American Journal of
Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Mini Review

Minimally Invasive Thread Carpal Tunnel Release: Early Outcomes and Applicability

Cody J Goedderz BS[1]*, Mark A Plantz MD[1], Corey A Jones MD[2] and Erik B Gerlach MD[1,3]

[1]*Department of Orthopaedic Surgery, Northwestern University. Chicago, IL, United States*

[2]*Department of Orthopaedic Surgery, Emory University. Atlanta, GA, United States*

[3]*Ovation Hand Institute. Chicago, IL, United States*

***Corresponding author:** Cody Goedderz B.S, Department of Orthopaedic Surgery, Northwestern Feinberg School of Medicine, Chicago, IL, United States.

To Cite This Article: *Cody J Goedderz BS, Mark A Plantz MD, Corey A Jones MD, Erik B Gerlach MD. Minimally Invasive Thread Carpal Tunnel Release: Early Outcomes and Applicability. Am J Biomed Sci & Res. 2022 - 15(6). AJBSR.MS.ID.002162.* DOI: 10.34297/AJBSR.2022.15.002162

Received: February 18, 2022; **Published:** March 17, 2022

Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy, with a prevalence up to 3.7% [1]. Due to CTS's frequently debilitating symptoms and high prevalence, it is one of the leading diagnoses for work time off and results in an annual economic cost of up to $4.8 billion [2,3]. Historically, open carpal tunnel release (OCTR) has been the gold standard in treating CTS - demonstrating significant symptomatic relief in most patients [4]. However, complications such as weakness, pillar pain, and scar tenderness motivated the innovation of novel, less-invasive techniques to transect the transverse carpal ligament (TCL). These techniques include endoscopic carpal tunnel release (ECTR), which utilizes an endoscope and specialized blades, and ultrasound-guided carpal tunnel release (CTR), which utilizes ultrasound visualization and specialized transection tools such as hook knives and needles [5]. These less-invasive techniques demonstrated quicker regaining of function and strength, but also left room for further innovation due to difficulties such as steep learning curves, large device cost, and repetitive cutting motions causing iatrogenic injury [6,7]. In response, Guo and colleagues introduced the ultrasound-guided thread carpal tunnel release (TCTR) in 2015 to utilize friction to transect the TCL [8,9]. TCTR is an ultra-minimally invasive surgical technique, utilizing 2 needle puncture sites to minimize skin trauma and selective thread transection of the transverse carpal ligament while sparing superficial palmar fascia and interethnic fascia [10]. The original TCTR technique required one-needle entry point at the wrist and one exit point at the palm -- but was updated shortly after to distal to proximal guide needle placement to decrease the incidence of incomplete release of the distal TCL [9,10]. Indications for TCTR include CTS symptoms which are refractory to conservative care with the goal of deterring progressive muscle atrophy, irreversible weakness, and sensory loss. Ultrasound is utilized to visualize the TCL and neurovascular structures at risk - including the palmar arch, recurrent branch of the median nerve, and the common digital nerve to the third and fourth digit. The thread is looped through the "safe zone", defined as the longitudinal plane between the median nerve and either the ulnar vessels or hook of the hamate [11]. In cases of inadequate visualization and atypical anatomy, conversion to an open approach may be warranted. TCTR can be performed in a clinic-based procedure room under local anesthesia [12]. Early clinical trials and cadaver studies have suggested that TCTR reduces iatrogenic injury, surgical cost, and patient recovery time [8,9,13,14]. The first TCTR clinical outcomes article published by Guo et al. in 2015 involved a case-series of 34 hands of 20 patients operated on with TCTR and found improved subjective sensibility within 24 hours, sleep quality improvement for all cases, no postoperative complications, and improved functional status measured by Levine-Katz questionnaire compared to endoscopic and open approaches [8]. Glue et also following study in 2017 treated 159 hands with

the updated TCTR technique. Through utilizing the BCTQ, they found significantly improved PROM scores compared to Tremble et all's open and endoscopic PROM scores at all time points from 1 day to 52 weeks following surgery [9,15]. Their most common post-procedure complication was pillar pain (5%). Burnham et. al published the most recent TCTR outcomes study in effort to offer an independent validation of the safety and efficacy. In a sample of 20 participants, they found similar BCTQ outcome scores to Glue et all's 2017 study, while also offering objective measurements, including pinch strength and median nerve CSA [13].

