Trauma Monthly 2021; 26 (6): 322-329

10.30491/TM.2021.294747.1331

Trauma Monthly

Original Article

Clinical Outcomes of Median Nerve Release in Carpal Tunnel Syndrome with and without Cervical Radiculopathy

Mehran Razavipour[1], Salman Ghaffari[1], Aboulfazl Ghadiri[*2]

[1] Assistant professor of orthopedic surgery, Orthopedic research center, Mazandaran university of medical science, Sari, Iran.

[2] Resident of orthopedic surgery, Orthopedic research center, Mazandaran university of medical science, Sari, Iran.

*Corresponding Author: Aboulfazl Ghadiri, Resident of orthopedic surgery, Orthopedic research center, Mazandaran university of medical science, Sari, Iran. Phone: +989113905982, Fax: +981133377169, Email: saghadiri.70@gmail.com.

Received 2021-05-02; **Accepted** 2021-07-17; **Online Published** 2021-12-28

Abstract

Introduction: Carpal tunnel syndrome (CTS) is a symptomatic compression neuropathy of the median nerve in the wrist. This study aimed to evaluate the clinical outcomes of median nerve release in CTS with and without cervical radiculopathy (CR) in patients referred to orthopedic research centers in Sari, Iran, to assess whether the CR patients need to be referred for proximal decompression spine surgery.

Methods: The patients were divided in two groups of 30 (CTS with and without cervical radiculopathy). The patients in the CR group were selected based on involvement in electromyography (EMG)/nerve conduction velocity (NCV). This study examined the variables of grip and pinch strength, QuickDASH questionnaire, Boston symptom severity scale (BQ-SS), Boston Questionnaire-Functional Scale (BQ-FS), and VAS index before surgery, three months and six months after surgery.

Results: The studied scores (grip and pinch strength, BQ-FS and BQ-SS, QuickDASH, and VAS) had a significant decrease in three and six months after surgery between the two groups ($P<0.05$). There was no significant difference between the two groups in reduction rate ($P>0.05$). The correlation between BQ-SS and VAS in studied patients was significant in different periods. So, that BQ-SS and VAS scores decreased after median nerve release in both groups, but the decreasing trend was significantly higher in the CTS group without CR than in the CTS group with CR ($P<0.001$).

Conclusion: The median nerve release can be effective in the two groups, and a six-month follow-up in the patients with CR and it revealed there was no need for referral for proximal decompression spine surgery.

Keywords: Carpal tunnel syndrome, median nerve, median nerve release.

Introduction

Carpal tunnel syndrome (CTS) is a symptomatic compression neuropathy of the median nerve in the wrist area. The prevalence of this syndrome in the general population is 3.8%, with an annual incidence of 276 per 10,000 people [1]. The CTS is more common in women than in men and usually occurs bilaterally, and is the most common peripheral neuropathy that affects the patient's daily activities and reduces the quality of life [2-4]. Common clinical manifestations of this syndrome include painful paresthesia or burning pain on the outside of the hand, especially in the first three fingers. The patient may complain of numbness, decreased agility, weakness, and in advanced cases decreased motor function and the atrophy [5]. The diagnosis of this syndrome is based on clinical signs and physical examination. Also, it may be confirmed by electrophysiological tests, especially electroneuromyography (ENMG). This confirmation is based on the delay and abnormality of conduction in the sensory and motor nerves [6]. The main goal of treatment is to relieve pressure on the median nerve, which can be performed surgically.

The CTS can be comorbid with many systemic diseases and other types of neuropathy [3]. Patients with symptoms of compression neuropathy often also have pain in the cervical spine [7, 8]. According to studies, proximal

damage along the course of an axon due to disruption of axoplasmic flow makes it prone to injury in the distal region [9, 10]. This hypothesis, known as double crush syndrome (DCS), was first reported by Upton and McComas in 1973 [10]. Detecting the comorbidity of cervical radiculopathy (CR) is necessary in patients with CTS. Because alone treatment of CTS may not yield acceptable and satisfactory outcomes in patients with CR [8]. The prevalence of CTS and CR comorbidity has been reported between 7 and 70% according to the age of patients [10]. The DCS is more prevalent in men and middle-aged people [9].

