Evaluation of Hand Pain, Disability and Quality of Life after Carpal Tunnel Release for patients had Median Nerve Entrapment secondary to Distal Radius Fracture Fixation: A Prospective Interventional Study

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Abstract

Background: Carpal tunnel syndrome (CTS) is a compression median nerve neuropathy at the wrist. Surgical treatment of distal radius fracture (DRF) might expose patients to developing CTS.

Objectives: To assess the feasibility and success rate of open carpal tunnel release (OCTR) for patients with symptomatizing CTS secondary to DRF fixation.

Patients and methods: 17 patients were evaluated preoperatively and 1,4,6,8 and 12-wk postoperative (PO) using the short-form McGill Pain Questionnaire (SF-MPQ), the Boston Carpal Tunnel Questionnaire (BCTQ), Patient-Reported Outcomes Measurement Information System (PROMIS) and the Quick Disabilities of the Arm, Shoulder & Hand (DASH) Questionnaire. Surgeries were performed as day-case surgery through mini-volar incision (1-inch) along the radial border of the extended ring finger. The study outcome is the reduction of pain scoring and improved physical function (PF) scores by >50% at 4-wk after surgery relative to preoperative scores.

Results: All surgeries were performed uneventfully with improved PO scores of the assessed items. At 8-wk PO, SF-MPQ increased significantly (P<0.001), while BCTQ scores increased insignificantly (P=0.529) in comparison to 4-wk scores. PF scorings decreased insignificantly (P=0.130), but mental function scores were significantly (P=0.0155) lower at 8-wk than at 4-wk PO. Total PROMIS score and DASH questionnaire scorings decreased significantly (P=0.0019 and 0.0001, respectively) at 8-wk than at 4-wk PO.

Conclusion: OCTR for symptomatic CTS secondary to DRF through small volar incision is safe and efficient approach in terms of improvement of pain, functional and mental scorings of patients with no procedure-related complications.

Keywords: Distal radius fracture; Symptomatizing carpal tunnel syndrome; Open carpal tunnel release; Pain; Physical function.

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Introduction

Distal radius fracture (DRF) is one of the most common fractures encountered in human body and its incidence is increasing and affects all age groups **(Kloberdanz et al., 2024)**. DRFs require careful consideration regarding the appropriate treatment options that range between conservative or surgical treatment for the large variability of fracture patterns, bone quality, and anatomy **(Bell et al., 2024)**.

Options for surgical treatment are multiple and range from closed to open procedures. However, treatment of difficult DRFs has potential pitfalls that are related to the appropriate surgical exposure and soft tissue handling, provisional reduction, fixation type, and augmentation of fracture fixation **(Seeher et al., 2024)**.

Carpal tunnel syndrome (CTS) is a compression neuropathy of the median nerve at the wrist **(Lusa et al., 2024)**. CTS is the most common nerve entrapment disorder worldwide that is characterized by having multi-factorial risk factors and guidelines to choose between its surgical and non-surgical treatment remain to be elucidated **(Dahlin et al., 2024)**. However, surgery is considered when symptoms persist despite of the use of non-surgical treatments **(Lusa et al., 2024)**.

Surgical treatment of DRF exposed patients to develop CTS by an incidence of 4-times higher than nonsurgical DRF treatment **(Chung et al., 2024)** and a systemic review reported 14.3% incidence of CTS after surgical management of DRFs **(Pacchiarini et al., 2024)**. Moreover, patients who developed CTS as a complication of surgical treatment of DRF had nearly three times higher rate of surgical carpal tunnel release (CTR) **(Chung et al., 2024)**.

This study's objectives included assessment of the feasibility and success rate of open carpal tunnel release (OCTR) for patients who had symptomatizing median nerve entrapment after DRF fixation as judged by the changes in the severity of hand pain, physical function (PF) and patients' quality of life.

Patients and methods

Design : Prospective interventional study.

Setting: Neurosurgery Department, Faculty of Medicine, Helwan University.

All patients referred to or attended the outpatient clinic of Neurosurgery complaining of hand pain and/or disabilities after surgery for DRF were evaluated for data collection. The collected data included patients' demographic data, type of work, the side affected, history of medical disorders, and previous treatment for the entrapped nerve

Inclusion criteria: Patients with hand pain and/or disability after DRF fixation and were diagnosed to have median nerve entrapment and were free of exclusion criteria were enrolled in the study.

Exclusion criteria: Patients had previous history of hand pain and/or disability before DRF, patients who were maintained on analgesia for other indications, patients who were waiting for oncoming other orthopedic surgeries, diabetic patients, patients who were maintained on renal replacement surgery, and patients who refused to participate in the study or missed during follow-up were excluded from the study.

Trial registration: The study protocol was approved by the Research Ethics Committee of the Faculty of Medicine, Helwan University with the reference number (99-2024). The study protocol was discussed with patients and those accepted to participate in the study were asked to sign the written fully informed consent before enrolment.

Sample size calculation

The study's null hypothesis is the significant differences between pain and PF scores at 1 week after surgery in comparison to preoperative scores. A previous study provided CTR for 14 cases of median neuropathy after DRF repair and reported significant improvements in patients' complaints **(Vernet et al., 2020)**. Thereafter, another study compared open versus endoscopic CTR in 19 patients who had acute CTS after radius fracture and reported insignificant differences in the presenting manifestations and median nerve morphology and concluded that both methods might provide successful outcomes **(Peters et al., 2021)**. Sample size was calculated using the G*Power (Version 3.1.9.2) **(Faul et al., 2007)**, to provide a study power of 80% using α-error 5%, and considering the effect size of 0.20, 17 patients was defined as the suitable number to ensure the certainty of the null hypothesis.

