30. Younes WM, Capelle HH, Krauss JK: Microvascular decompression of the anterior inferior cerebellar artery for intermediate nerve neuralgia. Stereotact Funct Neurosurg 88:193-195, 2010.

31. Walker HK: Cranial nerve VII: the facial nerve and taste. In: Walker HK, Hall WD, Hurst JW, editors. Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd edition. Boston: Butterworths, 1990.

32. Wang Y, Yu CY, Huang L, Riederer F, Ettlin D: Familial neuralgia of occipital and intermedius nerves in a Chinese family. J Headache Pain 12:497-500, 2011.

Conflict of interest statement: The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received 17 November 2011; accepted 29 March 2012
Citation: World Neurosurg. (2013) 79, 5/6:763-767.
http://dx.doi.org/10.1016/j.wneu.2012.03.023
*Journal homepage: **www.WORLDNEUROSURGERY.org***
*Available online: **www.sciencedirect.com***

Early versus Delayed Endoscopic Surgery for Carpal Tunnel Syndrome: Prospective Randomized Study

P. Sarat Chandra, Pankaj Kumar Singh, Vinay Goyal, Avnish Kumar Chauhan, Nirmal Thakkur, Manjari Tripathi

Key words
- Carpal tunnel release
- Carpal tunnel syndrome
- Endoscopic surgery
- Flexor retinaculum

Abbreviations and Acronyms
APB: Abductor pollicis brevis
CTS: Carpal tunnel syndrome
EP: Electrophysiology
ICMR: Indian Council for Medical Research
NSAIDs: Nonsteroidal antiinflammatory drugs

Department of Neurosurgery, All India Institute of Medical Sciences, New Delhi, India

To whom correspondence should be addressed:
Manjari Tripathi, D.M.
[E-mail: manjari.tripathi1@gmail.com]

Citation: World Neurosurg. (2013) 79, 5/6:767-772.
http://dx.doi.org/10.1016/j.wneu.2012.08.008
*Journal homepage: **www.WORLDNEUROSURGERY.org***
*Available online: **www.sciencedirect.com***

OBJECTIVE: **To compare the effects of early versus delayed endoscopic surgery in patients with moderately severe carpal tunnel syndrome (CTS).**

METHODS: **The study included 100 patients with CTS. Investigations performed before surgery excluded secondary causes. Patients with moderately severe CTS (grade 3–4) were randomly assigned. Bland's neurophysiologic grading scale for CTS was used to assess the patients. Patients underwent an endoscopic carpal tunnel release using an indigenously designed instrument.**

RESULTS: **Following a course of conservative treatment, surgical treatment was offered in two groups: early surgery ($n = 51$; <1 week after diagnosis) and delayed surgery as per the usual waiting list ($n = 49$; >6 months after diagnosis). Improvement in both groups was significant ($P < 0.001$). When both groups were compared, improvement was better for the early surgery group ($P < 0.001$; confidence interval 6.35–9.12).**

CONCLUSIONS: **On the basis of this study, early endoscopic surgery is proposed in patients with moderately severe CTS.**

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common nerve entrapment syndrome occurring in the upper extremity, with a prevalence of up to 9% (18). Classic symptoms of CTS include pain, paresthesia (characteristically worse during the night, termed *brachialgia paresthetica nocturna*), and hypoesthesia in the hand. Weakness and atrophy of the abductor pollicis brevis (APB) and muscles innervated by the median nerve may also be observed. The characteristic prolongation of distal motor latency confirms the diagnosis (1, 25). Initially, a conservative approach to treatment is preferred for persisting symptoms; however, the treatment of choice is surgical dissection of the transverse carpal ligament (flexor retinaculum) with decompression of the nerve (16, 18).

Open dissection of the transverse carpal ligament has been the standard procedure performed for >50 years (5, 21). Endoscopic surgical techniques were developed and introduced to ameliorate the inconveniences and adverse events of open dissection. Endoscopic carpal tunnel release was introduced by Okutsu et al. in 1987 (15). Subsequently, several other clinicians developed endoscopic techniques for dissection of the transverse carpal ligament (3, 12-23). These techniques were introduced with the presumed advantage of being minimally invasive with decreased surgical duration, resulting in better patient compliance. Generally, most reviews state that both endoscopic and open techniques are safe and equally effective in relieving the symptoms of CTS.

The timing of surgery (early or delayed) is also important. Most patients who are routinely considered for surgery are usually given a trial of conservative treatment, followed by surgery after 3–6 months. Earlier studies have shown that both conservative and surgical treatments lead to improved outcomes. However, the improvement has been shown to be better in patients who underwent surgery (20, 21).