Numerous procedures are currently performed for CTS surgery and proximal nerve entrapment, but the surgery to release the median nerve is the preferred surgical procedure for many surgeons [11-13]. This procedure may exhibit complications such as pillar pain, tenderness, scarring, patient dissatisfaction with the ugliness of the surgical site, and decreased grip and pinch strength [11, 14]. Proximal surgeries in patients with CR also account for multiple procedures and their own complications such as bleeding, infection, spinal cord injury, chronic arm pain, transient dermatomal hyperesthesia, deformed scars, and sometimes symptom recurrence due to unsuccessful surgery [15]. It is still unclear whether cervical surgery in these patients eliminates the chronic symptoms of the disease. On the other hand, most CR patients with experience of peripheral nerve surgery reported improvement in symptoms, but neurological symptoms are still more likely to be associated with peripheral nerve surgery [16].

Since referral of CR patients for proximal release is an ambiguous decision, the current study aimed to compare the clinical outcomes of median nerve release surgical treatment in CTS patients with and without CR.

Methods

The present descriptive-analytical cross-sectional study was conducted on CTS patients with and without CR referred to orthopedic research centers in Sari in 2020. Wessel et al. [16] estimated the sample size to be 60 in total, including 30 in the CTS group with CR and 30 in the CTS group without CR, who were selected by convenience sampling. Inclusion criteria were a history of isolated CTS for one group and CTS with CR for the other group. Exclusion criteria were the history of carpal tunnel release surgery, polyneuropathy based on electromyography (EMG)/nerve conduction velocity (NCV), history of hand trauma, age under 18 years, and history of CR surgery.

The patients enrolled in the study based on the inclusion and exclusion criteria and obtaining written consent. Demographic data (age and gender) were recorded in a questionnaire. They were selected into two groups, the first group of CTS patients with CR and the second group of patients with isolated CTS.

Criteria for diagnosing CTS in the electrophysiological test were as follows:

DML latency>4.5 m/sec

DSL latency>3.5 m/sec

The selection of patients in the CR group was based on EMG/NCV.

This test was performed for all patients by the same physician or neurologist. The patients' grip and pinch strength were measured by a Saehan dynamometer (made in South Korea with U.S. Jamer technology). The QuickDASH scale was also recorded for patients. It consists of 11 questions on the ability to perform daily activities by hand, with an overall score between 0 and 100.

In addition, the Persian version of the Boston questionnaire (BQ-SS) was completed for patients, consisting of two parts: measuring the severity of symptoms and measuring the patient's functional status. The section on estimating the severity of symptoms has 11 questions about the severity and frequency of symptoms such as night and day numbness, burning, pain and muscle weakness. The section on measuring functional status has eight questions about the patient's problems with performing specific activities such as writing, holding a book, buttoning clothes, holding a telephone, opening a jam jar lid, doing laborious housework, bathing, carrying a shopping bag and getting dressed. The mean scores in each section were calculated to obtain the severity of symptoms and functional status; the higher the mean obtained, the more severe the symptoms or disability will be in the patient. When it came to filling out the questionnaires, the patients with sufficient literacy completed the questionnaire themselves. But those who were less literate and had difficulty reading, the questionnaire was read face-to-face to complete.

Surgery was performed by a fellowship-trained hand surgeon with an approach of MINI-PALM" OPEN CARPAL TUNNEL RELEA (based on Campbell reference) for all CTS patients with and without CR.

Surgical indications included chronic signs and symptoms of nerve compression, failure of medical treatment for two months, and a moderate to severe electro diagnostic test confirming the physician's need for surgical treatment. Immediately after surgery, patients were encouraged to shake their hands and fingers. Splinting was performed on patients, then the bandage was opened two days after surgery, and the sutures were removed after two weeks.