Evaluation Tools

The evaluation questionnaire fulfillment was the duty of an assistant who was not included as an author to allow patients to respond to the questions even if illiterate

1. **The short-form McGill Pain Questionnaire (SF-MPQ)** for evaluation of present pain intensity and consists of 11 sensory and 4 affective items that were evaluated on 4-point scale with 0 = none, 1 = mild, 2 = moderate or 3 = severe, and total score was calculated **(Melzack 1987)**.
2. **PEG score**: this is a three-item questionnaire including assessment of **p**ain, **e**njoyment, and **g**eneral activity of patients complaining of pain. Each of the three items was assessed on a 10-point scale and the total score of the 3-items was the result of dividing the summation of the scores of the three items by three with the lower score the better patient condition **(Brailo and Zakrzewska 2015)**. Two cutoff points were proposed as lower (4 points) and upper (7 points) limits for the PEG score **(Roldán-Majewski et al., 2022)**.
3. **The Boston Carpal Tunnel Questionnaire (BCTQ)** is a two-scale questionnaire; Symptom Severity Scale (SSS) and Functional Status Scale (FSS), which consist of 11 and 8 questions, respectively. These questions were scored on 1-5-point Likert scale with no difficulty scored by 1 and 5 indicated extreme difficulty **(Levine et al., 1993)**.
4. **Patient-Reported Outcomes Measurement Information System (PROMIS) physical/mental health questionnaire** is an 8-domain, 29-item questionnaire including PF, anxiety, depression, fatigue, sleep disturbances, ability to participate in social activities, pain interferences, and pain intensity. The items of these 8 domains were answered and scored on a 1-5 point Likert scale. For PF, 5 indicates doing physical functions without any difficulty and 1 indicates unable to do. For the other 7 domains, 1 indicates never and 5 indicate always. The sum of scores for these 7 domains was calculated and higher scores indicated worse functions **(Beleckas et al., 2017)**.
5. **Quick Disabilities of the Arm, Shoulder & Hand (DASH) Questionnaire** is an 11-item questionnaire used to measure the magnitude of disability and symptoms specific to the upper extremity. The DASH questionnaire includes six items to

measure the degree of difficulty in performing various physical activities because of a shoulder, arm, and hand problem, while the other 5 items are related to the quality of sleep, social activities, and daily activities, and the intensity of pain and numbness. The answers to the questions range between no, mild, moderate, or severe difficulty or unable to do and answers were scored using a 1-5 Likert scale and the sum of scores was transformed to a percentage with a higher percentage indicating severe difficulty **(Beaton et al., 2005; Moradi et al., 2016)**.

Operative procedure

Surgeries were performed under local intravenous anesthesia with 100% oxygen mask ventilation, and general opioid-free total intravenous anesthesia to provide rapid recovery and guard against the side effects of the intubation, such as sore throat and postoperative opioid-related side effects such as nausea, vomiting, or respiratory depression or local infiltration anesthesia according to circumstances and patients' preference to allow case management as a day-surgery case. Briefly, the procedure entails making an inch-length incision along the radial border of the extended ring finger that was deepened until the carpal tunnel ligament (CTL) exposure. The most ulnar aspect of CTL was released under direct vision using scissors or scalpel and its radial leaflet was kept over the median nerve. After assuring that the CTL was completely released proximally and distally, the skin wound was closed using 3-0 nylon **(Samarakoon et al., 2014)**.

Postoperative (PO) care

Immediately after surgery, the hand and wrist are splinted and suspended. The patient was prescribed broad-spectrum antibiotics, analgesics, and anti-inflammatory drugs. Using the operated hand was prohibited till the 1st PO visit on the 3rd PO Day, for wound examination and re-wrapping and splinting of the hand and wrist. Patients were examined at 1-, 4-, 6-, 8- and 12-wk PO for re-assessment of the evaluation tools. Work was prohibited for 8 weeks if the operated hand was the dominant, while if not the dominant, using the hand was allowed after four weeks.

Study outcomes

1. The primary outcome is the reduction of pain scoring and improved PF scores by >50% at 4-wk after surgery in comparison to preoperative scores **(Manchikanti et al., 2010)**.
2. The secondary outcomes included:
   - The frequency and extent of improvement in the scores of the evaluation tools in relation to preoperative scorings
   - Evaluation of the impact of work through determination of the extent of pain and PF on return to work at 8-week PO.
   - Patients' satisfaction by outcomes graded on a 5-likert score ranging between very satisfied to very dissatisfied.

Statistical analysis

Statistical analyses were performed using IBM® SPSS® Statistics software (Version 27, 2020; Armonk, USA). The Kolmogorov-Smimov test of normality and the normal Q-Q plots were used to test the data normality. Data are presented as mean and standard deviation (SD) that were compared using paired t-test for data determined at each assessment session in comparison to preoperative data. The data presented as percentages were compared using the Chi-square test. Data concerning the percentage of change were compared using the One-

way ANOVA test. Pearson's Correlation analysis was applied to assess the relationship between at 4-week pain and PF scorings. The significance of the result was determined at a cutoff point of $P<0.05$.

Results

The preliminary evaluation excluded 3 patients who needed revision for their DRF, 3 patients who had carpal tunnel nerve entrapment but were free of DRF and 2 patients who were maintained on renal dialysis, and one diabetic patient (**Fig. 1**). The study included 17 patients fulfilling the inclusion criteria and their enrolment data are shown in (**Table.1**).

