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Research Article

Outcomes of open Carpal Tunnel Release (oCTR) with no Tourniquet Compared to oCTR with Tourniquet

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Abstract

Introduction: The open carpal tunnel release (oCTR) with no tourniquet using a local anesthetic with epinephrine for hemostasis, has been used for decades. We examined multiple methods and elected to implement oCTR with no tourniquet and compare to the current practice technique in our facility (oCTR with tourniquet) with the hypothesis that there would be no difference in clinical outcomes.

Methods: One hundred and four adult patients with carpal tunnel syndrome were randomized to either oCTR with no tourniquet or oCTR with tourniquet. The Levine-Katz symptom severity and functional status scale was used preoperatively and postoperatively to compare the clinical change in each cohort. Demographics, procedure length, blood loss, incision length, outcomes were also gathered and compared.

Results: The no tourniquet (N=52) and tourniquet (N=45) groups were similar on age, sex, procedure length, blood loss, and incision length, hematoma, nerve damage, and self- reported symptom resolution. The difference in Levine-Katz symptom severity and functional status scales between groups (tourniquet & no tourniquet) was not statistically significant. The main effect showed a statistically significant difference in mean improvement from pre to post of both symptom severity and function (P<.0005) for both groups (no tourniquet and tourniquet).

Conclusion: These results support the use of oCTR with no tourniquet for patients and surgeons that prefer this method. Both can be reassured that the outcomes will be similar with either procedure. Moving forward oCTR with no tourniquet is being implemented in our practice with further plans to implement wide wake oCTR with no tourniquet.

Keywords: Carpal tunnel syndrome; Plastic surgery; Hand; Carpal tunnel release

Introduction

Carpal Tunnel Syndrome (CTS) is caused by compression of the median nerve at wrist and results in paresthesias and/or numbness of the digits in the median nerve distribution, aching in the thenar eminence, weakness and atrophy of the abductor pollicis brevis and opponens pollicis. CTS is a clinical diagnosis based on a combination of symptoms and characteristic physical findings, which can be confirmed with electrodiagnostic studies.

Indications for surgery include worsening pain and paresthesia particularly at night, diminished motor function and grip strength, and loss of muscle tone in the median nerve distribution. Currently in our institution, we perform most CTR in an ambulatory outpatient surgery setting using the open technique, with or without a tourniquet and with sedation or without sedation using a local anesthetic with epinephrine only. The open Carpal Tunnel Release (oCTR) with no tourniquet approach, using a local anesthetic with epinephrine for hemostasis, has been used for decades with good results [1]. Tourniquet use offers the advantage of a near bloodless operative field that provides better exposure, which may potentially decrease operative time and complications and ultimately lead to better results.

Methods

In order to streamline oCTR for improved efficiency, cost re-

duction, increased patient ease, high level of patient satisfaction and successful results, we are implementing a wide-awake approach to oCTR to be performed in our outpatient clinic minor operating room. Although the wide-awake approach has been established and studied with good results, we believed it prudent to test applicability to our patient population and healthcare system. Prior to implementing the wide-awake approach, we chose to limit the variables to help identify if tourniquet use would have different outcomes compared to no tourniquet use in a randomized study. We hypothesized no difference in clinical outcomes comparing the two techniques.