The tests and questionnaires were completed before surgery, three and six months after surgery. Assessments and follow-up of patients were performed by an orthopedic resident partner. The clinical outcomes of median nerve release surgery in CTS were compared between two groups of CTS with and without CR.

Data collected from questionnaires and test results were analyzed by SPSS version 22 software using descriptive statistics (including mean and standard deviation for quantitative data, and frequency and percentage for qualitative data), as well as repeated measures ANOVA at a statistical significance level of $P<0.05$.

Results

In the study, 30 CTS patients without CR and 30 CTS patients with CR were studied at three-month and six-month intervals. Figure 1 shows the study design. Seven patients were male (11.7%), and 53 were female (88.3%), as well as 33 (55.5%) had the right hand, and 27 (45.0%) had the left hand in terms of the prevalence of the dominant hand.

The pinch strength, grip strength, Quick DASH score, BQ-SS, Boston Questionnaire-Functional Scale (BQ-FS) and VAS score in two groups of 30 CTS patients without CR and 30 CTS patients with CR were examined at the intervals of three and six months (Table 1 and Figures 2 and 3). The results showed that the relationship of the BQ-SS index in patients in different periods was significant. So that the BQ-SS index after median nerve release surgery had a decreasing trend in both groups. But, the rate of BQ-SS improvement in the CTS group without CR was significantly higher than in the CTS group with CR ($P<0.001$). The VAS index was also decreased after median nerve release surgery in both groups, but there was no significant difference between the two groups ($P>0.05$). Pinch strength, grip strength, QuickDASH score, and BQ-FS score also improved after median nerve release surgery, but no significant difference between the two groups ($P>0.05$).