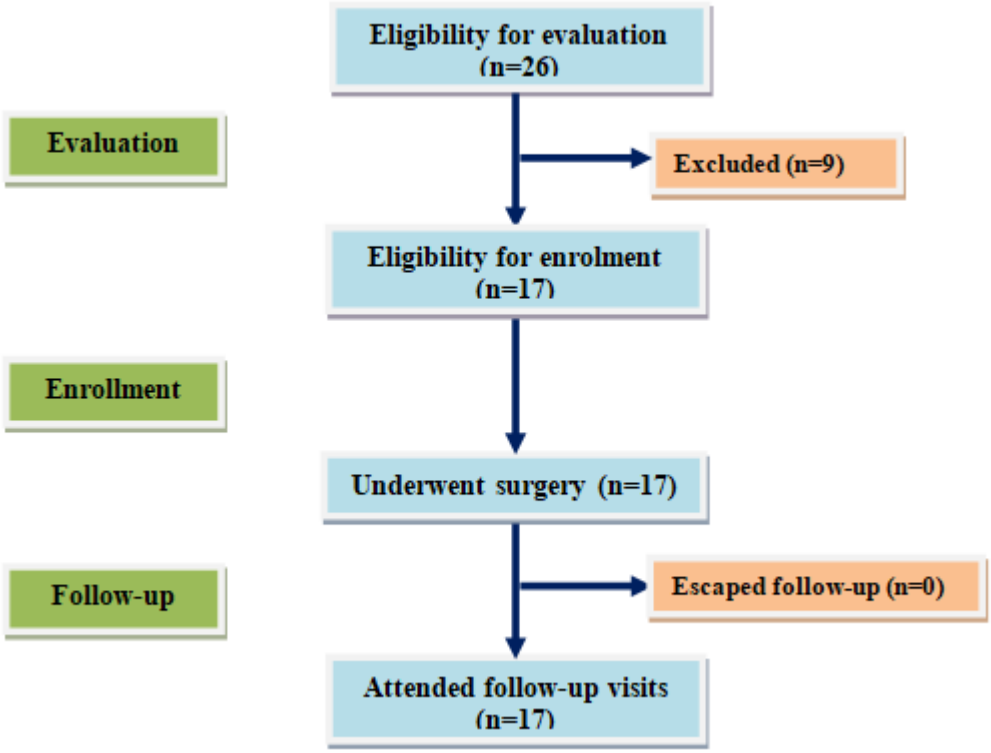

Fig.1.Patient's Flow Chart.

Table 1. Patients' enrolment data

Data		Findings
Age (years)	**<40**	10 (58.8%)
	≥40	7 (41.2%)
	Average (±SD)	40±4.2
Gender	**Male**	6 (35.3%)
	Female	11 (64.7%)
Body mass index (kg/m^2)	**<30**	2 (11.8%)
	≥30	15 (88.2%)
	Average (±SD)	31.8±1.4
Type of work	**Housewife**	3 (11.8%)
	Worker	6 (35.3%)
	Farmers	4 (23.5%)
	officers	3 (17.6%)
	drivers	2 (11.8%)

The side of the affected hand	**Dominant**	15 (88.2%)
	Not dominant	2 (11.8%)
Frequency of medical disorders		3 (17.6%)
Previous treatment	**No**	11 (64.7%)
	Medical	4 (23.5%)
	Local injection	2 (11.8%)
	Surgery	0

Ten patients (58.8%) who were mostly females received general anesthesia, five patients (29.4%) received local intravenous anesthesia and two patients (11.8%) received local infiltration anesthesia. Five surgeries (29.4%) required <60 min, while 12 surgeries (70.6%) required operative time of >60 min for a mean operative time of 62.4±11.7 min. All patients were managed as day-surgery with a mean duration of postoperative (PO) hospital stay of 5.8±1.2 h; 7 patients (41.2%) stayed for <6 h and 10 patients for ≥6 h. Wound care during the immediate follow-up period detected no wound-related complications apart from mild hyperemic wound edge that was reported in three cases 3 (17.6%) and wound edema in two cases 2 (11.8%) and all had subsided and no wound infection or disruption occurred (**Table. 2**).

Table 2. Perioperative data

Data		**Findings**
Anesthesia	**General**	10 (58.8%)
	Local intravenous	5 (29.4%)
	Local infiltration	2 (11.8%)
Operative time (min)	**<60**	5 (29.4%)
	≥60	12 (70.6%)
	Average (±SD)	62.4±11.7
Postoperative hospital stay (h)	**<6**	7 (41.2%)
	≥6	10 (58.8%)
	Average (±SD)	5.8±1.2
Wound-related complications	**Edema**	2 (11.8%)
	Hyperemia	3 (17.6%)
	Infection	0
	Disruption	0

The scores of all the re-assessed tools were significantly improved from the 1st till the 12th week PO in comparison to scores determined preoperatively as shown in (**Table.3**).

Table 3. Outcome of surgery

Tool / Time		**Pre**	**1-w**	**2-w**	**4-w**	**6-w**	**8-w**	**12-w**
SF-MPQ		19±4.9	14±3.8*	11.8±3*	7.9±2.2*	8.2±2.4*	9.9±2.5*†	8.1±2.4*
PEG score		6.1±0.8	4.7±0.9*	3.6±0.7*	2.3±0.6*	1.9±0.4*†	2.3±0.5*	2.3±0.6*
BCTQ	**SSS**	27±5.	21±3.6	16.3±2.	13.9±2.	12±1.4*	13.7±1.	15.8±2.2

score		1	*	5*	3*		8*	*†
	FSS	33±6	26.9±4.8*	23.1±4.1*	19.2±3.6*	15.6±2.9*†	13.3±3*†	13±4.2*†
	Total	60±10.8	47.9±7.9*	39.4±6.3*	30.5±6.3*	27.6±3.8*†	27±4.1*†	28.9±5.5
PROMIS score	**PF**	1.7±0.7	2.8±0.9*	3.5±0.6*	4±0.8*	4±1.1*	3.6±0.9*†	3.1±0.9*†
	MF	27±3.1	22.5±2.8*	20±2.7*	16.6±2.8*	14.9±2.9*†	14±4.3*†	13±4.6*†
	Total	28.7±3.2	25.4±2.8*	23.5±2.8*	20.6±2.7*	18.9±2.8*	17.6±4*	16.1±4.4*
DASH score		35±5.5	29.4±3.7*	26.3±3.3*	21.7±2.6*	19.5±3*†	17.5±4*†	16.4±5.9*†

SF-MPQ: Short-form McGill Pain Questionnaire; BCTQ: Boston Carpal Tunnel Questionnaire; SSS: Symptom Severity Scale; FSS: Functional Status Scale; PF: Physical function; MF: Mental function; PROMIS: Patient-Reported Outcomes Measurement Information System; DASH: Quick Disabilities of the Arm, Shoulder & Hand Questionnaire; *: significant difference versus preoperative scores; † indicates significant versus 4-wk scores

Assessment of PO pain using SF-MPQ showed progressively decreasing scores till 4-wk PO and later on scores started to increase with insignificantly higher scores at 6-wk (P=0.096) and 12-wk (P=0.529) PO, while at 8-wk PO on return to work the difference was significant (P<0.001) in comparison to 4-wk scores. Regarding PEG scores, it was decreased progressively reaching their lowermost levels at 6-wk PO with significantly (P=0.0007) lower scores compared to scores determined at 4-wk PO, while at 8-wk and 12-wk PO PEG scores were insignificantly (P=0.9) increased than scores determined at 4-wk scores (**Table.3, Fig. 2**).

