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Outcomes of the surgical treatment of carpal tunnel syndrome under local anesthesia: comparison of the surgeries with and without tourniquet use

Karpal tünel sendromunun lokal anestezi ile yapılan cerrahi tedavisinin sonuçları: turnikeli ve turnikesiz yapılan ameliyatların karşılaştırılması

Bilal Aykaç, Alper Türkkan

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Abstract

Purpose: Carpal tunnel syndrome is the most common upper limb entrapment neuropathy. The current study reviews outcomes in carpal tunnel syndrome surgeries performed with local anesthesia in a procedure room outside the operating room and compares the surgeries with and without tourniquet use.

Materials and methods: Patients who underwent carpal tunnel syndrome surgery between June 2019 and January 2023 were retrospectively analyzed. Patients were divided into two groups: with and without tourniquet use. Demographic characteristics, operative time, complications, and outcomes were compared. All patients were examined preoperatively and at postoperative month 3 using the Quick Disabilities of the Arm, Shoulder and Hand scale (QDASH) questionnaire, which measures upper extremity activity and participation restrictions.

Results: The study included 119 patients. The operative time was longer in the nontourniquet group than in the tourniquet group, with a statistically significant difference (16.75±2.39 min and 14.47±1.88 min, p<0.001). Bipolar use was higher in the nontourniquet group, with a statistically significant difference (p<0.001). The preoperative QDASH score was statistically similar in both groups (62.58±6.67 and 63.86±6.04, p=0.229). The mean postoperative QDASH score was 4.79±7.65 in the nontourniquet group and 4.24±3.86 in the tourniquet group (p=0.799).

Conclusions: Tourniquet use may slightly shorten the operative time and may be more effective in controlling bleeding. However, there was no significant difference between the groups regarding postoperative results. The results indicate that operating with a local anesthesia alone is an effective alternative to tourniquet use and a safe choice.

Keywords: Carpal tunnel syndrome, tourniquet, wide awake hand surgery.

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Öz

Amaç: Karpal tünel sendromu en sık görülen üst ekstremite tuzak nöropatisidir. Bu çalışma, ameliyathane dışında bir işlem odasında lokal anestezi ile yapılan karpal tünel sendromu ameliyatlarının sonuçlarını gözden geçirmekte ve turnikeli ve turnikesiz ameliyatları karşılaştırmaktadır.

Giriş ve yöntem: Haziran 2019 ile Ocak 2023 tarihleri arasında karpal tünel sendromu ameliyatı geçiren hastalar retrospektif olarak incelendi. Hastalar turnikeli ve turnikesiz olmak üzere iki gruba ayrıldı. Demografik özellikler, operasyon süresi, komplikasyonlar ve sonuçlar karşılaştırıldı. Tüm hastalar ameliyat öncesi ve ameliyat sonrası 3. ayda, üst ekstremite aktivitesini ve katılım kısıtlamalarını ölçen Hızlı Kol, Omuz ve El Engelliliği ölçeği (QDASH) anketi kullanılarak değerlendirildi.

Bulgular: Çalışmaya 119 hasta dahil edildi. Ameliyat süresi turnike olmayan grupta istatistiksel olarak anlamlı derecede daha uzundu (16,75±2,39 dk ve 14,47±1,88 dk, p<0,001). Bipolar kullanımı turnike olmayan grupta istatistiksel olarak anlamlı derecede daha yüksekti (p<0.001). Preoperatif QDASH skoru her iki grupta istatistiksel olarak benzerdi (62,58±6,67 ve 63,86±6,04, p=0,229). Ameliyat sonrası ortalama QDASH skoru turnikesiz grupta 4,79±7,65, turnikeli grupta 4,24±3,86 idi (p=0,799).

Sonuç: Turnike kullanımı ameliyat süresini biraz kısaltabilir ve kanama kontrolünde daha etkili olabilir. Ancak ameliyat sonrası sonuçlar açısından gruplar arasında anlamlı fark yoktu. Bu, tek başına lokal anestezik ile ameliyatın turnike kullanımına güvenli ve etkili bir alternatif olduğunu düşündürmektedir.