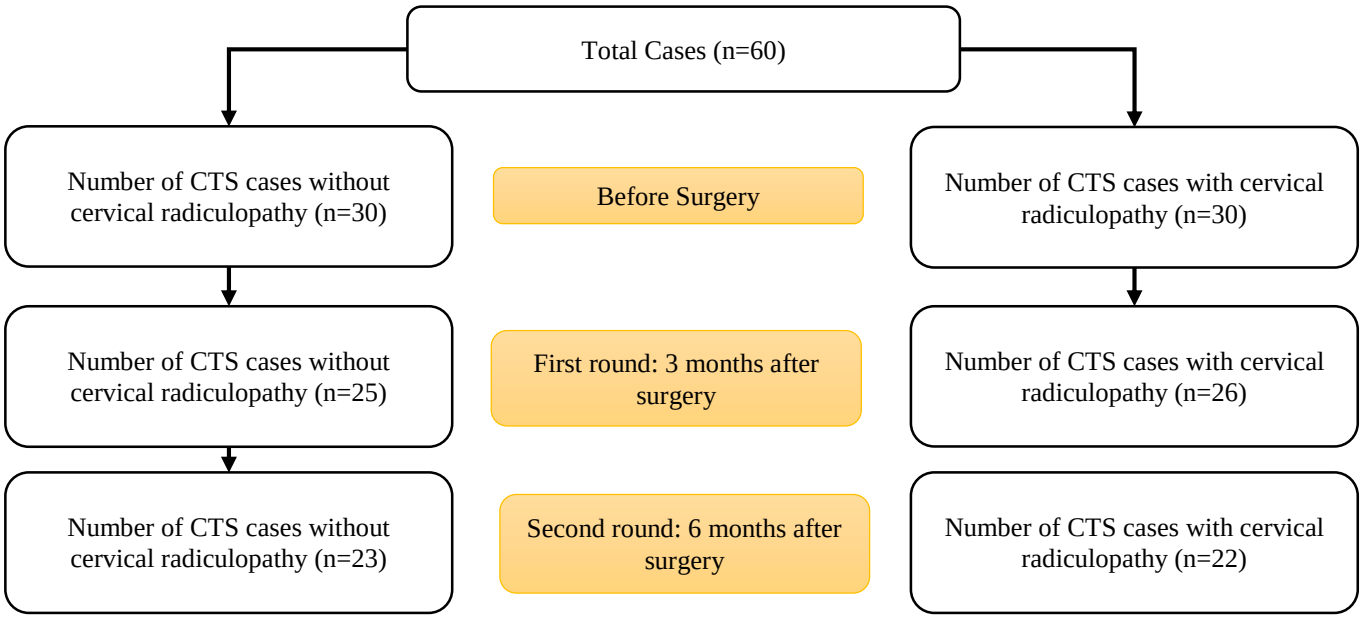

Figure 1: Diagram of how to evaluate the studied patients.