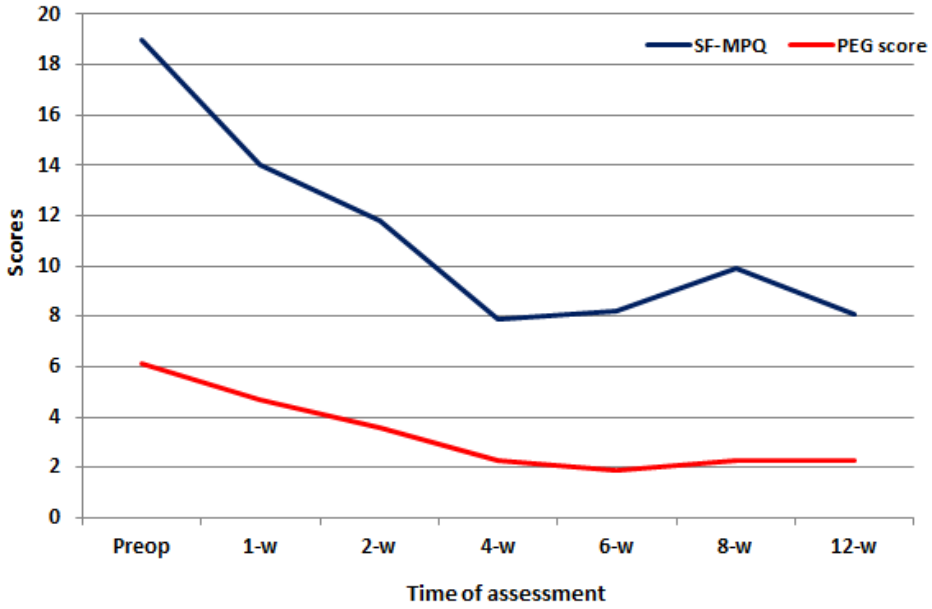

Fig. 2. SF-MPQ and PEG scores assessed during 3-m follow-up in relation to preoperative scores.

Both components of BCTQ score showed progressive time-dependent decreased scores; SSS reached its lowermost level at the 6-wk PO and

increased insignificantly at the 8-wk (P=0.529), but significantly (P=0.0005) at the 12th week PO. FSS reached its lowermost level at the 12th PO week; the scores determined at 4-wk PO were significantly higher in comparison to scores determined at 6-wk (P<0.001), 8-wk (P<0.001) and 12-wk (P=0.0002) as shown in (**Fig.3**). Total BCTQ score also decreased progressively to its lowermost level at 8-wk PO. Total BCTQ score determined at 4-wk PO was significantly higher than score determined at 6-wk (P=0.0026) and at 8-wk (P=0.0032), but was insignificantly (P=0.343) higher than at 12-wk score (**Table.3**).

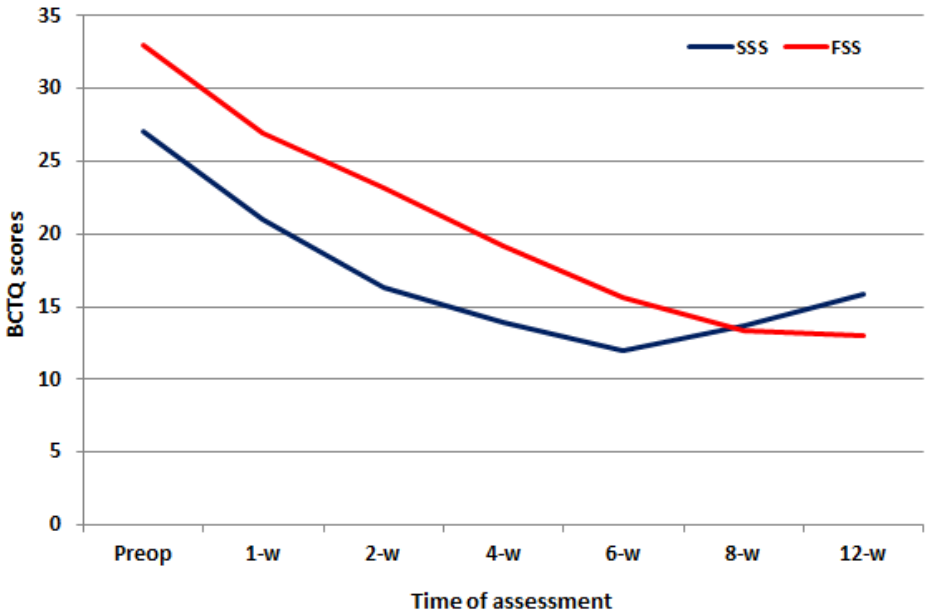

Fig. 3. SSS and FSS scores assessed during 3-m follow-up in relation to preoperative scores.

Physical function (PF) scorings increased progressively reaching a peak score at 4-wk and 6-wk PO, while decreased insignificantly at 8-wk (P=0.130), but significantly (P=0.0037) at 12-wk PO compared to score determined at 4-wk PO. Stressed mental function (MF) scoring decreased progressively to reach its lowermost value at the 12th week PO. MF scores determined at 6-wk, 8-wk, and 12-wk were significantly (P=0.0043; 0.0155 & 0.0053, respectively) lower in comparison to scores determined at 4-wk PO (**Fig. 4**).