Anahtar kelimeler: Karpal tünel sendromu, turnike, uyanık el cerrahisi.

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Bilal Aykaç, M.D. Bursa Hayat Hospital, Department of Orthopaedic Surgery, Bursa, Türkiye, e-mail: draykac@gmail.com (https://orcid.org/0000-0002-6180-2467)

Alper Türkkan, M.D. Medicana Hospital, Department of Neurosurgery, Bursa, Türkiye, e-mail: alperturkkan@hotmail.com (https://orcid.org/0000-0002-1437-2396) (Corresponding Author)

Introduction

Carpal tunnel syndrome (CTS) is the most prevalent entrapment neuropathy of the upper extremity [1, 2]. Treatment of CTS includes both conservative and surgical practices. For mild-to-moderate symptoms patients may receive nonsurgical treatments [3]. However, many patients do not respond to conservative treatment, and surgical release of the carpal ligament is required if severe symptoms occur [2, 3].

To improve cost and efficacy, CTS surgery has recently been performed outside of the operating room in a smaller procedure room with patients awake [4-6]. Surgical procedures can be performed under local anesthesia (LA) and through mini incisions with or without a tourniquet.

Tourniquet devices are widely used in orthopedic procedures to provide a blood-free operating field in surgical procedures involving the extremities [7]. However, patients may experience pain, discomfort, and compression-related complications when the tourniquet is inflated [2, 7]. Therefore, some surgeons have suggested non-tourniquet procedures, stating that it is possible to control bleeding with alone local anesthetic injection [1, 8-11]. At the same time, patients can have a more comfortable perioperative period with the elimination of pain and discomfort that may occur due to the tourniquet [8, 12, 13]. It has been reported by many authors in the literature that surgeries without tourniquet do not increase the duration of surgery and complications [8, 10, 12, 14]. However, there is no consensus on which of these two approaches is superior to the other.

In this study, we retrospectively reviewed patients who underwent CTS surgery with and without tourniquet use under LA in a procedure room outside the operating room. In our study, we aimed to evaluate the effect of two different surgical procedures on the recovery status of the patients and possible complications.

Materials and methods

This retrospective examination was approved by Bursa Medicana Hospital Clinical Research Ethics Committee with the number 2023/03 and was subsequently performed by the regulations of the Declaration of Helsinki. In our study, 119 patients who underwent surgery for CTS between June 2019 and January 2023 in the Neurosurgery Clinic and the Orthopedics and Traumatology Clinic of our hospital, whose diagnosis was confirmed by electromyography (EMG) after examination, and who did not respond to conservative treatment were retrospectively studied.