Treatment for moderately severe (Bland score 3–4 [defined subsequently]) (25) CTS is controversial. Few studies favored both surgery and conservative treatment. How-

ever, the primary limitations of these studies were that the results did not originate from randomized controlled trials. We compared the outcomes of early surgery (<1 week) versus delayed surgery (≥6 months) with regard to the primary outcomes of general improvement, nocturnal awakening, and severity of other critical symptoms, in addition to certain secondary outcomes. To the best of our knowledge, no study has compared early versus delayed surgery following a trial of conservative treatment for moderately severe CTS.

METHODS

Clinical Material

We compared early and delayed surgical treatment of moderate-to-severe CTS (electrophysiology [EP] score of 3–4) (2) at a large tertiary level neurosurgery department in India. The study reflected the standard of care and was performed according to the guidelines of the Indian Council of Medical Research (ICMR) and the ethics committee of the institution.

The study included 100 patients operated by an endoscopic technique at our institution from 2001–2008 with follow-up data for at least 6 months after surgery. All patients were provided verbal and written documentation of the trial, and informed consent was obtained from all patients. The patients were evaluated for routine procedures on determining their suitability for surgery, and the rationales for early and delayed surgical treatment were discussed among the investigators. The average waiting time for this surgery in our institution ranges from 6–7 months. It was explained to patients that random assignment for the purpose of this study would result in an equal chance of being assigned to either the early or the delayed surgical group (delayed surgery group = conservative management). A person who was blinded to the patients, using a computer-generated allocation, performed randomization. The patients were informed that they could withdraw from the study at any point. The early surgery group underwent immediate investigations followed by surgery within 1 week. This period of 1 week was arbitrarily chosen considering that this time duration would be a comfortable period for our center, taking into account all logistic factors for the patients to be operated for an elective, non-emergency procedure as early as possible. If bilateral symptoms were present, hands with the worse symptoms were operated first followed by the other in the next 2–3 weeks. The delayed surgical group underwent a trial of conservative treatment followed by surgery at 6 months. The follow-up assessments were carried out by a third professional not involved in the study or in assessment of the patient's preoperative condition.

Inclusion Criteria

All patients (i) who presented with symptoms of CTS with a score of 3–4 on the EP scale (see subsequently), (ii) who provided a detailed informed consent, and (iii) who had not received a steroid injection were included.

Exclusion Criteria

Patients who refused to provide written consent and patients with CTS secondary to diabetes mellitus, hypothyroidism, acromegaly, amyloidosis, rheumatoid arthritis, or tuberculous tenosynovitis were excluded from the study.

Presurgical Investigations

Before surgery, all patients underwent detailed nerve conduction studies, which were repeated approximately 3 months after surgery. Clinical follow-up was performed for ≥6 months. Bland's neurophysiologic grading scale for CTS was used for assessment (2). Grading of the scale is as follows:

- Grade 0: Normal
- Grade 1: Very mild CTS; demonstrable only with the most sensitive tests
- Grade 2: Mild CTS; sensory nerve conduction velocity slow on finger or wrist measurement; normal terminal motor latency
- Grade 3: Moderate CTS; sensory potential preserved with motor slowing; distal motor latency to APB <6.5 milliseconds
- Grade 4: Severe CTS; sensory potentials absent but motor responses preserved; distal motor latency to APB <6.5 milliseconds
- Grade 5: Very severe CTS; terminal latency to APB >6.5 milliseconds
- Grade 6: Extremely severe CTS; sensory and motor potentials effectively not recordable (surface motor potential from APB <0.2 mV amplitude)

Conservative Treatment

All patients randomly assigned to delayed surgery were given a trial of conservative treatment with drugs (nonsteroidal antiinflammatory drugs [NSAIDs], pregabalin), with or without splint, and physiotherapy. This treatment was followed by surgery after 6 months.

Surgical Technique

All patients underwent an endoscopic surgical procedure using a specially designed, low-cost, disposable instrument. Following an ethical clearance from the local institutional review board and patent office, the endoscopic instrument was initially applied to about 100 patients before the onset of this trial. The surgery was performed under local anesthesia as an outpatient procedure and took about 10–15 minutes.

After preparation of the surgical area, 3 mL of 2% plain lidocaine (Xylocaine) was injected into the middle of the wrist and forearm. A 0.5-mm, horizontal skin incision was made over the proximal crease of the wrist. Using a mosquito artery forceps, the fascia was dissected, and the entry point underneath the flexor retinaculum was defined. Once this was achieved, the obturator along with the sheath (about 5 mm diameter) was introduced under the flexor retinaculum. A stab incision was made distally on the distal palmar crease, the obturator was brought out from the other end, and the inner sheath was removed. A rigid rod lens scope was introduced from the distal end, and a malleable ligament cutter was introduced proximally. Under visualization, the flexor retinaculum was cut until fat was seen being prolapsed underneath. Bleeding was controlled with saline flushes, pressure application, and reinsertion of the inner sheath. When the entire length of the retinaculum was cut, the obturator was removed, and pressure was applied for about 3–4 minutes. Two single sutures were applied distally and proximally.

After the procedure, a dressing was ap-