Patient-reported outcomes after acute carpal tunnel release in patients with distal radius open reduction internal fixation

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Abstract

Background Acute carpal tunnel syndrome (CTS) is a complication that can develop after distal radius fractures. Our hypothesis tested whether patient-reported outcomes after acute carpal tunnel release (CTR) performed in combination with distal radius fracture open reduction internal fixation (ORIF) are worse than patient-reported outcomes with only elective CTR as measured by the symptom severity and functional status scales of the Boston carpal tunnel questionnaire (BCTQ).

Methods A retrospective assessment identified 26 patients treated with acute CTR at the same time as distal radius ORIF, no history of pre-existing CTS or CTR, no other injuries, and >12 months follow-up. Sixteen of these patients (Group A) could be contacted and answered the BCTQ. Group A was age- and sex-matched to control patients (Group B) treated with only elective CTR. A case-control study was performed comparing outcomes of both groups.

Results The average age of patients was 51 ± 15 years, with an average follow-up of Group A at 49 ± 21 months versus Group

B at 55 ± 20 months. The mean symptom severity scale score for Group A was 1.4 ± 0.4 and for Group B was 1.4 ± 0.4 . The mean functional status scale score for Group A was 1.4 ± 0.5 and for Group B was 1.3 ± 0.4 . The mean total BCTQ score for Group A was 26.5 ± 7.5 and for Group B was 24.9 ± 7.5 . There were no statistical or clinically significant differences between Group A and Group B for symptom severity, functional status, and total BCTQ scores.

Conclusions Patients with acute CTR performed at the same time with distal radius ORIF do as well in the long-term as those patients with only elective CTR as measured by the BCTQ. Patients should expect similar recovery of subjective nerve function from acute median nerve dysfunction when CTR is performed with distal radius ORIF as patients with only elective CTR.

Keywords Acute median nerve dysfunction · Acute carpal tunnel release · Distal radius fracture · Distal radius fracture ORIF · Boston carpal tunnel questionnaire

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Introduction

Distal radius fractures may cause symptomatic median nerve dysfunction through compression of the median nerve by volarly displaced fragments, an increase in intra-compartmental pressure secondary to post-traumatic edema, direct injury from fragment displacement causing contusion of the median nerve, hemorrhage, or a combination of any of these conditions [4, 8, 9, 15, 19]. The percentage of fracture fragment translation can be considered one of the most important risk factors for developing acute median nerve symptoms in patients with distal radius fractures and subsequent open reduction internal fixation (ORIF) [6]. The reported incidence of a median nerve neuropathy associated

with distal radius fractures varies greatly in the literature and is reported to range from 0.5% to 21 % overall [5, 12].

This case-control study was designed to test the hypothesis that the patient-reported outcomes after acute carpal tunnel release (CTR) performed in combination with distal radius fracture ORIF are worse than patient-reported outcomes with only elective CTR as measured by the Boston carpal tunnel questionnaire (BCTQ).

Methods

This study was approved by the institutional review board at the senior author's affiliated hospital. We retrospectively obtained a list of patients from January 2001 through January 2008 treated with acute CTR and distal radius fracture ORIF. Inclusion criteria for patients included acute CTR at the time of distal radius ORIF, adequate documentation of acute median nerve symptoms, and ≥ 12 months of clinical follow-up. Patients were excluded if they had pre-existing symptoms of carpal tunnel syndrome (CTS), previous treatment with CTR, suffered open fractures, more proximal forearm fractures, or any other types of injuries (including prior distal radius fractures in the affected extremity). The diagnosis of pre-existing CTS was defined as any previous known diagnosis of CTS or symptoms of numbness and tingling in the median nerve distribution prior to their distal radius fracture. Acute median nerve dysfunction was defined as decreased sensibility or subjective numbness and tingling in the median nerve distribution. The diagnosis of acute median nerve dysfunction was made by the attending surgeon on call. Carpal tunnel pressures and preoperative electromyograms (EMG) were not performed in any patients.

Twenty-six patients that were identified in the patient database met the inclusion criteria. Of these 26 patients, 16 could be contacted by the first author and agreed to participate in the BCTQ after informed consent was obtained (Group A). All patients in Group A were surgically treated by a mini-open CTR technique that was performed in combination with a distal radius fracture ORIF. All distal radius fracture ORIFs were performed using a standard volar, flexor carpi radialis approach. For Group A, the average duration between injury and time to surgery was 6 days (SD 3).

An age- and sex-matched control group of 16 patients undergoing only elective CTR was identified in the same database of patients and designated as Group B. There were multiple patients initially identified in the age- and sex-matched control patient sample. However, once the first author was able to contact a patient who met the inclusion criteria, that patient was selected, and the search was concluded. There were no secondary selection criteria administered during the selection of the control patients. Also,

preoperative EMGs were obtained for this patient population based on the discretion of the treating surgeon, and not any other factors. Therefore, this data is not included. All patients in Group B were surgically treated by a mini-open CTR technique.

The patients in both groups were contacted by the first author and all the patients agreed to participate in the BCTQ after informed consent was obtained. No form of blinding was utilized for this study in either group.

The BCTQ is a patient-oriented questionnaire that assesses the severity of symptoms and functional status of CTS patients [11]. It is a reliable and validated instrument for outcome measures in patients with CTS [3, 10, 11, 16]. The symptom severity scale consists of 11 questions about symptoms experienced during the past 2 weeks and is rated on a scale of 1 (none) to 5 (severe). The functional status scale consists of eight questions dealing with a patient's ability to perform activities over the previous 2 weeks and is rated on a scale of 1 (no difficulty) to 5 (can not do activity). The total BCTQ is a combination of the symptom severity scale and functional status scale scores and rated on a scale of 19 (best outcome) to 95 (worst outcome). Since this study was retrospective, only post-operative outcomes were measured in both Groups A and B, as the purpose of our study was to determine if a difference existed between Group A and B in long-term follow-up of both groups. The minimum clinically important difference (MCID) of the mean symptom severity scale score of the BCTQ is estimated at 1.0 [14].