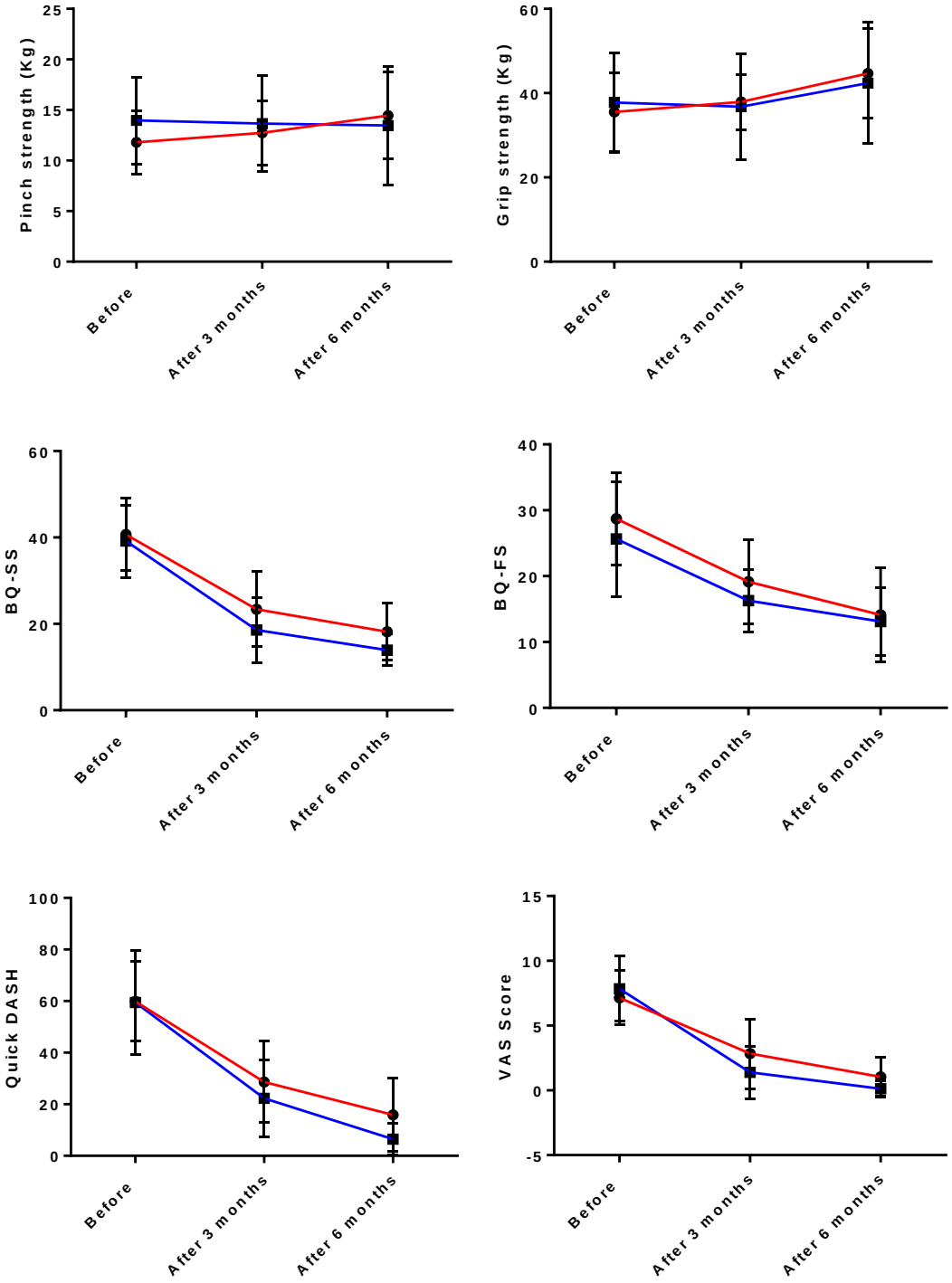

Figure 2: Comparison of Pinch strength, Grip strength, Quick DASH, BQ-SS, BQ-FS, VAS between CTS with (Red line and ●) and without (Blue line and ■) cervical radiculopathy

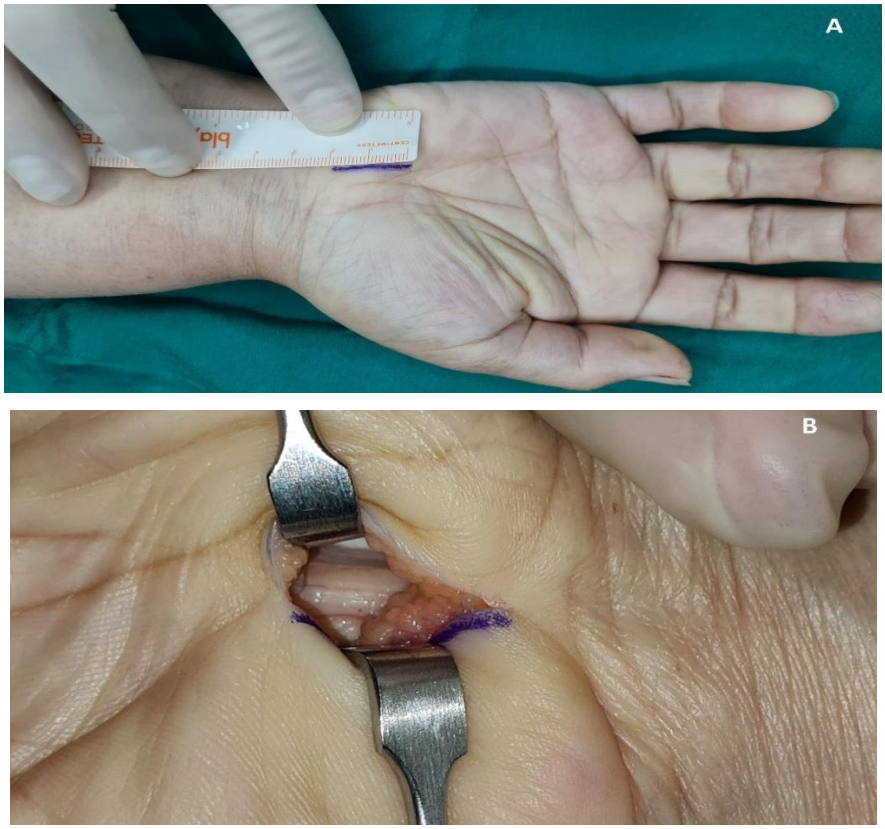

Figure 3: A: CTS surgical incision by "mini palm open carpal tunnel release" method B: Median nerve in carpal tunnel after release of retinaculum flexor.