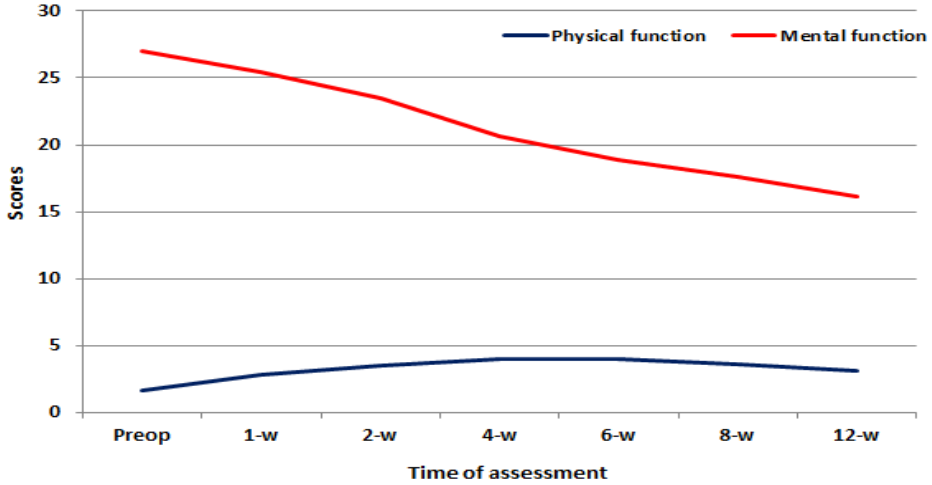

Fig. 4. PF and MF scores assessed during 3-m follow-up in relation to preoperative scores.

Total PROMIS score decreased progressively reaching its lowermost level at the 12th week PO with a significantly higher score at 4-wk in comparison to scores determined at the 6th week (P=0.0005), 8th week (P=0.0019) and 12th week (P=0.0005) PO. DASH questionnaire scorings were decreased progressively during follow-up with significantly lower DASH scores at 6-wk (P=0.0004), 8-wk (P=0.0001), and 12-wk (P<0.001) in comparison to scores determined at 4-wk PO (**Table 3, Fig. 5**).

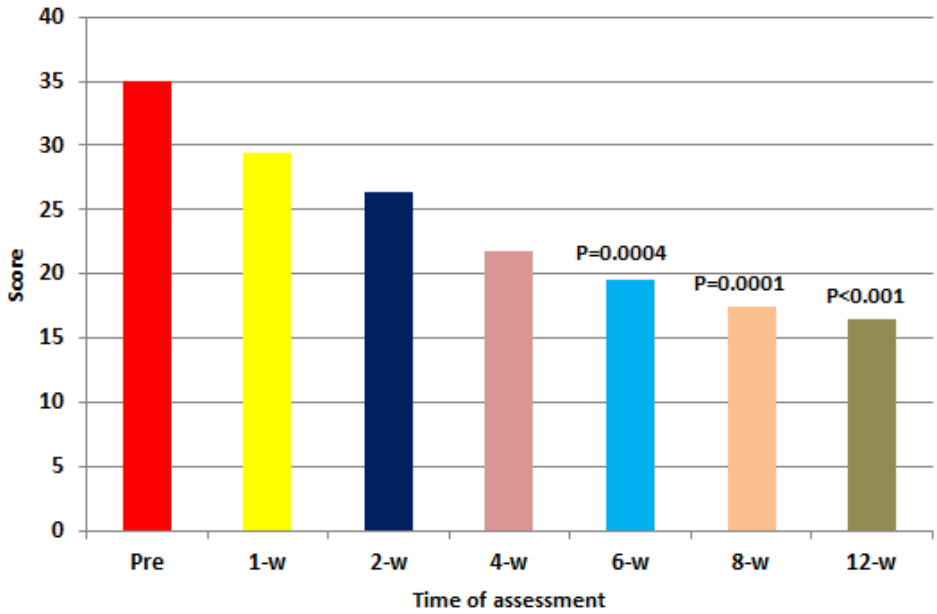

Fig. 5. DASH scores assessed during 3-m follow-up in relation to preoperative scores showing the significance of difference versus scores determined at 4-week PO.

The maximum change in the SF-MPQ scores was at 4-wk PO but decreased significantly (P<0.001) on return to normal activities at 8-wk but re-improved gradually up to insignificant (P=0.471) difference at the 12th week PO whenever the scores were significantly (P=0.0008) higher than score determined at the 8th week PO. The determined PEG scores at 4-12 weeks PO were decreased by about 60% with the maximum decrease determined at 4-wk PO and re-increased significantly at 8-wk (P=0.0008) and 12-wk (P=0.019) with insignificant (P=0.827) difference between 8-wk and 12-wk scores. BCTQ total score decreased by 48.9% at 4-wk, but increased significantly at 8-wk (P=0.002) and non-significantly (P=0.484) higher at 12-wk PO with significantly (P=0.034) lower total score at 12-wk than 8-wk PO. Similarly, the PROMISE total score was decreased by 28.1% and increased significantly at 8-wk (P=0.002) and 12-wk (P=0.0004) with a significantly (P=0.00005) higher score at the 12th versus the 8th week PO. As regards, the DASH score it decreased at the 4th PO week by 31.3% and re-increased significantly (P=0.0002) at 8-wk and 12-wk (P=0.0006) with insignificantly (P=0.069) higher score at the 12th than the 8th PO weeks (**Table 4, Fig. 6**).

