The Japanese Experience with Endoscopic Carpal Tunnel Release

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ABSTRACT

Endoscopic carpal tunnel release (ECTR) is generally touted to be a less invasive operation that offers the advantages of less postoperative pain and an earlier return to work compared with conventional open carpal tunnel release (OCTR). ECTR, however, does require special new skills that preferably should be acquired by practice on cadavers before clinical use. Because access to fresh cadavers is restricted in Japan, here we have to gain this experience in actual clinical cases with the assistance of another surgeon who is familiar with the technique. In contradistinction, a “mini” open technique can be learned stepwise just by shortening the conventional incision of OCTR during one’s own clinical experience. Because reimbursement for ECTR was recently raised to be 1.5 times that for OCTR in Japan, that factor alone might make ECTR more popular in a few years. However, at least for the present, the mini open technique is still less costly without the associated risks of complications inherent with ECTR and has proved for the time being to be more suitable for the current medical climate in Japan.

KEYWORDS: Carpal tunnel syndrome, one-portal, two-portal, endoscopic carpal tunnel release, mini open carpal tunnel release

There is an intimate historical relationship between endoscopic surgery in general and Japan in particular. Takagi first performed arthroscopy of a cadaveric knee joint using a cystoscope in 1918.¹ Subsequently, the basis for current arthroscopic equipment was developed by Watanabe.² Arthroscopy of the knee joint was formally developed in 1959 and progressed to include small joints by 1970.² In 1986, an endoscopic system for carpal tunnel release (Universal Subcutaneous Endoscope [USE] System; TACT Medical, Hongo, Tokyo, Japan) was introduced by Okutsu as a “one-portal” procedure^{3,4} (Fig. 1). Another endoscopic system for carpal tunnel release was devised by Chow as his “two-portal” procedure (ECTRA System; Smith and Nephew Dyonics, Andover, Mass) in 1989.⁵ Both procedures proved to be commercially viable and represent the two main-

stream approaches to endoscopic carpal tunnel release (ECTR) today in Japan.

ECTR is generally recognized as a less invasive operation that offers the advantage of less postoperative pain and a theoretically earlier return to work when compared with conventional methods of open carpal tunnel release (OCTR).^{6–10} ECTR does require special skills that preferably should first be acquired by practice on cadavers prior to clinical use. Because availability of fresh cadavers is restricted in Japan, we must gain this experience in real clinical cases with the assistance of another surgeon already familiar with the technique.¹¹ This reason alone may explain why in our early cases of performing ECTR, there was a greater risk of complications than is the norm in the United States. As a direct consequence, ECTR has not become extremely popular in Japan.

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Figure 1 Universal Subcutaneous Endoscope (USE) System set with two mirror-image transparent outer cannulas suitable for each hand, a retrograde-cutting knife, a scraper, and a nondisposable instrument handle.

INDICATIONS

For the treatment of presumed carpal tunnel syndrome, the indications for ECTR are similar to conventional OCTR and include:

1. Dysesthesias in the median nerve distribution and/or severe pain consistent with median nerve compression that disturb the patient's normal activities of daily living.
2. The presence of thenar muscle atrophy.
3. Distal latency of the median nerve more than 5 milliseconds and/or sensory conduction velocity distinctly decreased on electrodiagnostic study.
4. If wrist extension is severely limited, the introduction of instrumentation may be impeded and thus preclude ECTR. A space-occupying lesion or other known anatomic anomaly that is the suspected cause of the carpal tunnel syndrome may represent another relative contraindication for using ECTR.

OPERATIVE TECHNIQUE

ECTR should be performed using local anesthesia because the patient's complaint of intraoperative pain is a very important sign for preventing iatrogenic injury to the digital nerves.¹² Although use of a tourniquet permits superior visualization unimpeded by any bleeding, especially valuable in the two-portal technique, not only is it not imperative, but also vascular injury such as to the nearby superficial palmar arch would then be immediately obvious.

One-Portal Procedure

The USE System available in Japan is set up and includes two transparent outer cannulas for dissection of each hand, a retrograde-cutting knife, a scraper, and a non-

disposable handle (Fig. 1). A 4-mm, 30-degree angle, forward-viewing endoscope is used.

The procedure begins with a 1.5-cm transverse incision made between the flexor carpi ulnaris and palmaris longus tendons at a point 1.5-cm proximal to the distal wrist crease. The distal antebrachial fascia is opened with a mosquito clamp. The outer cannula contacts the flexor tendons while all fingers are held in flexion and are then inserted into the carpal canal while extending the fingers for up to 5 to 7 cm. The endoscope is inserted into the cannulas, and the undersurface of the transverse carpal ligament is examined. In case tenosynovium obscures fine visualization, it is removed with the scraper. The ideal position of the cannula requires that the flexor superficialis tendon of the ring finger should be identified on the radial side.

Next, the distal edge of the flexor retinaculum is identified. A retrograde-cutting knife is inserted ulnar to the outer surface of the cannula. Care must be taken while doing this that the tip of the knife does not injure any adjacent tissues. The knife is hooked at the distal edge of the flexor retinaculum and pulled proximally to divide it. This cutting maneuver not uncommonly is needed up to 3 times for complete division of the retinaculum because its distal portion is typically twice the thickness of the proximal portion.¹³ This may be as Okutsu has pointed out because of the existence of another ligamentous tissue, found volar to the distal flexor retinaculum and connecting the thenar and hypothenar muscles, which must in addition be divided for complete carpal tunnel release. For the sake of completeness, he calls this the "distal holdfast fibers of the flexor retinaculum (DHFFR)"¹⁴ (Fig. 2A). DHFFR can be identified on the volar side of the thin fat layer after division of the flexor retinaculum (Fig. 2B). After division of the DHFFR and thus complete release of the carpal canal, the incision is closed by us using a buried 4-0 absorbable suture. A bulky dressing is used for the day of surgery, which allows restriction of finger motion.