Further considerations of TCTR's application include the relative reduction of pain following operation, which paired with non-opioid medication utilization if postoperative pain is experienced, offers a valid strategy to limit the use of opioid prescription induction following CTR [16]. Additionally, ultrasound's ability to offer a live, detailed image of the thread and needle locations, as well as the subsequent transection of the TCL and protection of the surrounding structures, greatly limits iatrogenic injury risk - demonstrated by relatively minimal cases of neuropraxia [9]. Finally, the ability for simple removal and re-routing of the thread placement when indicated, offers the surgeon a valuable opportunity for adjustments prior to transection. By minimizing damage to the skin and surrounding structures of the TCL, TCTR provides an effective means for treating CTS, while reducing the risk of complications, including pillar pain and scar complications. TCTR has the potential to lessen the social and economic burden of CTS, through a quicker return to daily activities and a more cost effective CTR procedure. Future large scale clinical trials with adequate controls directly comparing TCTR to other percutaneous and minimally invasive CTR techniques will help solidify its future widespread use in the treatment of CTS. Further, targeted analysis of TCTR's applicability to patient populations which historically demonstrate worse outcomes - such as workers' compensation and heavy laborer patients - will further validate TCTR's external validity.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

References

1. G D Papanicolaou, S J McCabe, J Firrell (2001) The prevalence and characteristics of nerve compression symptoms in the general population. J Hand Surg Am 26(3): 460-466.

2. Zachary S Hubbard, Tsun Yee Law, Samuel Rosas, Sarah C Jernigan, Harvey Chim (2018) Economic benefit of carpal tunnel release in the Medicare patient population. Neurosurg Focus 44(5): E16.

3. William E Daniell, Deborah Fulton Kehoe, Gary M Franklin (2009) Work-related carpal tunnel syndrome in Washington State workers' compensation: utilization of surgery and the duration of lost work. Am J Ind Med 52(12): 931-942.

4. Vwaire Orhurhu, Sebastian Orman, Jacquelin Peck, Ivan Urits, Mariam Salisu Orhurhu, et al. (2020) Carpal Tunnel Release Surgery- A Systematic Review of Open and Endoscopic Approaches. Anesth Pain Med 10(6): e112291.

5. Eli T Sayegh, Robert J Strauch (2015) Open versus endoscopic carpal tunnel release. Orthop Clin North Am 473(3):1120-1132.

6. Zuo D, Zhou Z, Wang H, Yuxin Liao, Longpo Zheng, et al. (2015) Endoscopic versus open carpal tunnel release for idiopathic carpal tunnel syndrome: a meta-analysis of randomized controlled trials. J Orthop Surg Res 10:12.

7. McCool L (2017) A review of advances in carpal tunnel release. J Neurol Neuromedicine 2(10): 6-8.

8. Danqing Guo, Yu Tang, Yizheng Ji, Tiansheng Sun, Joseph Guo, et al. (2015) A non-scalpel technique for minimally invasive surgery: percutaneously looped thread transection of the transverse carpal ligament. Hand (N Y) 10(1): 40-48.

9. Danqing Guo, Danzhu Guo, Joseph Guo, Steven C Schmidt, Rachel M Lytie (2017) A clinical study of the modified thread carpal tunnel release. Hand (N Y) 12(5): 453-460.

10. Danqing Guo, Danzhu Guo, Joseph Guo, Daniel G Malone, Nathan Wei, et al. (2016) A Cadaveric Study for the Improvement of Thread Carpal Tunnel Release. J Hand Surg Am 41(10): e351-e357.

11. Jose Manuel Rojo Manaute, Alberto Capa Grasa, Francisco Chana Rodríguez, Ruben Perez Mañanes, Guillermo Rodriguez Maruri, et al. (2016) Ultra-Minimally Invasive Sonographically Guided Carpal Tunnel Release. J Ultrasound Med 35(6): 1149-1157.

12. Wilson Z Ray, Mark A Mahan, Danzhu Guo, Danqing Guo, Michel Kliot (2017) An update on addressing important peripheral nerve problems: challenges and potential solutions. Acta Neurochir (Wien) 159(9): 1765-1773.

13. Robert S Burnham, Eldon Y Loh, Brian Rambaransingh, Shannon L Roberts, Anne M Agur, et al. (2021) A Controlled Trial Evaluating the Safety and Effectiveness of Ultrasound-Guided Looped Thread Carpal Tunnel Release. Hand (N Y) 16(1): 73-80.

14. Joseph Ingram, Benjamin M Mauck, Norfleet B Thompson, James H Calandruccio (2018) Cost, value, and patient satisfaction in carpal tunnel surgery. Orthop Clin North Am 49(4): 503-507.

15. Thomas E Trumble, Edward Diao, Reid A Abrams, Mary M Gilbert Anderson (2002) Single-portal endoscopic carpal tunnel release compared with open release: a prospective, randomized trial. J Bone Joint Surg Am 84(7): 1107-1115.

16. Asif M Ilyas, Andrew J Miller, Jack G Graham, Jonas L Matzon (2019) A Prospective, Randomized, Double-Blinded Trial Comparing Acetaminophen, Ibuprofen, and Oxycodone for Pain Management After Hand Surgery. Orthopedics 42(2): 110-115.