Table 4.The percentage of PO change in the evaluation scores in relation to preoperative scores of the studied patients

Scores / Time		At 4-wk	At 8-wk	At 12-wk
SF-MPQ score	% of change	58±6	47.1±6.8	56.5±12.2
	P1		<0.001	0.471
	P2			0.0008
PEG score	% of change	69±5.2	61.5±9.5	62.1±11.9
	P1		0.0008	0.019
	P2			0.827
BCTQ score	% of change	48.9±6.7	54.3±6.6	50.8±11.4
	P1		0.002	0.484
	P2			0.034
PROMIS	% of change	28.1±5.1	38.7±12.6	43.9±15.1
	P1		0.002	0.0004
	P2			0.00005
DASH	% of change	31.3±6.5	48.9±14.2	52.4±18.2
	P1		0.0002	0.0006
	P2			0.069

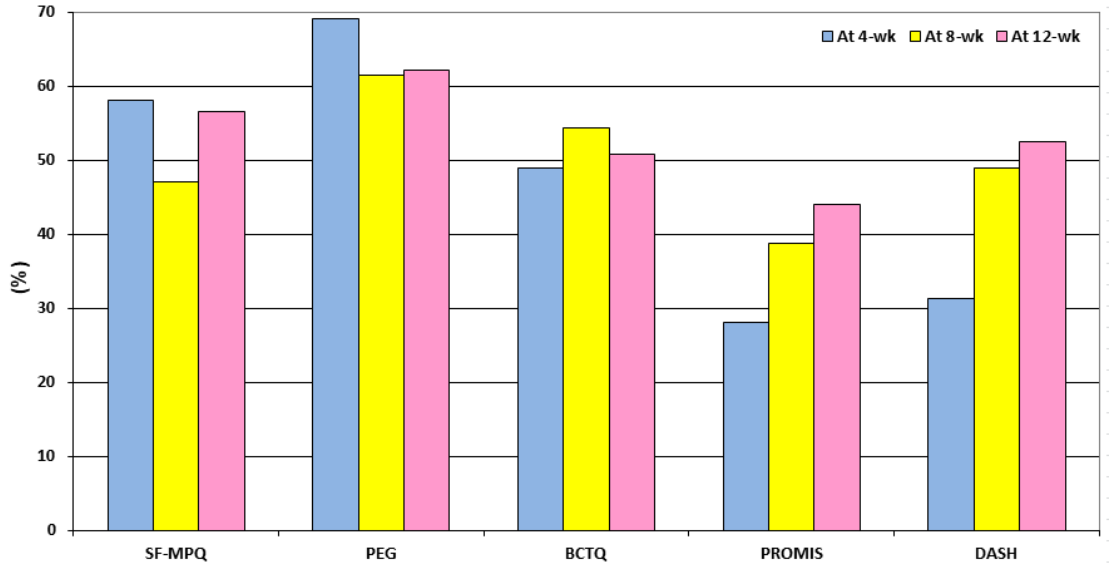

Fig. 6. Mean value of the percentage of change of outcome evaluation parameters during follow-up of the studied patients.

Regarding the primary outcome; at the 4th PO week, two patients had improved SF-MPQ score by <50% with improved PF by only 50% of the preoperative scores. Additionally, a 3rd patient had improved PF by 50% despite of decreased SF-MPQ score of 62.5% in relation to the preoperative scores. Another 6 patients had decreased SF-

MPQ scores in the range of 50-60%; 4 of them had increased PF by 50-100% and in 2 patients PF scores increased by 150%. In the remaining 8 patients SF-MPQ scores were decreased by >60% and PF scores were increased in 3 patients by 200% and in 5 patients by 300%. The percentage of change in PF scores was positively correlated with the percentage of change in SF-MPQ with a significant (r=0.552, P=0.022) correlation as shown in **(Fig.7**).

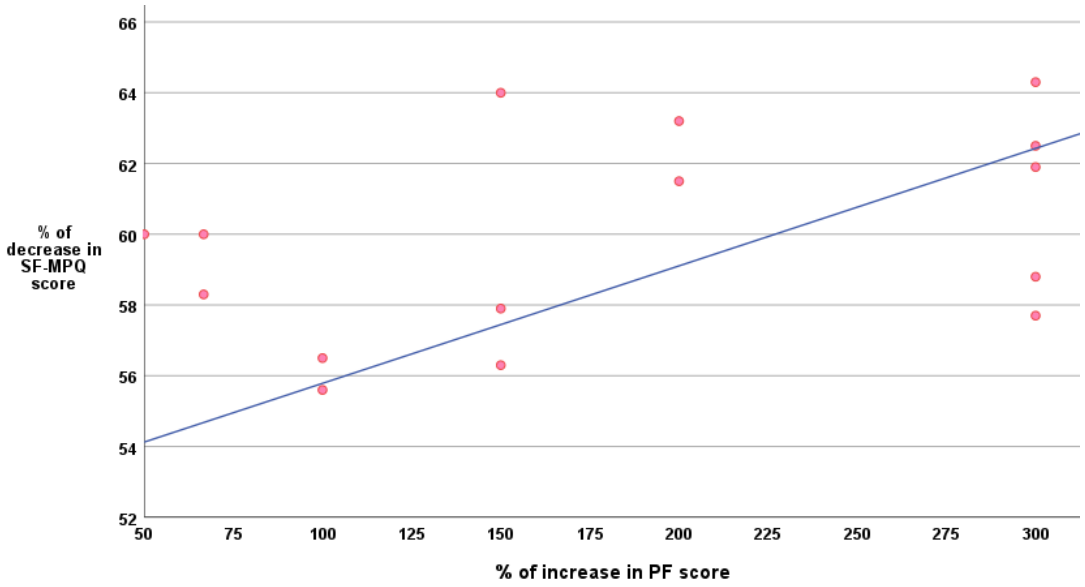

Fig. 7. Correlation between the percentages of change in PF and SF-MPQ scores of the studied patients at the 4th PO week.

At the end of the 12-wk follow-up, 5 patients (29.4%) were very satisfied and 8 patients (47.1%) were satisfied by surgery outcomes, while 4 patients (23.4%) found the outcome is good.

Discussion

At the 4th PO week, only two patients had improved pain scores by <50% with improved PF by 50% of the preoperative scores, while the remaining 15 patients (88.2%) had improvements that were coincident with the study target (≥50%). Additionally, assessment of the other evaluation tools assured the improved mental functional statuses of all patients. These results assured the feasibility and appropriateness of the applied procedure for open CTR (OCTR) for patients who had median nerve entrapment secondary to correction of distal radius fracture (DRF).

