². There are certain factors related to occupation and risk that impacts the prevalence of carpal tunnel syndrome³. For the treatment of this syndrome, a conservative procedure which includes non-steroidal anti-inflammatory drugs, splinting, and local corticosteroid is used. When the conservative treatment fails, open carpal tunnel release (OCTR) surgery is performed. OCTR is a conventional treatment that is widely accepted as a common surgery for carpal tunnel syndrome⁴. This treatment identifies anatomical variations, enables direct visualization, and also enables reliable division of the flexor retinaculum. However, there is a possibility of scar sensitivity, pain in the wound as well as pillar pain after the surgery⁵. In order to avoid these complications, several mini-open approaches have been advanced. An endoscopic carpal tunnel release surgery was performed which reduced the wound pain and pillar pain after the surgery. It also reduced the scar sensitivity but there was a limitation of incomplete division of flexor retinaculum or vascular injury⁶. Later, mini-open carpal tunnel release surgery was developed which showed lower complications as compared to OCTR and endoscopic carpal tunnel release and it combined all the advantages of both approaches.

The aim of this study is to compare the long-term results of conventional treatment [open carpal tunnel release (OCTR)] with the results of mini-open carpal tunnel release surgery (MCTR), performed through the palmar approach. This study was done to see the result of minimal invasive surgery as this will avoid wound complications, we recommend minimal invasive surgery however our sample size was short and needs more evaluation.

METHODOLOGY

This was a retrospective study, This research includes a total of 40 patients who were divided into 2 groups. Each group contained 20 patients respectively. One group was treated with mini-open carpal tunnel surgery and the other was treated with conventional treatment. Each patient had to conduct follow-ups for at least 2 years. The patients had almost similar ages in both groups. Each group was assigned a hand specialist and an experienced consultant.

The symptoms of carpal tunnel syndrome include severe pain, development of sensory weaknesses, and supply territory of the median nerve. To test the median nerve neuropathy, electromyography was performed, before the surgery. Every patient failed the conservative treatment which included splinting and physiotherapy.

Those patients who had complications such as diabetes mellitus, rheumatoid arthritis, smoking, or polyneuropathies were excluded from the study. Moreover, patients who had soft tissue defects, distortion of anatomy, hand and wrist surgeries, signs of inflammation, and other symptoms for more than one year were also excluded from this research.

All of the treatments were conducted in the operation theatre. An upper arm tourniquet was used in all of the surgeries. The hands were fixed with a lead hand splint and they were all placed in the supine position. Drainage was done with a mini-suction drainage which had to be there for about 24 hours. Non-absorbable 5.0 sutures were used to perform wound closure. It was done without the Leukostrips. For the compression of the wound directly, a Gauze Swab was used. The Gauze Swab was used as an early dressing, which was used as a padding roll for releasing the upper arm tourniquet. The hands remained in the bandage for 24 hours after the surgery. After 24 hours, the surgeon removed the early dressing and the mini-suction drainage and plaster were applied. After the plaster was applied, the

patients were discharged. The patients had to avoid heavy weight lifting for about 2 weeks. The sutures were removed in the first follow-up which was after 2 weeks of the surgery.

OCTR: In the OCTR surgery, an incision of 2 inches is performed on the palmar crease and it is stopped at a 0.5 cm distance from the wrist crease. Then the surgeon uses surgical instruments to enlarge the carpal tunnel by cutting the carpal ligament. This incision is cut in a proximal direction ⁷.

MCTR: In the MCTR surgery, a parallel line is drawn in the palm and then it is cut accordingly. The incision of MCTR is smaller than OCTR ⁸.