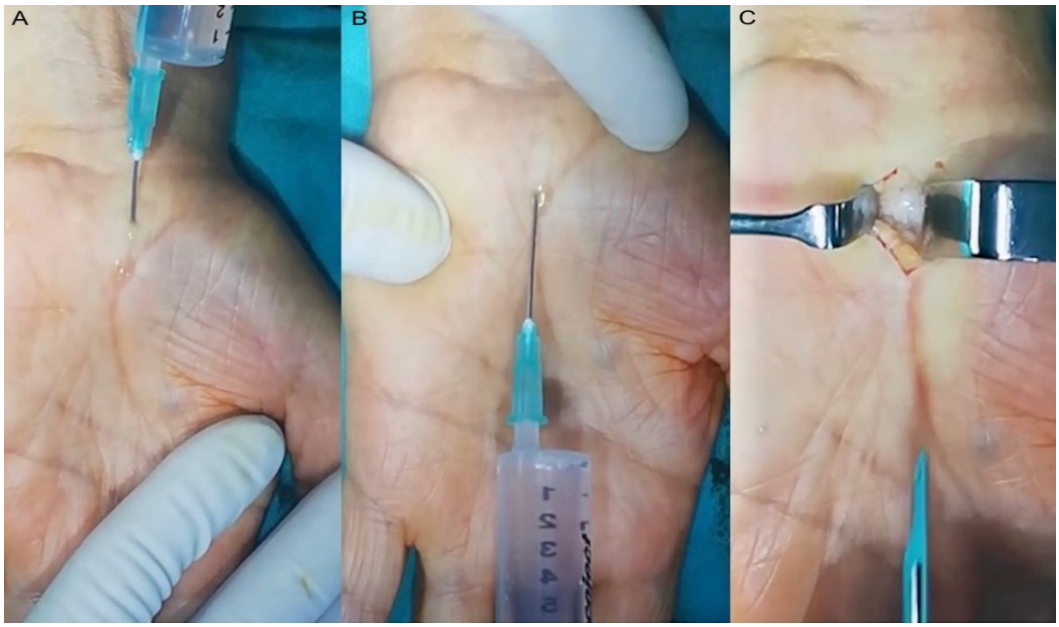
Our study included 119 patients who were given LA in a procedure room outside the operation room. The patients included in the investigation were split into two groups: those who received a tourniquet with a cuff (TY) and those who underwent surgery without a tourniquet (TN). Patients who underwent bilateral or additional hand surgery in the same session were excluded. At the same time, patients with peripheral neuropathy as well as patients who underwent surgery after fracture revision surgery and surgery under sedation and general anesthesia in the operating room were excluded from the study. Age, gender, date of surgery, use of a tourniquet, use of bipolar cautery, postoperative complications, and total follow-up time of all cases were analyzed from the patient record system.

In 71 patients in the TY group, after the upper arm was wrapped with circular cotton wool and an arm cuff was applied, the surgical field was cleaned with povidone iodine and the surgical field was covered with a sterile drape. Then, 5 mL prilocaine (2%) was injected into the incision site and 5 mL prilocaine (2%) into the carpal tunnel. At the 1st minute after LA, the surgical procedure was started after tourniquet application under 250 mmHg pressure, with the upper extremities elevated just before the surgical incision. In the TN group, 48 patients underwent the same surgical preparation and local procedures without tourniquet use (Picture 1).

At the end of both preparation phases, the patients underwent the same surgical procedure. An incision of approximately 2 cm starting from the distal part of the flexor line of the volar aspect of the wrist was made. Blunt dissection was performed up to the flexor retinaculum. When the median nerve was visualized after opening the flexor retinaculum with sharp dissection, the nerve was protected and the flexor retinaculum was loosened proximally and distally. The bleeding was checked. Bipolar cautery was not

used in any of the patients in the tourniquet-applied group, whereas bipolar cautery was used for bleeding control in 7 of the 48 patients without tourniquet application. The skin incision was primarily sutured. The wound was closed with a sterile dressing.

Wrist and finger movements were allowed in the early postoperative period. Patients in both patient groups were evaluated based on their preoperative and postoperative 3rd month Quick Disabilities of the Arm, Shoulder and Hand scale (QDASH) functional scores (Figure 1).



Picture 1. A) Local injection application to the incision site. B) Local anesthetic application into the carpal tunnel. C) Median nerve decompression with mini incision