In support of the effectiveness of OCTR, **Wipperman and Penny. (2024)** in a rapid evidence review documented that endoscopic (ECTR) and open techniques for CTR are equally effective and **Schroeder et al. (2024)** found both techniques did not differ in terms of PO patient calls for pain, number of opioid refills, or occupational therapy referrals.

Re-assessment of the evaluation tools during 12-week follow-up showed significant differences in comparison to the preoperative scores. Moreover, the functional recovery of the studied patients according to the DASH scoring system showed progressively decreasing DASH scores during follow-up and the return to work for patients who had surgery on the

dominant did not compromise the improved hand grip but DASH scoring continued to decrease with significant lower scores at 8 (P=0.0001) and 12 weeks (P<0.001) in comparison to scores at 4 weeks. In line with these findings, **Donati et al. (2024)** in a retrospective comparative study between ECTR and OCTR documented no significant difference between the effects of both procedures on the grip strength despite the lower DASH scores with endoscopic release. Also, **El Masri et al. (2024)** in a meta-analysis of outcomes of CTS cases who underwent ECTR versus OCTR documented similar outcomes but found that ECTR was associated with higher pinch strength and shorter time to return to work. These two studies **(Donati et al. (2024); El Masri et al. (2024))** assured the appropriateness of the applied technique and supported the success of open CTR for cases of CTS.

The operative procedure was conducted through a 1-inch longitudinal volar incision along the radial border of the extended ring finger. No incision-related complications were reported and the incision showed no impacts on pain, BCTQ, or DASH scores. In line with the applied incision and its relation to outcomes, **Bassil et al. (2024)** could not detect a statistically significant difference between CTR through a longitudinal palmar mini-incision and transverse incision at the palmar crease and documented that, patients of both groups showed improved grip strength and BCTQ scores during PO follow-up. Furthermore, **Eberlin et al. (2024)** compared CTR with ultrasound guidance to mini-open CTR and found both approaches provided comparable improvement as judged by insignificant differences in the mean values of changes in BCTQ-SSS, BCTQ-FSS and numeric pain scale with low complication rates over 1 year of follow-up and only one revision surgery for a patient had CTR with US guidance.

The current study included patients who required CTR for CTS secondary to DRF after a duration ranging between 24 and 72 days since DRF. Unfortunately, prospective studies for the management of similar conditions are scarce, but the obtained results supported the results obtained by **Tannan et al. (2015)** who demonstrated statistically insignificant differences as regards the extent of improvement in functional severity scores, symptom severity, and grip strength between using the extended flexor carpi radialis versus the traditional volar Henry approach for prophylactic CTR at the time of volar plate osteosynthesis for DRF via a single incision and detected significant improvement of symptom severity score at 6 and 12 weeks, respectively.

However, retrospectively **Zemirline et al. (2018)** reviewed 10 consecutive cases of DRF associated with symptomatic CTS, using a volar locking plate and endoscopic CTR through a single 15-mm minimally-invasive approach and reported significant improvements in DASH and pain scores with improved hand-grip strength, but the complication rate was 50% and two cases developed complex regional pain syndrome type I. Thereafter, **Bhashyam and Kao. (2022)** retrospectively documented that concurrent endoscopic CTR using the flexor carpi radialis approach for DRF is safe from major complications and effective at releasing the transverse carpal ligament.

The results of the current study were superior to those reported retrospectively by **Zemirline et al. (2018)** and were coincident with the results obtained by **Bhashyam and Kao. (2022)**, but the possibility of a

high complication rate for simultaneous repair of DRF and CTR as documented by **Zemirline et al., (2018)** allows the choice between simultaneous CTR or waiting for an observation period to assess the outcomes of the DRF but not to wait to develop complications.

In support of this suggestion, **Dalton et al., (2023)** retrospectively reported significant improvement after both prophylactic CTR during open reduction and internal fixation (ORIF) and symptomatic CTR after DRF with no intergroup significant difference regarding final follow-up PROMIS physical function and Quick-DASH Wrist scores and concluded that prophylactic CTR strategy is not associated with improved PROs compared with a symptomatic strategy during ORIF of DRF.

***Recommendations*:** Wider scale multicenter studies are required to establish symptomatic CTR as the principal line of management for CTS secondary to DRF and to allow evaluation of the prophylactic CTR.

Conclusion

The obtained results allowed considering symptomatic open CTR through a small volar incision as a safe and efficient approach for CTR in patients who developed CTS secondary to DRF. Moreover, symptomatic CTR allowed improvement of pain and functional and mental scorings of patients with no procedure-related complications.

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References

- **Bassil G, Otayek J, Moucharafieh R, Badra M. (2024)** A Comparison of Mini Open Transverse Incision and Longitudinal Incision for the Release of Moderate and Severe Carpal Tunnel Syndrome. Cureus, 16(3): e56677.
- **Beaton DE, Wright JG, Katz JN. (2005)** Development of the QuickDASH: comparison of three item-reduction approaches. Journal of Bone and Joint Surgery, 87(5):1038-1046.
- **Beleckas CM, Padovano A, Guattery J, Chamberlain AM, Keener JD, Calfee RP. (2017)** Performance of Patient-Reported Outcomes Measurement Information System (PROMIS) Upper Extremity (UE) Versus Physical Function (PF) Computer Adaptive Tests (CATs) in Upper Extremity Clinics. Journal of Hand Surgery, 42(11):867-874.
- **Bell J, James N, Mauck B, Calandruccio J, Weller W. (2024)** The Pitfalls of Difficult Distal Radius Fractures and Provisional Reduction. Orthopedic Clinics of North America, 55(1):113-122.
- **Bhashyam AR, Kao DS. (2022)** Surgical Technique for Concurrent Endoscopic Carpal Tunnel Release and Distal Radius Fracture Fixation Using the Flexor Carpi Radialis Approach: A Case Series. Journal of Hand Surgery Global Online, 4(3):166-171.
- **Brailo V, Zakrzewska JM. (2015)** Grading the intensity of nondental orofacial pain: identification of cutoff points for mild, moderate, and severe pain. Journal of Pain Research, 8:95-104.