Two-Portal Procedure

This surgical procedure follows the extrabursal modified Chow two-portal technique that has been described more completely in other reports.^{5,15} The only variation in Japan is that because Asian women have comparatively small hands, the distal portal is made a little more proximally than that of the originally described technique.¹⁶

COMPLICATIONS OF ECTR

Untoward events peculiar to ECTR have been described and are here reiterated to reinforce the need to avoid these potential pitfalls.

Figure 2 (A) An additional ligamentous tissue found volar to the distal flexor retinaculum and connected between the thenar and hypothenar muscles has been called the “distal holdfast fibers of the flexor retinaculum (DHFFR)”. FR, flexor retinaculum; DHFFR, distal holdfast fibers of the flexor retinaculum. (B) The DHFFR is sandwiched between fat layers and can routinely be identified on the volar side of the thin fat layer found after division of the flexor retinaculum. Only after division of the DHFFR will complete release of the carpal tunnel roof, as shown, be obtained.

1. *Nerve injury:*

Usually this involves the common or proper digital nerve to the middle and/or ring finger(s), which are in a direct line coincident with the insertion of the cannula. Strong resistance to this insertion due to impinging these nerves may be manifested by paresthesias in either of these two fingers. A complete or partial nerve laceration(s) to any digital nerve or even the recurrent motor branch can occur due to the deep insertion of the cutting knife without clear visualization of the flexor retinaculum.^{17,18}

2. *Superficial palmar arch injury:*

Because the distance between the superficial palmar arch and the distal edge of the flexor retinaculum is only 9.4 ± 3.5 mm,¹⁹ too distal insertion of the knife should be avoided. Incomplete injury of the arch has been reported to have caused a pseudoaneurysm.¹⁸

3. *Flexor tendon injury:*

This occurs most frequently to the flexor digitorum superficialis tendon of the ring finger and is due to a lack of pulling the cutting knife straight backward, typically a risk in the one-portal procedure.¹⁸

4. *Violation into Guyon's canal:*

If the flexor digitorum superficialis tendon cannot be observed, one explanation is that the instrumentation has been inserted improperly into Guyon's canal.¹⁸ This

could potentially allow injury to the ulnar nerve or artery. Once realized, this must be corrected by reinsertion of the cannula.

5. *Incomplete release:*

The incidence of incomplete release with ECTR is higher than that with the open method. The frequency of incomplete release in cadaver studies was found to be as high as 50% after ECTR using the technique of Chow.^{20,21} Part of this could be the anatomy, including the DHFFR, which could be overlooked. Unfortunately, the only recognition of this may be the persistence of the symptoms of carpal tunnel syndrome in the postoperative period.

ECTR FOR HEMODIALYSIS PATIENTS

In general, we shun the use of a tourniquet on that upper extremity that has a functioning dialysis shunt. For that reason, ECTR is recommended rather than OCTR.²² Although it is still controversial whether any amyloid synovitis found in the carpal tunnel should be removed, a simultaneous tenosynovectomy cannot of course be performed with ECTR. However, Nagano empirically states that simultaneous synovectomy is not necessary, as long as hyperplasia of the synovium does not obstruct the motion of fingers.²³ Okutsu reported that there was no significant difference between the rate of recurrence after a one-portal ECTR procedure and OCTR in hemodialysis patients.^{24,25} The incidence of recurrence after the one-portal ECTR procedure was less than 5% and on average took 6.9 years before reoperation. On the

other hand, the recurrence rate in the two-portal ECTR procedure was 8.7%, and it took a mean 4.5 years until reoperation.²⁴

DISCUSSION

The Chow two-portal ECTR technique is preferred by some Japanese authors and has been described as safer and technically easier.²⁶⁻²⁸ Yet Okutsu reported only an 0.3% complication rate using the one-portal procedure²⁹ and emphasizes that complete release of the carpal tunnel needs division of the DHFFR, which is impossible using the two-portal procedure^{14,29} (Fig. 2).

Because both ECTR and OCTR are done as outpatient procedures in Japan, the benefit of ECTR with respect to the duration of hospitalization is not as dramatic as that afforded by other laparoscopic or arthroscopic surgeries.³⁰ The touted advantage of less pain, especially pillar pain,³¹ may also not be valid as it has been reported to be as high as 9% in one study using the one-portal procedure.³²

If thenar muscle atrophy is present, and because the recurrent motor branch may sometimes pierce the flexor retinaculum instead of following the more usual distal extraligamentous route,³³ ECTR should perhaps be avoided as a relative contraindication. OCTR better allows identification and the mandatory decompression of the recurrent motor branch under direct vision.³⁴

Finally, as has become a universal curse, the economics of medicine cannot be overlooked. Until recently in Japan, the compensation for ECTR has been equivalent to that of OCTR. Now the fee is 1.5 times that of OCTR. It should be noted that the cost of the disposable USE System is two thirds the fee for ECTR, which is not yet deducted from any reimbursement. Perhaps this change in the fee schedule will lead to greater popularity of ECTR in Japan in the future, but the "mini" open technique under the current circumstances is more suitable for the usual Japanese hand surgeon.

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