Adult (>18 years) patients, diagnosed with CTS, who elected to undergo oCTR and consented to study participation were randomized per procedure into one of two groups: either oCTR with a Tourniquet and sedation (oCTR+T) or oCTR without a tourniquet using a local anesthetic with epinephrine with or without sedation (oCTR-T). This study was conducted at a 453 bed, private, rural, community hospital in western Pennsylvania. One hundred and four adult patients with CTS meeting inclusion criteria were enrolled. We excluded patients undergoing any additional procedures or acute CTS due to trauma. CTS was largely diagnosed clinically and confirmed with Electromyography (EMG) as needed. Demographics, procedure length, blood loss, incision length, and outcomes (i.e. hematoma, nerve damage, and self-reported symptom resolution) were gathered and compared (Table 1). Table 2 has the results of the Levine-Katz symptom severity and functional status scale, a validated self-administered questionnaire for the assessment of severity of symptoms and functional status in patients who have carpal tunnel syndrome, used preoperatively (preop) and postoperatively (postop) to assess the clinical change of each patient [2]. In all cases, local anesthetic was administered in order to assess differences between cases with and without tourniquet. The oCTR was performed in either the main operating room or in the ambulatory outpatient operating room by the same board certified plastic surgeon with the assistance of a general surgery resident. The oCTR+T group had a tourniquet applied following adequate sedation, it was and was released prior to skin closure. The patient received local anesthetic once sedation was given. An unsterile tourniquet applied but not inflated. The hand was then prepped and draped. The tourniquet was then inflated to a pressure of 100 mmHg above systolic blood pressure and incision was made. Once the transverse carpal ligament was incised the tourniquet was deflated and the wound inspected for uncontrolled bleeding. In all cases, a standard minipalm incision was used, closed with a 4-0 or 5-0 non-absorbable nylon suture, and the hand dressed and wrapped. Patients were discharged home on the day of surgery and were evaluated postoperatively within two weeks of surgery. At this follow-up visit, the postop portion of the Levine-Katz questionnaire was completed. Statistical analyses were performed using ANOVA, Pearson Chi-square, and Fisher's Exact test for between-group assessment of homogeneity on demographic and intraoperative variables. Outcome variables were analyzed using Pearson Chi-square, ANOVA, and the Mann-Whitney U test. Overall alpha level was set at 0.05. The Bonferroni correction was applied as necessary. IBM SPSS version 24 was used.

Results

Target sample size was 106 completed participants. Our study had 87 unique patients consent and undergo the oCTR procedure, for a total of 97 procedures. Ten patients underwent CTR on both hands, but not on the same day. Five were randomized into the no tourniquet group for each procedure, one was randomized to the tourniquet group for each procedure and four patients were randomized into both groups. In all cases, fidelity to randomization was preserved with application per procedure. Not all patients seen postoperatively completed the questionnaires. The research staff was very diligent in ensuring complete data through phone calls to all patients with missing data. The no tourniquet (N=52) and tourniquet (N=45) groups were statistically homogeneous on age, gender, anesthetic, incision length, procedure length, and blood loss. Self-reported symptom resolution, hematoma, and nerve damage were also similar. Blood loss was similar due to the tourniquet deflated prior to closing which resulted in bleeding in the field however, the carpal tunnel has been released at this point. It is our practice to inspect the wound without the tourniquet before closing to identify bleeding that may result in a hematoma. By deflating the tourniquet after dressings applied could result in a hematoma that would potentially have been identified if deflated before skin closure. By time point, the difference in Levine-Katz symptom severity and functional status scales between groups (tourniquet & no tourniquet) was not statistically significant (preop: $P = .951$, $P = .731$; postop: $P = .634$, $P = .498$, respectively per scale). The main effect of time showed a statistically significant difference in mean improvement from preop to postop of both symptom severity and function ($P < .0005$) for both groups (no tourniquet and tourniquet).

Discussion

CTR is performed in an outpatient setting and with any combination of the following: open or endoscopic, with or without a tourniquet, under conscious sedation or wide-awake. The best method has yet to be determined; however, any combination can seemingly be performed. Choice of technique is most likely dependent on surgeon preference and familiarity with the procedure. Each aspect of safety, efficiency, patient satisfaction, cost, ease, technical considerations, and outcomes of many operative procedures are intensely and continually scrutinized by surgeons and administrators to find opportunities for improvement without sacrificing any one aspect for the other. Over the years, modifications to CTR have been successful in reducing costs and improving patient satisfaction, e.g. the transition to an outpatient setting, endoscopic techniques, local anesthetic with epinephrine and no sedation, no tourniquet, and evidence-based postoperative dressing protocols. Since CTR is one of the most commonly performed hand procedures in

Table 1. Patient Demographics, Procedure Details and Outcomes of oCTR with and without a Tourniquet.

