ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 03 | March - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARISON OF MINI OPEN AND EXTENDED OPEN INCISION IN CARPAL TUNNEL SYNDROME

Orthopaedics

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ABSTRACT

Introduction: The aim of this study was to compare surgical outcomes of carpal tunnel syndrome treated with mini incision versus extensile release. **Materials and Methods:** This was a prospective study that was conducted from July 2019 to August 2021 which included 50 consecutive patients who presented to the Post graduate Department of Orthopaedics, Govt. Hospital for Bone and Joint Surgery, an associated hospital of Govt. Medical College Srinagar and diagnosed as having carpal tunnel syndrome. Among enrolled patients, two different methods were employed and patients were distributed in two groups A (mini-open release techniques) and B (extended open release techniques) with 25 patients in each group. **Results:** There were no differences in improvements of opposition, grip and paresthesia in two groups. There was no wound infection or nerve damages in patients of either groups. Return to work and satisfaction were also significantly faster and higher in group A compared to group B. VAS scores in group A were lower than those in the group B patients. **Conclusion:** The results of this matched-pair study demonstrated that mini-open and extended open carpal tunnel release have similar long-term clinical outcomes without any major complications.

KEYWORDS

Carpal tunnel syndrome, extended release, mini-open release, matched-pair analysis.

INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the most prevalent forms of nerve entrapment neuropathy worldwide [1]. The carpal tunnel (CT) is a fibro-osseous tunnel in the volar part of the wrist. It extends from the wrist flexion crease to the distal border of the thenar eminence and it contains median nerve and the tendons of the flexor digitorum superficialis, flexor digitorum profundus and flexor pollicis longus. Compression of the median nerve at the wrist producing pain, sensory disturbances, and motor weakness is described as 'carpal tunnel syndrome' (CTS). Carpal Tunnel Syndrome (CTS) is a fairly common peripheral neuropathy, caused by median nerve compression at the wrist level [2, 3]. The prevalence of CTS is believed to be 3.8% of general population around the world [4].

The first description of CTS was reported in 1880 by Putnam [5], but Marie and Foix defined the pathology and recommended decompression of the carpal tunnel in 1913 [6]. In recent years there has been an increase in incidence of CTS, may be due to the awareness of people about this disease, the upward disease detection rate, the work is more and more meticulous and delicate requiring using wrist continuously [7, 8].

Aetiologies of CTS include idiopathic, wrist trauma involving the bony tissue, diabetes mellitus, hypothyroidism, rheumatoid arthritis, oral contraceptives, occupations that involve repetitive motion of the wrist, and pregnancy [9, 10].

The high prevalence of CTS and its effect on quality of life makes it worthy of evaluation to find an effective method of treatment which would be cost-effective and satisfactory [1]. Non-surgical modalities are mostly preferred in mild to moderate stages. These include wrist splints or corticosteroid injections. Surgical treatment is generally performed for severe cases with persistent clinical symptoms [11, 12].

The classical approach of decompression is open release of the carpal tunnel. Phalen[3] first reported his experience and results of open carpal tunnel surgery in 1966. The classical surgical incision of the open carpal tunnel surgery extends from Kaplan's cardinal line (KCL) to wrist crease.

This extended technique prevents inadequate decompression by visualization of the surgical site both proximally and distally. However, many surgeons favor shorter incisions due to unsettling scar formation after extended approach. Also, the mini- open technique has been shown to produce lower recurrence and shorter recovery period with obvious reduction in pain and numbness.

In this study, we aimed to compare mini-open and extended open release techniques in patients with moderate to severe CTS.

MATERIALS AND METHODS

This was a prospective study that was conducted from July 2019 to August 2021 which included 50 consecative patients who presented to the Post graduate Department of Orthopaedics, Govt. Hospital for Bone and Joint Surgery, an associated hospital of Govt. Medical College Srinagar and diagnosed as having carpal tunnel syndrome. Inclusion criteria were Signs, symptoms and electro-diagnostic tests characteristic of carpal tunnel syndrome and no response to conservative treatment for at least 6 months. Exclusion criteria were patients with peripheral neuropathy, prior Carpal Tunnel release, inflammatory arthropathy, deformity of hand/wrist.

