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Ultrasound-guided Modified Thread Carpal Tunnel Release with Smartwire®; A Pilot Study

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Introduction

➢Carpal tunnel syndrome (CTS) is a common neuropathy caused by pressure on the median nerve.
➢The carpal tunnel is a narrow space surrounded by carpal bones (bottom and sides) and transverse carpal ligament (top) and median nerve and flexor tendons pass through it.
➢When the symptoms of CTS are severe-muscle weakness progresses, or previous treatments have failed- carpal tunnel release (CTR) surgery is considered.
➢During the surgery, the transverse carpal ligament is cut to relieve pressure on the median nerve.
➢However, sedation is inevitable for the surgery.
➢The modified thread carpal tunnel release (mTCTR) performed in this study is a minimally invasive method using a needle and thread to guide the procedure using ultrasonography (US) without sedation.
➢This study investigated the clinical efficacy and safety of the mTCTR in patients with CTS as a step-up study to the previous cadaver study.

Method

➢ The patients who were diagnosed with CTS by nerve conduction study (NCS), electromyography (EMG), and nerve US and deemed to require CTR were enrolled.
➢The patients were undergone mTCTR under local anesthesia. The modified thread used in this study is Smartwire® which is strong enough to cut through the ligament but also flexible enough to bend around the curves of the wrist.
➢For measuring the effect, the numerical rating scale (NRS) of pain and Boston carpal tunnel syndrome questionnaire (BCTQ) for symptom severity and functional status were checked before mTCTR, after 4, 8, and 12 weeks.
➢The follow up NCS/EMG and US measuring median nerve cross sectional area (CSA) at the wrist were performed at 12 weeks after mTCTR.

Figure 1. Ultrasonography of median nerve before (A) and right after (B) modified thread carpal tunnel release (mTCTR) procedure. (C) The process of mTCTR procedure

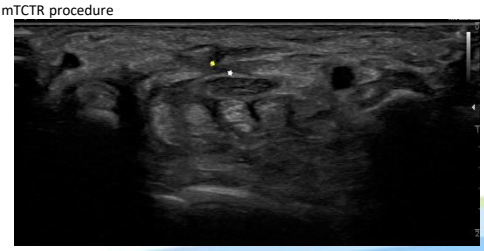

Figure 2. Torn transverse carpal ligament (flexor retinaculum) after modified thread carpal tunnel release (mTCTR) procedure

Results

➢A total of 11 patients (12 wrists, 1 male, and 5 left sides) were included. The mean age was 47 (range 40-65).
➢There were no complications or adverse effects reported through the study period.
➢The NRS and BCTQ score (symptom severity and function) were improved significantly after the procedure, and the improvement persisted for the whole period of follow-up (NRS and BCTQ of symptom severity, P<0.001; BCTQ of function, p=.012).
➢After 12 weeks of procedure, the latency and velocity of median sensory nerve action potential of the affected side improved significantly compared to pre-procedure.
➢There was no significant change in the CSA of the median nerve of the affected side before and after the procedure.

Table 1. Changes in numerical rating scale (NRS) and Boston carpal tunnel syndrome questionnaire (BCTQ) before and after modified thread carpal tunnel release (mTCTR)

Parameters	Pre-mTCTR	4 weeks	8 weeks	12 weeks	*P*-value
NRS	6.4 (1.8)	2.0 (1.9)	2.3 (1.6)	2.1 (2.0)	<.001*
BCTQ					
Total	32.4 (7.9)	17.7(5.9)	19.4 (7.0)	19.3 (7.2)	<.001*
Function	21.3 (7.8)	15.6 (5.6)	15.1 (7.4)	13.8 (6.6)	.012*

* Statistically significant compared to Pre-mTCTR and 4/8/12 weeks

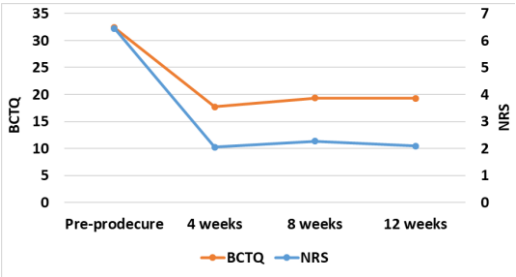

Figure 3. Changes of numeric rating score (NRS) of pain and Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) scores at before and after 4, 8, and 12 weeks of modified thread carpal tunnel release procedure

Table 2. Changes in median nerve ultrasound and nerve conduction study features before and 12 weeks after modified thread carpal tunnel release (mTCTR)

Parameters (affected side)	Pre-mTCTR	12 weeks	*P*-value
Median nerve CSA (mm^2)	15.3 (4.9)	12.8 (3.8)	0.788
Nerve conduction study			
Sensory nerve action potential (SNAP)			
Latency (ms)	5.4 (1.3)	4.7 (1.1)	.010*
Amplitude (uV)	15.8 (9.8)	17.5 (13.3)	.189
Velocity (m/s)	27.8 (6.8)	31.8 (7.4)	.019*
Compound muscle action potential (CMAP)			
Latency (ms)	5.4 (1.5)	4.4 (1.0)	.089
Amplitude (mV)	6.9 (2.5)	7.7 (2.5)	.385
Velocity (m/s)	52.2 (3.6)	52.9 (14.2)	.589

* Statistically significant (*P* <.05)

Conclusion

➢The US-guided CTR using modified thread-Smartwire® is a safe and effective procedure which is a possible alternative treatment to surgery. The pain, symptom severity, and function were improved significantly and the improvement persist at least 12 weeks after the procedure.