Table 1: Comprision of Pinch strength, Grip strength, Quick DASH, BQ-SS, BQ-FS, VAS between CTS with and without cervical radiculopathy

Variables	CTS with cervical radiculopathy			CTS without cervical radiculopathy			P-Value*
	Before	After 3 months	After 6 months	Before	After 3 months	After 6 months	
Pinch strength (Kg)	11.80±3.12	12.73±3.13	14.45±4.28	13.96±4.30	13.65±4.71	13.47±5.87	0.505
Grip strength (Kg)	35.53±9.33	37.92±6.55	44.68±10.65	37.76±11.78	36.80±12.65	42.39±14.44	0.926
Quick DASH	59.88±15.39	28.65±15.72	15.90±14.22	59.44±20.29	22.28±14.85	6.45±6.02	0.096
BQ-SS	40.69±8.43	23.38±8.72	18.18±6.60	39.16±8.36	18.56±7.60	13.95±3.66	0.019
BQ-FS	28.73±7.02	19.15±6.44	14.13±7.07	25.64±8.72	16.28±4.77	13.13±5.12	0.108
VAS	7.15±2.09	2.84±2.69	1.04±1.49	7.84±2.51	1.39±2.03	0.13±0.62	0.258

Discussion

This study aimed to compare the clinical outcomes of median nerve release surgery in CTS patients with and without CR. Based on the results of this study, BQ-FS and BQ-SS, QuickDASH, and VAS scores had a significant decrease three months and six months after surgery compared to before surgery in the two groups of CTS with and without CR ($P<0.05$).

In the study, BQ-SS and BQ-FS scores were calculated and analyzed. The results of which showed that BQ-FS and BQ-SS scores were significantly improved three and six months after surgery in both CTS groups with and without CR. In addition, the BQ-SS and BQ-FS scores in the six monthsalso decreased significantly compared to the two months in the two groups, and the two groups did not differ significantly. The median nerve release surgery in two groups of CTS patients with and without CR causes a decreasing trend in BQ-SS and BQ-FS scores. Aminzadeh et al. compared changes in an ultrasound before and after median nerve release in patients with CTS and found that the Boston index was declining both in symptom and functional level after surgery, in line with the present findings [17]. Kim et al. (2014) in South Korea examined 35 hands undergoing surgery using median nerve ultrasound for nerve area at the canal entrance before surgery and then two and 12 weeks after surgery. The results showed that the score of the first part of the Boston questionnaire improved with a clear significant correlation up to two weeks after surgery. But the score of the functional part of the questionnaire and nerve area decreased significantly until 12 weeks later. The area before surgery had a significant relationship with the score of both parts of the Boston questionnaire. However, there was no significant relationship between the area before and after surgery (2 and 12 weeks later). Also changes in the size of the area after surgery with the scores of the questionnaire after surgery, were not according to the results of Aminzadeh et al. study. Kwang Kim et al. emphasized that the clinical symptoms improved rapidly after open CTR surgery. But it takes several months for clinical function and nerve swelling to recover. Moreover, pre-operative median nerve swelling can predict the pre-operative severity of clinical symptoms and functional impairment. Although, reduced postoperative median nerve swelling was not associated with reduced postoperative clinical symptoms and functional impairment in patients [18]. Oh et al. indicated that the index of the first part of the Boston questionnaire improved. But the functional index did not differ significantly from the control group [19]. Since no extensive study has compared so far the advantages and disadvantages of median nerve release in CTS patients with and without CR, thus it may be said that the median nerve release in both groups can be effectively improving the Boston index based on the results of this study.

This study compared the QuickDASH score before and after surgery between two groups of CTS with and without CR. Based on the results of this comparison, the QuickDASH score in the periods of three and six months after surgery had a significant decrease compared to before surgery in the two groups of CTS with and without CR. In addition, the QuickDASH score in the six months was significantly lower than the two months in the two groups, and the two groups were not significantly different from each other. In conclusion, the median nerve release surgery in both groups of CTS patients with and without CR causes a decreasing trend of QuickDASH score. In this regard, Oh et al. conducted a clinical trial between 2011 and 2013 on 67 patients with CTS. The patients were randomly divided into two groups one group consisted of 32 patients undergoing open surgery, and the other group consisted of 35 patients who underwent endoscopic surgery. DASH questionnaires and wrist ultrasonography were performed for patients to assess the area and ratio of nerve expansion before surgery and 24 weeks after surgery. The results showed a significant improvement in the mean QuickDASH scores after median nerve release, inconsistent with the results of this study [19]. Aminzadeh et al. [17] reported results similar to our and Oh et al.'s studies. Following the mentioned results, the use of the median nerve release method can be effective in improving the QuickDASH index in both groups of CTS patients with and without CR based on the results of the present study.