	Tourniquet	No tourniquet	P - value	Statistical Test
	45	52		
Age, years				
Mean	52	53	0.659	ANOVA
Gender (count, %)				
male	16 (35.6%)	24 (46.2%)	0.29	Pearson Chi-Square
female	29 (64.4%)	28 (53.8%)		
Anesthesia type (count, %)				
0.25% marcaine with epinephrine	42 (93.3%)	49 (94.2%)	0.406	Fisher's Exact Test
1% lidocaine with epinephrine	2 (4.4%)	1 (1.9%)		
4% marcaine with epinephrine	0 (0%)	2 (3.8%)		
0.25% Marcaine with epinephrine & 1% lidocaine (50/50)	1 (2.2%)	0 (0%)		
Anesthesia amount (mL)				
mean	4.5[a]	4.8[b]	0.085	ANOVA
Incision length (cm)				
mean	3.6	3.6	0.643	ANOVA
Procedure length (min)				
mean	24.5	24.5	0.974	ANOVA
Blood loss (mL)				
mean	10	11	0.502	ANOVA
Tourniquet time (min)				
mean	1.8			
Tourniquet pressure				
200 mmHg	3			
250 mmHg	42			
CTS symptoms resolved				
Yes	37 (82.2%)	44 (84.6%)	.774[c]	Pearson Chi-Square
No	2 (4.4%)	1 (1.9%)		
Unknown	6 (13.3%)	7 (13.5%)		
Hematoma				
No	39 (86.7%)	45 (86.5%)	0.985	Pearson Chi-Square
Unknown	6 (13.3%)	7 (13.5%)		
Nerve damage				
Yes	1 (2.2%)	1 (1.9%)	.995[c]	Pearson Chi-Square
No	38 (84.4%)	44 (84.6%)		
Unknown	6 (13.3%)	7 (13.5%)		
oCTR = open carpal tunnel release; CTS = carpal tunnel syndrome				
[a]N = 40, [b]N = 49, [c] No statistical significance confirmed by Fisher's Exact Test				

Table 2. Levine-Katz Questionnaire for Assessment of CTS Severity of Symptoms and Functional Status by Time Period with and without a Tourniquet.

Domain	Tourniquet	No tourniquet	P - value
Symptom Severity Domain	n = 45	n = 52	
Preop (mean)	3.7	3.7	.951 [a]
Symptom Severity Domain	n = 45	n = 52	
Postop (mean)	1.6	1.7	.634 [a]
Functional Status Domain	n = 45	n = 52	
Preop (mean)	2.8	2.8	.731 [a]
Functional Status Domain	n = 44	n = 51	
Postop (mean)	1.7	1.6	.498 [a]
CTS = carpal tunnel syndrome			
[a] For each domain, an independent ANOVA testing between group (CTS technique) for each time point separately was utilized.			
Due to violations of normality, the finding of no statistical significance has been confirmed by Mann-Whitney U test.			
For both groups and both domains, the pre-post change represents a statistically significant improvement, P < .0005. Bonferroni's correction was applied to adjust for multiple tests.			
SS scale: 11 questions, each using a 5-point Likert-scale			
FS scale: 8 questions, each using a 5-point Likert-scale			

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the United States, modifications are likely to continue. The results of our study showed no statistical or clinical difference between oCTR with and without a tourniquet, including patient self-reported symptom and functional change [3]. Our results support the use of oCTR with no tourniquet for patients and surgeons who prefer this method. Both can be reassured of similar clinical outcomes regardless of chosen procedure. Moving forward, we are endeavoring to enhance our patients' experience with the elimination of preop testing including medical clearance, allowing food intake the night before surgery, and the removal of the need for anesthesia so that they can drive themselves to and from the procedure. Currently, oCTR with no tourniquet is being used in our practice. It will be followed by wide-awake oCTR with no tourniquet to further the process of procedure-specific improvement and add to the body of research evidence on this topic.

Conflict of Interest

The authors have no conflict of interest to declare.

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