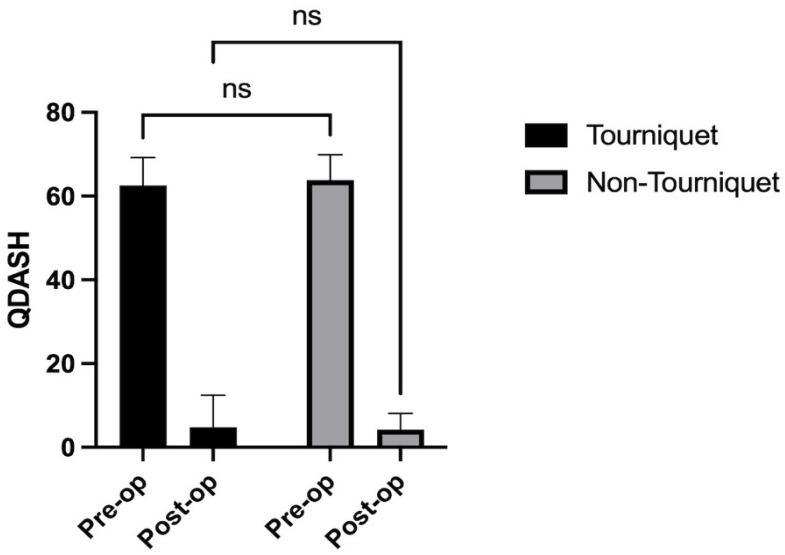


Figure 1. Comparison of preoperative and postoperative 3rd month Quick Disabilities of the Arm, Shoulder and Hand scale (QDASH) scores in tourniquet groups (TY) and non-tourniquet groups (TN) groups, ns: not statistically significant

Statistical method

The data were in the IBM SPSS Statistics Version 26 statistical package program (IBM Corp., Armonk, New York, USA). The number of units (n), percent (%), mean±standard deviation (x±sd), median (M), minimum (min) and maximum (max) values were given as descriptive statistics. The Shapiro-Wilk normality test was used to test the normal distribution of the numerical variables and based on the results, the Mann-Whitney U test was employed to compare single measurement numerical variables of the patients in the groups. Pearson Chi-square test was employed to compare categorical variables with each other. A *p* -value of <0.05 was assessed as statistically significant.

Results

In our study, 138 patients who underwent surgery for CTS between June 2019 and January 2023 were retrospectively studied. Fifteen patients who had bilateral CTS and three patients with missing information in their records were excluded from the study. A total of 119 patients were included in the study; 94 patients (79%) were male and 25 (21%) were female. The mean age was 54.56±13 years (26-88 years), and 42 patients (35.3%) were diabetic and 53 (44.5%) were current smokers. Demographic information of the patients is summarized in Table 1.

Table 1. Descriptive characteristics of the patients

Variables	n (%) x±sd M (min-max)
Age	
x±sd	54.6±13
M (min-max)	56 (26-88)
Gender, n (%)	
Famale	94 (79.0)
Male	25 (21.0)
QDASH Preop	
x±sd	63.4±6.4
M (min-max)	63.6 (48.7-80.0)
QDASH Postop 3rd Months	
x±sd	4.4±5.7
M (min-max)	4.5 (0-54)
QDASH Delta	
x±sd	58.9±7.4
M (min-max)	60 (17.7-73.2)
Tourniquet	
x±sd	4.5±0.6
M (min-max)	4 (3-6)
Operation Time	
x±sd	15.4±2.4
M (min-max)	15 (10-25)
Bipolar Use, n(%)	
No	112 (94.1)
Yes	7 (5.9)

x: Mean, sd: Standard Deviation, M: Median, %: Row Percent,
QDASH: Quick Disabilities of the Arm, Shoulder and Hand scale

Patients were divided into two groups: TY group (n=71) and TN group (n=47). The gender distribution of the patients was statistically similar in both groups. There was no statistical difference in age distribution between the groups (53.13±12.57 years vs. 56.69±13.46 years, p=0.101) (Table 2).

The operative time was longer in the TN group than in the TY group, and this difference was statistically significant (16.75±2.39 min and 14.47±1.88 min, p<0.001). In the TY group, the tourniquet inflation time was 4.47±0.60 min (Table 2) (Figure 2).

Bipolar use was needed in seven patients (14.6%) in the TN group for bleeding control. Bipolar use was not needed in the TY group.

Intraoperative complications were not observed in the groups. No infection was detected in either of the two groups. Only one minor complication (transient ulnar nerve palsy) was recorded in the postoperative period in the TY group and resolved spontaneously within the first 24 hours postoperatively (p=0.210) (Table 2). None of the patients required reoperation.

The mean preoperative QDASH score was 62.58±6.67 in the TN group and 63.86±6.04 in the TY group. The preoperative QDASH score was statistically similar in both groups (p=0.229). The mean postoperative QDASH score was 4.79±7.65 in the TN group and 4.24±3.86 in the TY group. The postoperative QDASH score was statistically similar in both groups (p=0.799). The QDASH score delta (preoperative-postoperative) value was 57.79±8.97 in the TN patient group and 59.61±5.99 in the TY group. The QDASH delta score was statistically similar in both groups (p=0.240) (Table 2).