Table 1: Descriptive Statistics of the Study Population (N=50)

Groups	No. of cases	Mean age	Gender			
			Male	Percentage	Female	Percentage
Group A	25	50.4	2	8	23	92
Group B	25	49.7	4	16	21	84

Among enrolled patients, two different methods were employed and patients were distributed in two groups A (mini-open release techniques) and B (extended open release techniques) with 25 patients in each group. In group A, an incision shorter than 2 cm in length was performed along the ulnar side of the fourth ray and both the transverse carpal ligament and distal end of forearm fascia were released by the aid of a spatula. In group B, an incision parallel to thenar palmar crease, 6 mm ulnar to thenar palmar crease, and extending from 1 cm distal to KCL to 1 cm proximal to wrist crease was performed. A zigzag incision towards ulnar side was planned while the incision passed wrist crease. The flexor retinaculum was released from the distal antebrachial fascia to the palmar fascia. The thenar branch was explored and preserved distal to the flexor retinaculum. The median nerve was explored under surgical binocular loop.

Patients were advised for routine follow-up in the first and third months postoperatively.

A Jamar hydraulic hand dynamometer (Sammons Preston, Bolingbrook, IL, USA) was used to measure pre- and postoperative third month grip strengths (GS). Visual Analogue Scale (VAS) was adopted for pain scoring at one day, one month, and three months after surgery, and the Boston Carpal Tunnel Questionnaire score was used to evaluate neurological recovery before, at one month, and three months after surgery. At the last follow-up, the Kelly grading scale was used to

evaluate the surgical efficacy. The grading scale rated surgical outcomes excellent (with complete relief of symptoms), good (with occasional and persisted mild symptoms), fair (with some persistent or distressing symptoms), and poor (with unchanged or worsened symptoms).

RESULTS

Baseline demographic parameters of two groups were shown in Table I. The correlation between age and follow-up was investigated by using the Spearman correlation coefficient (rho) and the results indicated no significant relationship between the variables .The mean follow-up duration was 38.7 (range 24-43) weeks in group A and 36.2 (range, 23-50) weeks in group B and it did not differ significantly between groups.

Length of scar was significantly smaller in group A patients. Post-operative pain was significantly lower in group A ($p < 0.001$). Return to work and satisfaction were also significantly faster and higher in group A compared to group B (both p-values were<0.001). There were no differences in improvements of opposition, grip and paresthesia in two groups ($p > 0.05$). There was no wound infection or nerve damages in patients of either groups.

The operation time and time of return to work in group A were all shorter than those in the group B, and differences were statistically significant. VAS scores in group A were lower than those in the group B patients (Table 2).

Table 2: Post-operative VAS comparison

Groups	Visual analog scale (VAS)		
	1 day post-operative	1 month post-operative	3 months post-operative
Group A	1.86 ± 0.89	0.9 ± 0.56	0.44 ± 0.24
Group B	2.62 ± 0.99	1.48 ± 0.90	0.58 ± 0.68

The detailed results of the pre- and postoperative clinical scores were shown in Table II.

In both groups, statistically significant improvements compared to preoperative measurements were achieved at the final follow-up. Although significant improvement in symptom severity and functional status were obtained in both groups at the final follow-up, there was no statistically significant clinical difference between the groups (Table 3).

Table 3: Pre and Post-operative mean clinical scores

Scores		Group A	Group B
Grip strength symptom severity score	Pre-operative	22.4 ± 1.6	21.7 ± 1.4
	Post-operative	28.1 ± 1.9	27.9 ± 1.7
Boston Carpal Tunnel Questionnaire symptom severity score	Pre-operative	34.1 ± 3.6	33.4 ± 4.2
	Post-operative	15.9 ± 2.6	16.1 ± 2.8
Boston Carpal Tunnel Questionnaire functional status scale	Pre-operative	28.9 ± 2.8	28.8 ± 3.0
	Post-operative	12.9 ± 2.3	13.0 ± 2.4

No median nerve branch injury occurred in either group of patients. Pain disappeared early at the postoperative period in all patients. Revision surgery was not required in any patient. In group B, Dysesthesia and pillar pain occurred in 2 (8 %) patients which subsided by the injection of Triamcinolone by the end of the final follow-up and no such complication was found in group A patients.