In this study, the pain intensity was assessed and compared based on VAS score before and after surgery between two CTS groups with and without CR. According to the results, the VAS score in three and six months after surgery was significantly lower than before surgery in the two groups of CTS with and without CR. Moreover, the VAS score in the period of six months had a significant decrease compared to two months between the two groups, and the two groups were not significantly different from each other. In summary, the median nerve release surgery in both groups of CTS patients with and without CR causes a decreasing trend in the VAS score. Payr et al. reported that the median nerve release surgery significantly reduced the VAS score in patients compared to before surgery. It is

consistent with the findings of the present study [20]. Okamura et al. showed that open carpal tunnel release surgery with the endoscopic technique could reduce the VAS score in patients after surgery [21]. It is according to the results of the present study. Therefore, since the main cause of CTS with or without radiculopathy is the nerve entrapment and compression inside the carpal tunnel, the median nerve release surgery can reduce the pressure caused by entanglement and contraction of the nerve, thus attenuating the pain intensity in these patients. According to the results of this study, the employment of median nerve release surgery can be effectively reducing the pain intensity in both groups of CTS patients with or without CR.

In this study, two different groups of CTS patients with and without CR were compared, which is one of the strengths of the present study. Moreover, the assessment of critical indicators is another strength of this study. The limitations of this study include the small sample size and the drop in patients during three-month and six-month follow-up due to the prevalence of COVID-19 as well as the duration of patient follow-up.

Conclusion

The findings obtained from the present study demonstrated that the median nerve release surgery is effective in CTS patients with or without cervical radiculopathy. Also, a six-month follow-up course of treatment revealed that there was no need for referral due to proximal release in the patients with CR and CTS symptoms. Future studies are needed to be performed with larger sample size and long follow-up periods plus MRI for cervical radiculopathy as a measurement tool.

Acknowledgments

None

Conflict of Interest Disclosures

The authors declare no potential conflict of interest, with respect to the research, authorship, and/or publication of this article.

Funding Sources

The authors received no financial support for the research, authorship, and/or publication of this article.

Authors' Contributions

Study concept and design: Mehran Razavipour and Salman Ghaffari.

Data collection and study management: Abolfazl Ghadiri.

Drafting of the manuscript: Abolfazl Ghadiri and Mehran Razavipour. Revision of the manuscript: Mehran Razavipour, Salman Ghaffari and Abolfazl Ghadiri.

Ethical Considerations

Institutional approval from the university Ethics Committee and review board of Mazandaran University of Medical Sciences was obtained and registration number:
IR.MAZUMS.IMAMHOSPITAL.REC.1398.5276

References

1. Kim PT, Lee HJ, Kim TG, Jeon IH. Current approaches for carpal tunnel syndrome. *Clin Orthop Surg.* 2014;6(3):253-7.

2. Karimi N, Tabrizi N, Moosavi M. Prevalence of carpal tunnel syndrome and associated risk factors. *Journal of Mazandaran University of Medical Sciences.* 2017;26(146):179-84.

3. Middleton SD, Anakwe RE. Carpal tunnel syndrome. *BMJ.* 2014;349:g6437.

4. Zieske L, Ebersole GC, Davidge K, Fox I, Mackinnon SE. Revision carpal tunnel surgery: a 10-year review of intraoperative findings and outcomes. *J Hand Surg Am.* 2013;38(8):1530-9.

5. Zamborsky R, Kokavec M, Simko L, Bohac M. Carpal Tunnel Syndrome: Symptoms, Causes and Treatment Options. Literature Reviev. *Ortop Traumatol Rehabil.* 2017;19(1):1-8.