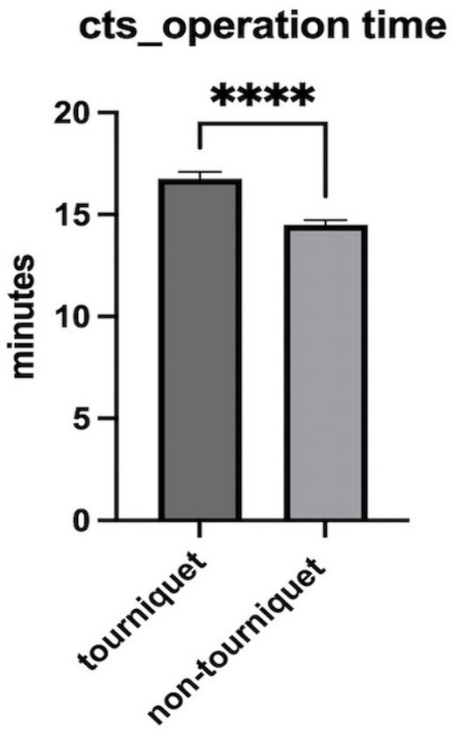


Figure 2. Comparison of the operative times in tourniquet groups (TY) and non-tourniquet groups (TN) groups
**** Statistically significant (p<0.001)

Table 2. Comparison of other variables by tourniquet groups

	Tourniquet		Test Statistics	
	No	**Yes**	**Test value**	***p* value**
Age				
x±sd	56.7±13.5	53.1±12.6	z=-1.640	0.101
M (min-max)	57 (26-88)	54 (32-88)		
Gender, n (%)				
Famale	37 (77.1)	57 (80.3)	χ^2=0.177	0.674
Male	11 (22.9)	14 (19.7)		
QDASH Preop				
x±sd	62.6±6.7	63.9±6.1	z=-1.204	0.229
M (min-max)	62.9 (62.5-80)	66.2 (47.8-72.7)		
QDASH Postop 3rd Monhts				
x±sd	4.8±7.7	4.3±3.9	z=-0.255	0.799
M (min-max)	4.5 (0-9)	4.5 (0-9)		
QDASH Delta				
x±sd	57.8±8.9	59.6±6	z=-1.176	0.240
M (min-max)	57.8 (14.7-73.2)	61.2 (43.7-70.4)		
Tourniquet				
x±sd	0±0	4.5±0.6	z=-9.787	<0.001
M (min-max)	0 (0-0)	4 (3-6)		
Operation Time				
x±sd	16.8±2.4	14.5±1.9	z=-5.399	<0.001
M (min-max)	16 (10-25)	14 (11-20)		
Bipolar Use, n(%)				
No	41 (85.4)	71 (100.0)		
Yes	7 (14.6)	0 (0.0)		
Complications n (%)				
Infection	0 (0)	0 (0)		
Vascular Nerve Injury	0 (0)	0 (0)		
Nerve Injury	0 (0)	1 (1.4)		

x: Mean, sd: Standard Deviation, M: Median, %: Row Percent, z: Mann-Whitney U test, χ^2: Chi-Square test statistics
QDASH: Quick Disabilities of the Arm, Shoulder and Hand scale

Discussion

Pain management and homeostasis control in patients are among the most important problems in CTS surgery. Sedation, regional block, or general anesthesia may be required to keep the patient from suffering. However, all of these interventions have the potential for risks and side effects [15, 16]. Therefore, most surgeons prefer less invasive techniques for this procedure that can be performed in less time [17]. In recent years, CTS surgeries are increasingly being performed in non-operating room settings, such as in procedure rooms, with field sterility [5, 6, 18, 19]. Surgery can be performed under LA with or without a tourniquet in less time and with very low infection rates. Another advantage of this technique is that it eliminates the need for overnight fasting, preoperative testing, and intravenous (IV) catheterization [14]. According to the literature, this technique is safe and well tolerated by patients [5, 18]. LeBlanc et al. [5] reported a superficial infection rate of 0.4% in a series of 1504 patients with CTS operated on in a minor intervention room with field sterility. No deep infection was observed in any patient [5]. In a systematic review by Jagodzinski et al. [20] articles on hand surgery performed in procedure rooms were reviewed. No infection was observed in three studies, and the infection