Statistical Analysis

The data sets were tested for normality and did not exhibit a normal distribution. Therefore, a Mann–Whitney–Wilcoxon test was used for statistical comparison between Group A (acute CTR + distal radius ORIF) and Group B (elective CTR). Symptom severity scale scores, functional status scale scores, and total BCTQ scores were used for this analysis [11].

A p value < 0.05 was deemed statistically significant. A difference in mean scores of 1.0 was deemed clinically significant [14]. Other studies have demonstrated the difference to be as low as 0.47 [2]. A sample size calculation using a power of 80% and two-sided Type I error of 0.05 demonstrated that a sample size of 16 patients could detect a difference of 0.4 in the symptom severity scale, importantly, better than the MCID.

Results

In Group A, there were 16 total patients (ten male, six female) with an average age of 51 years old (SD 15). The

mean clinical follow-up for these patients was 49 months (SD 21). In Group B, 16 patients (ten male, six female) were age- and sex-matched to Group A patients. The mean clinical follow-up for these patients was 55 months (SD 20).

Results of Boston Carpal Tunnel Questionnaire

The mean symptom severity scale score for Group A was 1.4 (SD 0.4) and for Group B was 1.4 (SD 0.4). The mean functional status scale score for Group A was 1.4 (SD 0.5) and for Group B was 1.3 (SD 0.4). The total BCTQ scores for Group A was 26.5 (SD 7.5) and for Group B was 24.9 (SD 7.5) (Table 1).

Comparative Analysis (Group A vs. Group B)

There was not a statistically significant difference between Group A and Group B for post-operative follow-up time (p value: 0.25), symptom severity scale scores (p value: 0.34), functional status scale scores (p value: 0.78), and total BCTQ scores (p value: 0.28). None of the measures appeared to have a clinically meaningful difference either.

Discussion

Acute median nerve dysfunction is a well-known complication of distal radius fractures [1, 4–6, 15]. There are differing opinions regarding decompression of the carpal tunnel with distal radius fracture ORIF. For patients with immediate median nerve symptoms and no progression of symptoms, they may be considered to have a median nerve contusion, which in some cases will resolve with observation [17, 18]. This is in distinction with patients who have progression of symptoms, where urgent decompression may lead to improved results [5]. However, at the time of injury to the wrist, there may be a combination of initial nerve contusion and carpal tunnel compression in cases of acute median nerve dysfunction with distal radius fractures [5]. If

the patient has no signs or symptoms of median nerve dysfunction, there is clinical evidence to suggest that a prophylactic CTR is not necessary, and in some circumstances can have a poor clinical outcome [7, 13, 20].

Our study was purposely designed to identify patient-reported outcomes that may be generalizable for common clinical practice. Since most preoperative decision making in acute median nerve dysfunction associated with distal radius fractures does not include data from slit catheter measurements or nerve conduction tests, we did not consider such data. Our patient sample included both patients with more classically defined acute carpal tunnel symptoms (e.g. hourly or daily progression of symptoms) as well as nerve contusion (onset of symptoms after distal radius fracture, persistence of symptoms at the time of operative release, but not progression of symptoms at the time of operative release), both of which may be treated with CTR at the time or ORIF in clinical practice. The subsets of these patient groups showed comparable results to the overall cohorts, but given the limited numbers in each subset, data mining of the results is not reported.

The main limitation of the study is lack of a preoperative BCTQ in either group. Therefore, one can't make conclusions regarding the degree of improvement, but one can still make an assessment regarding final outcome. Other limitations of our study include a small sample size and an inability to contact 38% of the patients who met our inclusion criteria, leading to a potential study selection bias. Residual nerve symptoms could also be a function of other pathologies not examined in this study.

In our study, those patients receiving acute CTR at the time of distal radius ORIF subjectively appear to do as well as those patients treated with only elective CTR in long-term follow-up as measured by the BCTQ. The patient-reported outcomes as measured by the functional status scale and symptom severity scale scores of the BCTQ are also similar between both groups. A prospective study could further clarify outcomes of acute carpal tunnel syndrome subsequent to a distal radius fracture. Specifically, the value from a prospective study would be the ability to match severity

Table 1 Boston carpal tunnel questionnaire scoring for Group A and Group B

Boston carpal tunnel questionnaire	Group A ^a ($n=16$)	Group B ^b ($n=16$)	p value
Symptomatic severity score per question	1.4 (SD 0.4); Range: 1–1.9	1.4 (SD 0.4); Range: 1–2.1	0.34
Total symptomatic severity score per patient	16 (SD 4.7); Range: 11–25	15 (SD 4.8); Range: 11–23	0.34
Functional status score per question	1.4 (SD 0.5); Range: 1–2.5	1.3 (SD 0.4); Range: 1–2.6	0.78
Total functional status score per patient	10.9 (SD 4.3); Range: 8–20	10.0 (SD 3.5); Range: 8–21	0.78
Total BCTQ score per patient	26.5 (SD 7.5); Range: 19–39	24.9 (SD 7.5); Range: 19–44	0.28

All values listed are averages and represented as value (SD); Range

^a Distal radius fractures and carpal tunnel release

^b Carpal tunnel release only

and demographics of both patient groups more carefully which would lead to decreased bias. Also, there would be the additional information necessary to compare preoperative and postoperative BCTQ scores.

Conflicts of Interest The authors of this manuscript have no conflicts of interest, commercial associations, or intent of financial gain regarding this research to declare.

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