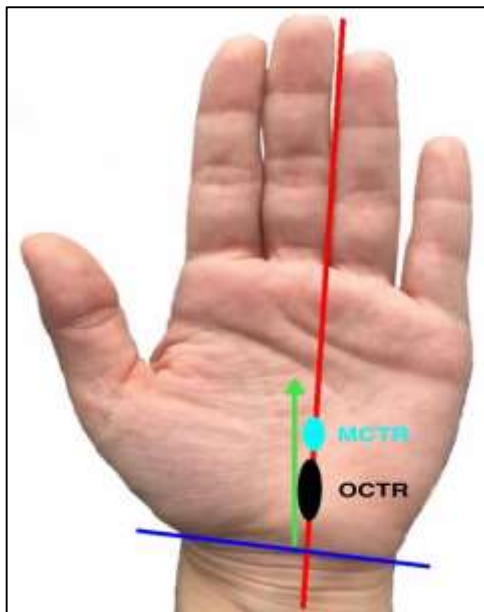


Figure 1: The difference between MCTR and OCTR

The data was collected in a hospital database. The data includes the demographics of patients (age and gender), the affected side, symptoms before the surgery, and time period of the surgery. The first follow-up of patients was after 2 weeks of treatment. The first follow-up was done by the surgeon who conducted the surgery. He evaluated the results on the basis of VAS, scar sensitivity, infection, and wound healing disturbances. The last and final follow-up was done by 2 surgeons. They evaluated the results on the basis of adverse events or changes in symptoms. The evaluation of VAS, FSS, DASH, and SSS was completed during the 2 yrs. The participants were also asked about the development of pain and scar sensitivity. Pillar pain was also assessed. The participants were asked about the surrounding of scars such as pain during palpation, burning discomfort, and hypersensitivity.

From the duration of the surgery to return to the workplace, everything was evaluated. Restitution was included in this process which means the time when patients were able to conduct their daily life activities without the pain. Adverse events' occurrence and recurrence were also assessed. Recurrence was defined as the symptoms returning after the surgery where the need for another operation was felt.

Statistical analysis: SPSS software version 26 was used to perform the statistical analysis. The mean, standard deviation, and quantitative data were considered continuous parameters. For demographic variables, descriptive statistics were used. To analyze the data according to the significance, non-parametric tests were used. Mann-Whitney test was used to differentiate between both of the groups (OCTR and MCTR). To evaluate the adverse events, a chi-square test was used. A p-value that was below 0.05 with a 95% CI was considered significant.

RESULTS

In the MCTR group, the percentage of females was higher than the males. There were 15 females (75%) and 5 males (25%). The participants' age varies from 35 to 80 years. The average age was 62 years. The percentage of left hand was greater than the percentage of right hands. A total of 65% of hands were left while 35% of hands were right. The mean duration of symptoms was 5 months while the mean time period of the surgery was 9.8 minutes.

In the OCTR group as well, the percentage of females was higher than the males. There were 14 females (70%) and 8 males (30%). The participants' age varies from 20 to 82 years. The average age was 59 years. The percentage of right hand was greater than the percentage of left hands. A total of 62% of hands were right while 38% of hands were left. The mean duration of symptoms was 5.5 months while the mean time period of the surgery was 12 minutes.

A statistical difference was seen between the groups regarding the time period of the surgery but no significant difference was seen regarding follow-ups and age.

First follow-up: The first follow-up was held after 2 weeks of the surgery. There were no adverse effects seen in both groups. In the MCTR group, 1 patient experienced scar sensitivity while 5 patients experienced it in the OCTR group. The DASH score was 4.2 and 8.9, SSS was 1.2 and 1.1, VAS was 0.5 and 0.9, and the FSS was 1.4 and 1.1. The scar sensitivity was lower in MCTR.

Table number 1 shows functional results of both groups. Table number 2 shows postoperative follow-up of both groups. Table number 3 shows the percentage of adverse events after the surgery. There were no recurrence observed in both of the groups. The rate of infection was 5 percent in the MCTR group while it was 10 percent in the OCTR group. Those patients who were suffering from an infection underwent another treatment. The average time between the main and the revised treatment in the MCTR group was 2 weeks while in the OCTR group, it was 6 weeks. There were zero tendon injuries, vessel lesions, and hematomas observed in both groups. In short, the rate of complication was only 10%.

Table 1: functional results of both groups

| | VAS | DASH | FSS | SSS |
|------|-----|------|-----|-----|
| OCTR | 0.9 | 8.9 | 1.1 | 1.1 |
| MCTR | 0.5 | 4.2 | 1.4 | 1.2 |

Table 2: postoperative follow-up of both groups.

| | Pillar pain (n) | Scar sensibility (n) | Restitution (weeks) | Return to work (days) |
|------|-----------------|----------------------|---------------------|-----------------------|
| OCTR | 6 | 5 | 15 | 20 |
| MCTR | 0 | 1 | 10 | 14 |

Table 3: percentage of adverse events after the surgery

| | Nerve lesion | Tendon injury | Vessel lesion | Hematoma | Infection |
|------|--------------|---------------|---------------|----------|-----------|
| OCTR | 0 | 0 | 0 | 3 | 2 |
| MCTR | 0 | 0 | 0 | 0 | 1 |

DISCUSSION

In 1955, Paine described a device first which was used as a retinaculum ⁹. According to Fernandes et al., this device is still used ¹⁰. Fernandes et al. conducted a study on more than five hundred patients in a duration of 17 years. They observed short term and long term outcomes with improved clinical results. In 1977, Aryan et al. conducted a study on 430 patients who showed improved symptoms ¹¹. There are limited studies relating to the long term results of mini-open carpal tunnel release surgery.