At the final follow-up, the grading was done by the Kelly grading scale, where there was not any statistically significant difference between two groups (Table 4).

Table 4: Results according to Kelly grading scale

KL Grading	Group A (n=25)		Group B (n=25)	
	No. of patients	Percentage	No. of patients	Percentage
Excellent	21	84	19	76
Good	3	12	4	16
Fair	1	4	2	8
Poor	0	0	0	0

DISCUSSION

Carpal tunnel syndrome is one of the most common neuropathies affecting peripheral nerves of upper limbs. Carpal tunnel decompression surgery has evolved over the years to decrease the complications associated with the surgical procedures. For moderate to severe CTS, a complete cure mainly depends on cutting the transverse carpal ligament and releasing the median nerve. Surgical treatment of CTS aims to increase the space in the carpal tunnel by cutting off the transverse carpal ligament and then reduce the pressure on the median nerve [13].

There are several modalities of surgical treatment for CTS, and the most common approaches are open carpal tunnel release through a standard or limited incision. In recent years, the application of the endoscopic carpal tunnel release (ECTR) methods has been reported. Although some trials have reported a sooner recovery and back to work by ECTR, other studies have not shown significant differences between ECTR and open carpal tunnel release [14, 15, 16]. Furthermore, although ECTR may lead to less postoperative pain and local tenderness, the degree of this advantage seems to be modest [15]. The conventional OCTR method is the classic operation for the treatment of CTS with sufficient intraoperative exposure and complete decompression. However, it is also accompanied by certain complications, such as scar hyperplasia, scar pain, and neurovascular injury [17]. Although the cause of dysesthesia is not yet fully understood, higher rate of scar discomfort in the extended open release group may be attributed to the injury of PCBMN and subsequent neuroma formation. In a cadaveric study, Ozcanli et al. [18] aimed to define the safe zone for mini-open release in 30 hands and they identified similar rates of thenar branch variations as in our study. They also described a safe zone for mini-open release in order to prevent any injury to the PCBMN as being between the PCBMN and superficial palmar arch.

CTS is one of the most common compressive neuropathies in clinical practice. In previous studies, it affected mainly the middle-aged population and mostly females [19-21]. In our study, CTS was more frequent in female patients 44 (88 %) as compared to male patients 6 (12 %) and with a mean age of 50.05 years.

The main finding of the present study was that both the techniques provided similar functional and symptom severity scores. However, extended release led to incision-related complications in 2 (8 %), while in the mini-open technique no such complication was found. Superiority among open or mini-open techniques for carpal tunnel release remains highly controversial in the orthopedic literature and among surgeons. Using a retrospective study, Murthy et al. [22] reported no significant differences between the two procedures with regard to patient-rated symptom severity or functional status outcomes. Although this study presented a large cohort of severe CTS patients, they were not adequately matched between the two groups with regard to age, gender and preoperative electrodiagnostic testing. In this study, a matched-pair design was chosen to achieve adequate comparability by minimizing confounding factors.

In a previous study, it reported that a longitudinal incision is more effective in relieving symptoms and better functional outcomes than a transverse incision [23]. So the design of the incision is a key element affecting the effect of mini-open incision surgery. In our study, the incision was placed in the radial border of the ring finger line, which begins about 1 cm from the distal flexor wrist crease and is distal to the Kaplan baseline [23]. For patients who were obese, the incision would be appropriately extended to facilitate the exposure of the surgical field. However, it was recommended that the proximal end should not exceed the distal wrist crease to prevent postoperative scar hyperplasia from affecting the flexion and extension of the wrist joint in patients with scar constitution.

CONCLUSION

The results of this matched-pair study demonstrated that mini-open and extended open carpal tunnel release have similar long-term clinical outcomes without any major complications. However, extended technique has higher rate of scar discomfort due to lengthier incision potentially injuring the PCBMN. Future studies are necessary to determine the reasons of scar discomfort.

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