rate was 0.4% in two studies, which included 1962 CTS cases [20]. In addition, studies in the literature show that using the main operating room for CTS surgery is more costly and less efficient [6, 19]. To ensure field sterilization, all patients in our study underwent surgery in a procedure room separate from the main operating room. Consistent with the literature, none of the patients developed a superficial or deep infection.

There are many options in the surgical treatment of CTS such as open surgery, endoscopic methods, ultrasound-guided surgery. The most common method is to cut the carpal ligament with open surgery. In recent years, endoscopic surgical methods have also gained popularity. Eroglu et al. [21] compared 60 patients who underwent open and endoscopic CTS surgery. They reported that endoscopic surgery was feasible, well tolerated and performed with low morbidity compared to standard open methods. In their study, which included a 10-year outpatient analysis of 571.403 patients diagnosed with CTS, Williamson et al. [22] reported no significant difference between open surgery and endoscopic surgery in terms of perioperative complications, including infection, nerve damage and wound complications. The only significant difference reported was higher cost for endoscopic surgery. In our study, all patients underwent open mini-incision surgery. Endoscopic or ultrasound-guided surgery was not performed [22].

Working in a blood-free environment during surgery is important for reassuring both the surgeon and the patient. In CTS, the surgeon can achieve intraoperative hemostasis in several ways [1, 12, 23]. Tourniquets are used to restrict blood flow and control bleeding, resulting in a blood-free surgical field. Therefore, better visualization of anatomical structures is possible, and dissection becomes easier. The choice that surgeons make regarding tourniquet use varies culturally and depending on the specific health system. In a survey of more than 700 respondents conducted by the “American Society for Surgery of the Hand”, 95% of surgeons reported using tourniquets in CTS surgeries [24].

However, tourniquet use is not without risk. When inflated, they may cause discomfort and pain for patients with direct mechanical pressure and the resulting anoxia [12, 13]. In their prospective randomized controlled study, Iqbal et al. [13] reported that the rate of pain complaints in the group of patients undergoing CTS surgery with tourniquet use was significantly higher than in the group of patients operated on without tourniquet use and that tourniquets caused unnecessary pain without any additional benefit. Furthermore, prolonged tourniquet use may cause deep vein thrombosis, pulmonary embolism, local soft tissue, nerve damage, and a temporary/permanent neurologic deficit [12, 25, 26]. Lim et al. [26] reported that patients could tolerate tourniquets for approximately 20 min in their study. Maury and Roy [27] determined the mean tourniquet tolerance time to be 18 min (range 10-26 min).

In our study, a tourniquet was used for hemostasis in 71 patients. The mean duration of tourniquet use was 4.4±0.60 min and was well tolerated by the patients. Only one patient experienced postoperative transient ulnar nerve paralysis, which resolved after 24 h of follow-up without the need for additional treatment. In terms of hemostasis, the TY group showed less bleeding and did not require the use of bipolar for bleeding control and did not require bipolar use for bleeding control.

CTS surgery with LA without tourniquet use has become popular in the last decade. Many centers use epinephrine in combination with local anesthetic to secure a blood-free surgical field through vasoconstriction (Wide awake local anesthesia no tourniquet (WALANT) technique) [9, 14, 28]. However, because epinephrine administration creates a more acidic solution, it irritates the tissue and causes a burning sensation [27]. Therefore, it should be buffered with sodium bicarbonate [8, 29]. In addition, its optimal effect of providing maximal vasoconstriction and hemostasis in the surgical field has been proven to take effect/last >25 min after local injection [10]. This prolongs the surgical time and adversely affects efficacy and cost savings in outpatient surgical cases [8, 14, 28].