There was another research conducted by Bai et al. which was similar to our study in performance, including 85 patients ¹². The mean duration of symptoms was 6.5 months in the MCTR group and 6.3 months in the OCTR group. The mean time period of the surgery was 25.2 minutes in the MCTR group while it was 23.5 minutes in the OCTR group. This was different from our research. There was no significant difference seen in the DASH and VAS scores. No patients experience wound pain in the MCTR

group while 4.7 percent of patients experience wound pain in the OCTR group.

Another research was conducted by Aslani et al. on 105 individuals who were divided into 3 groups¹³. The three groups were; MCTR, OCTR, and endoscopic CTR. The average time to return to work was longer in the OCTR group which was 21.2 days. The mean absence duration at the workplace was shorter in the MCTR group which was 2 weeks only while it was more than 2 weeks in the OCTR group.

Another study was conducted by Zhang et al. on 207 individuals who were also divided into 3 groups (MCTR, endoscopic CTR, and OCTR)¹⁴. The MCTR group contained 73 patients while the OCTR group contained 65 patients. The endoscopic CTR group contained 69 patients. The average symptom duration was 6 months in the OCTR group and MCTR group. This is comparable to our research. There were no significant differences seen in both the groups in the final follow-up. In both groups, the mean FSS and SSS were 1.2 which is also similar to our results.

The range of recurrent nerve compression is from at least 2% to at most 25%¹⁵. In prior studies that were conducted in a long term, the recurrence rates are found to be between 3.7% to 57%¹⁶. Nevertheless, the proper definition for recurrence is not yet found in the literature which can define this range. There are some researchers who define recurrence as symptoms before the surgery, some say that it determines the need for revision surgery. According to the research of Cresswell et al., the recurrence rate was higher in the MCTR group as compared to the OCTR group¹⁷. The outcomes were evaluated till 2 years after the surgery. In the follow-up of 2 years, there was no recurrence seen which continued till the last follow-up.

If the recurrence of the nerve compression becomes consistent, it can cause the transverse ligament to split or a postoperative fibrosis. There is a possibility that the postoperative fibrosis is positively influenced by early motion protocol from the first day after the surgery. According to Kilinc, the possibility of recurrent CTS is very unlikely. In both the groups, the number of adverse events were low. The results favored the MCTR method as a reliable procedure.

The direct visualization of the median curve is one advantage. Moreover, due to the proximal direction of incision, no iatrogenic lesions of the palmar arch are developed. In our research, in the MCTR group, one partial median nerve laceration was seen in 1 patient. According to the research of Cresswell et al., one lesion of the median nerve was seen in 53 participants¹⁷. Similarly, in the research of Lee and Strickland, two median nerve lesions were seen in 694 participants with the retinaculum. By analyzing the outcomes, the median nerve lesion is a major complication¹⁸.

There are certain limitations of this research. First, we only compared 2 groups, the MCTR group and the OCTR group. We did not include the endoscopic CTR group. Secondly, there was no randomized assignment calculated for both of the groups. Moreover, our research is retrospective because we only included prospectively collected data. We recommend having randomized controlled trials in future studies to evaluate the outcomes. Although conflicts occur regarding the decision about the surgery, patients as well as the surgeons prefer the MCTR process more. These are the factors that were not evaluated in our research. The last limitation is that the financial implications were not assessed.

There are also certain strengths of this research. The main strength is the long term timeframe to assess the outcomes. Secondly, as the surgical process was based on superficial anatomical landmarks, it was easy to re-operate. Experienced practitioners along with surgeons were a part of this study. The method that we used was established under anatomical safe zones and landmarks provided by Hohenberger et al. in their research^{19,20}.

CONCLUSION

Mini-open carpal tunnel release is a better option than the conventional treatment. It is a fast, reliable, and simple process which relieves the patient from scar sensitivity. The complication rate is lower in the MCTR group as compared to the OCTR group. There were no patients who experienced the pillar pain or recurrences. The scar sensitivity was lower in the MCTR group. Overall, the outcomes of the MCTR group shows that it is a fast, challenging procedure that allows direct visualization of anatomical structure at risk.

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