- **Chung J, Mahmoud Y, Ilyas A. (2024)** Incidence and Treatment of Carpal Tunnel Syndrome Following Distal Radius Fractures: A TriNetX Analysis of 39,603 Patients. Journal of Hand Surgery Global Online, 6(3):308-312.
- **Dahlin L, Zimmerman M, Calcagni M, Hundepool C, van Alfen N, Chung K. (2024)** Carpal tunnel syndrome. Nature Reviews Disease Primers, 10(1):37.
- **Dalton J, Luchetti T, Cluts L, Bhogal S, Kaufmann R, Goitz R, et al. (2023)** Comparison of Patient-Reported Outcomes With or Without Prophylactic Carpal Tunnel Release After Distal Radius Fracture Stabilization. Orthopedics, 46(6): e362-e368.
- **Donati D, Goretti C, Tedeschi R, Boccolari P, Ricci V, Farì G, et al. (2024)** Comparing endoscopic and conventional surgery techniques for carpal tunnel syndrome: A retrospective study. JPRAS Open, 41:80-87.
- **Eberlin K, Amis B, Berkbigler T, Dy C, Fischer M, Gluck J, et al. (2024)** Final 1-Year Results of the TUTOR Randomized Trial Comparing Carpal Tunnel Release with Ultrasound Guidance to Mini-open Technique. Plastic and Reconstructive Surgery – Global Open, 12(3): e5665.
- **El Masri J, Chanbour H, Ghazi M, El Masri D, Salameh P, Liles C, et al. (2024)** Endoscopic Versus Open Carpal Tunnel Release: An Umbrella Review and a Meta-analysis. Annals of Plastic Surgery, 92(6):677-687.
- **Faul F, Erdfelder E, Lang AG, Buchner A. (2007)** G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39, 175-191.
- **Kloberdanz AL, Meyer J, Kammermeier K, Strahl A, Schlickewei C, Mader K, et al. (2024)** Impact of body mass index on fracture severity, clinical, radiological and functional outcome in distal radius fractures: a retrospective observational study after surgical treatment. Archives of Orthopaedic and Trauma Surgery, 144(6):2915-2923.
- **Levine DW, Simmons BP, Koris MJ, Daltroy LH, Hohl GG, Fossel AH, et al. (1993)** A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. Journal of Bone and Joint Surgery, 75(11):1585–92.
- **Lusa V, Karjalainen T, Pääkkönen M, Rajamäki T, Jaatinen K. (2024)** Surgical versus non-surgical treatment for carpal tunnel syndrome. Cochrane Database of Systematic Reviews, 1(1):CD001552.
- **Manchikanti L, Singh V, Falco FJE, Cash KA, Pampati V, Fellows B. (2010)** Comparative effectiveness of a one-year follow-up of thoracic medial branch blocks in management of chronic thoracic pain: A randomized double-blind active controlled trial. Pain Physician, 13:535-48.
- **Melzack R. (1987)** The short-form McGill Pain

Questionnaire. Pain, 30(2):191-197.

- **Moradi A, Menendez ME, Kachooei AR, Isakov A, Ring D. (2016)** Update of the Quick DASH Questionnaire to Account for Modern Technology. Hand (New York, NY), 11(4): 403–409.
- **Pacchiarini L, Oldrini L, Feltri P, Lucchina S, Filardo G, Candrian C. (2024)** Complications after volar plate synthesis for distal radius fractures. EFORT Open Reviews, 9(6):567-580.
- **Peters BR, Martin AM, Memauri BF, Bock HW, Turner RB, Murray KA, et al. (2021)** Morphologic Analysis of the Carpal Tunnel and Median Nerve Following Open and Endoscopic Carpal Tunnel Release. Hand (New York, NY), 16(3):310-315.
- **Roldán-Majewski C, Broedel E, von Korff M, Rammelsberg P, Schindler H, Giannakopoulos N. (2022)** Diagnostic accuracy of the Pain (P), Enjoyment (E), and General activity (G) scale, a three-item questionnaire, for grading the impact of orofacial pain-related dysfunction. Pain, 163(4): e540-e546.
- **Samarakoon MB, Guruge M, Jayasekara M, Malalasekera A, Anthony D, Jayasekara R. (2014)** Anatomical landmarks for safer carpal tunnel decompression: an experimental cadaveric study. Patient Safety in Surgery, 8(1):8.
- **Schroeder M, Reddy N, Rust A, O'Brien A, Jain S. (2024)** Open Versus Endoscopic Carpal Tunnel Release: A Comparison of Opioid Prescription Patterns and Occupational Therapy Referrals. Hand (New York, NY), 19(5):776-782.
- **Seeher U, Bode S, Arora R. (2024)** [Basic principles of surgical treatment of distal radius fractures. Unfallchirurgie (Heidelberg), 127(6):419-429.
- **Tannan S, Pappou I, Gwathmey F, Freilich A, Chhabra A. (2015)** The Extended Flexor Carpi Radialis Approach for Concurrent Carpal Tunnel Release and Volar Plate Osteosynthesis for Distal Radius Fracture. Journal of Hand Surgery (American Volume), 40(10):2026-2031.e1.
- **Vernet P, Gouzou S, Diaz JJH, Facca S, Liverneaux P. (2020)** Minimally invasive anterior plate osteosynthesis of the distal radius: A 710 case-series. Orthopaedics & Traumatology: Surgery & Research, 106(8):1619-1625.
- **Wipperman J, Penny M. (2024)** Carpal Tunnel Syndrome: Rapid Evidence Review. American Family Physician, 110(1):52-57.
- **Zemirline A, Taleb C, Naito K, Vernet P, Liverneaux P, Lebailly F. (2018)** Distal radius fracture fixation with a volar locking plate and endoscopic carpal tunnel release using a single 15mm approach: Feasibility study. Hand Surgery and Rehabilitation, S2468-1229(18)30068-9.