6. Wang WL, Hanson T, Fowler JR. A Comparison of 6 Diagnostic Tests for Carpal Tunnel Syndrome Using Latent Class Analysis. *Hand (N Y).* 2020;15(6):776-9.

7. Molinari WJ, 3rd, Elfar JC. The double crush syndrome. *J Hand Surg Am.* 2013;38(4):799-801; quiz 801.

8. Uchiyama S, Itsubo T, Nakamura K, Kato H, Yasutomi T, Momose T. Current concepts of carpal tunnel syndrome: pathophysiology, treatment, and evaluation. *J Orthop Sci.* 2010;15(1):1-13.

9. Kwon HK, Hwang M, Yoon DW. Frequency and severity of carpal tunnel syndrome according to level of cervical radiculopathy: double crush syndrome? *Clin Neurophysiol.* 2006;117(6):1256-9.

10. Lee SU, Kim MW, Kim JM. Ultrasound Diagnosis of Double Crush Syndrome of the Ulnar Nerve by the Anconeus Epitrochlearis and a Ganglion. *J Korean Neurosurg Soc.* 2016;59(1):75-7.

11. Aroori S, Spence RA. Carpal tunnel syndrome. *Ulster Med J.* 2008;77(1):6-17.

12. Badger SA, O'Donnell ME, Sherigar JM, Connolly P, Spence RA. Open carpal tunnel release--still a safe and effective operation. *Ulster Med J.* 2008;77(1):22-4.

13. Iida J, Hirabayashi H, Nakase H, Sakaki T. Carpal tunnel syndrome: electrophysiological grading and surgical results by minimum incision open carpal tunnel release. *Neurol Med Chir (Tokyo).* 2008;48(12):554-9.

14. Keramettin A, Cengiz C, Nilgun C, Ayhan B. Microsurgical open mini uniskin incision technique in the surgical treatment of carpal tunnel syndrome. *Neurol India.* 2006;54(1):64-7.

15. Gutman G, Rosenzweig DH, Golan JD. Surgical Treatment of Cervical Radiculopathy: Meta-analysis of Randomized Controlled Trials. *Spine (Phila Pa 1976).* 2018;43(6):E365-e72.

16. Wessel LE, Fufa DT, Canham RB, La Bore A, Boyer MI, Calfee RP. Outcomes following Peripheral Nerve Decompression with and without Associated Double Crush Syndrome: A Case Control Study. *Plast Reconstr Surg.* 2017;139(1):119-27.

17. Aminzadeh B, Ebrahimnezhad M, Ebrahimzadeh MH, Mehrad Majd H, Moradi A. Evaluation and Comparison of Changes in Ultrasonography before and after Carpal Tunnel release. *Iranian Journal of Orthopaedic Surgery*. 2018;16(4):265-71.

18. Kim JK, Koh YD, Kim JO, Choi SW. Changes in Clinical Symptoms, Functions, and the Median Nerve Cross-Sectional Area at the Carpal Tunnel Inlet after Open Carpal Tunnel Release. *Clin Orthop Surg.* 2016;8(3):298-302.

19. Oh WT, Kang HJ, Koh IH, Jang JY, Choi YR. Morphologic change of nerve and symptom relief are similar after mini-incision and endoscopic carpal tunnel release: a randomized trial. *BMC Musculoskelet Disord.* 2017;18(1):65.

20. Payr S, Tiefenboeck TM, Moser V, Turkof E. Surgery of True Recurring Median Carpal Tunnel Syndrome with Synovial Flap by Wulle Plus Integument Enlargement Leads to a High Patient's Satisfaction and Improved Functionality. *J Clin Med.* 2019;8(12).

21. Okamura A, Meirelles LM, Fernandes CH, Raduan Neto J, Dos Santos JB, Faloppa F. Evaluation of patients with carpal tunnel syndrome treated by endoscopic technique. *Acta Ortop Bras.* 2014;22(1):29-33.