Bleeding control in surgical procedures with only LA is often related to the surgeon’s success in managing soft tissue bleeding. Bleeding occurs mostly at the edge of the incision and from subcutaneous tissues. These bleedings can be easily controlled by cauterization. In addition,

the tension supplied by the retractor and the injection's swelling effect, which enhances the local pressure in the subcutaneous tissue, may also even donate to hemostasis. In our study, surgery was performed only under LA without epinephrine administration in the TN group. Regarding hemostasis, the bleeding at the incision site was controlled with the help of bipolar use. In the TN group, bipolar use was employed for bleeding control in seven (14.6%) patients, which is statistically significant compared to the TY group.

One of the goals of our study was to compare operative time and complications in patients with and without tourniquet use. Olaiya et al. [11] showed that tourniquet application shortened the mean operative time by 1.82 min. In this study, no significant difference was reported between the intraoperative blood loss and the complication rates [11]. In our study, the TY group had a statistically significant mean operative time variance of 2.28 min. However, this period included only the operative time. The preoperative preparation time for the tourniquet was not included in this time frame. There are many complications that can occur during CTS surgeries. These include tendon ruptures, nerve injuries, infections, and incomplete decompression [8, 13, 20, 27, 30]. In our study, no intraoperative complications were observed in either group, and they were comparable in this respect.

In our study, all patients were evaluated preoperatively and at the 3rd month postoperatively using the QDASH questionnaire. Hudak et al. [31] described the Arm, Shoulder and Hand Disability Scale (DASH) in 1996 and reported that it was reliable in evaluating CTS results. The Arm, Shoulder and Hand Quick Disability Scale (QDASH) is a shortened and improved scale. The validity and reliability of the DASH version and the Turkish version have been demonstrated in CTS patients [32]. The QDASH questionnaire has been reported as one of the most frequently used and reliable questionnaires for evaluating individuals with upper extremity injuries [33]. In our study, we found a statistically significant difference between the QDASH values measured in the preoperative period and at the postoperative 3rd month in both groups (p<0.001). The mean preoperative QDASH score was 62.58±6.67 in the TY group and 63.86±6.04 in the TN group. The preoperative QDASH score was statistically similar in both groups (p=0.229). The mean postoperative QDASH score was 4.79±7.65 in the TY group and 4.24±3.86 in the TN group. The postoperative QDASH score was statistically similar in both groups (p=0.799). The QDASH score delta (preoperative-postoperative) value was 57.79±8.97 in the TN group and 59.61±5.99 in the TY group. The QDASH delta score was statistically similar in the TY and TN groups (p=0.240).

Some prognostic factors affecting the success of CTS operations have been reported in the literature [34, 35]. Gunes and Ozeren [34] emphasized the importance of age and body mass index (BMI) and reported that better results were obtained in younger patients. In this study, it was reported that age is an unchangeable factor, but since BMI can be changed, surgical success can be increased by developing weight loss strategies in patients [34]. Tonga and Bahadir [35] reported that high BMI and Vitamin B12 deficiency exacerbate CTS symptoms and weight control with appropriate diet can reduce the severity of these symptoms.

As a result, the use of tourniquet may slightly shorten the operative time and may be more effective in controlling bleeding. However, the overall complication rate was low in both groups, and there was no significant difference in postoperative outcomes. The findings indicate that operating with a local anesthetic alone is an effective alternative and safe option to tourniquet use.

The limitations of this study are presented in this section. First, the study was not double-blinded. Second, the follow-up period was relatively short, i.e., 3 months, but within this time, patients in both groups achieved satisfactory symptomatic and functional improvement. Third, this is a single-center study, and studies with better design and more participants are needed to confirm our findings.

Conflict of interest: No conflict of interest was declared by the authors

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Authors' contributions to the article

B.A. and A.T. constructed the main idea and hypothesis of the study. B.A. developed the theory and arranged the material and method section. B.A. and A.T. have done the evaluation of the data in the Results section. Discussion section of the article was written by A.T.; A.T. reviewed, corrected and approved. In addition, all authors discussed the entire study and approved the final version.