Magnetic Resonance Imaging After Endoscopic Carpal Tunnel Release

John D. Beck, MD, Robert B. Jones, MD, W. James Malone, DO, Janice L. Heimbach, AS, Tim Ebbitt, MD, Joel C. Klena, MD

Purpose To determine with magnetic resonance imaging (MRI) the morphologic changes in the carpal tunnel and median nerve 3 months after endoscopic carpal tunnel release (ECTR).

Methods We enrolled patients who had complete resolution of numbness and pain by 6 weeks after ECTR. Patients who met these inclusion criteria received an MRI at 3 months after surgery. Images were analyzed to determine whether median nerve morphology changes and discrete gap or separation of the flexor retinaculum could be appreciated on MRI.

Results There were 17 patients screened and 15 met the inclusion criteria. Three-month MRI in all patients demonstrated changes in the flexor retinaculum over the median nerve. In all 15 patients, a distinct gap or separation in the fibers of the flexor retinaculum overlying the median nerve could not be appreciated. Median nerve width-to-height ratios at the level of the pisiform and at the hook of the hamate were 2.4 and 2.1, respectively. Median nerve cross-sectional area was 14.1 at the pisiform and 13.3 at the hook of the hamate.

Conclusions MRI of patients 3 months after successful ECTR does not demonstrate a discrete gap or separation in the flexor retinaculum overlying the median nerve but may be useful for evaluating median nerve morphology. *(J Hand Surg 2013;38A:331–335. Copyright © 2013 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Diagnostic II.

Key words MRI, carpal tunnel syndrome, carpal tunnel release, endoscopic, median nerve.

CARPAL TUNNEL SYNDROME (CTS) is the most frequent compressive neuropathy in the upper extremity, with an incidence of 1 to 3 cases per 1,000 patients per year.[1] Surgical treatment has been shown to provide long-term improvement in both symptoms and functional status in the majority of patients that fail nonsurgical treatment. Whereas open carpal tunnel release (OCTR) has been the conventional treatment, the desire to improve on morbidity associated with OCTR while maintaining equivalent median nerve decompression has led to endoscopic carpal tunnel release (ECTR) being performed with increasing frequency.[2–6]

Despite the high success of carpal tunnel release (CTR), some patients remain symptomatic after surgical treatment. Persistence of symptoms after CTR has been attributed to incomplete division of the transverse carpal ligament.[7] Electrophysiological studies can remain abnormal even after adequate nerve decompression and cannot be used as the basis for reoperation in the face of recurrent or persistent symptoms.[8,9]

The potential role of magnetic resonance imaging (MRI) in planning revision CTS has been discussed.[10,11] The goal of this study was to determine with MRI the morphologic changes in the carpal tunnel and median nerve 3 months after ECTR.

MATERIALS AND METHODS

Institutional review board approval was obtained for this study. Patients were evaluated preoperatively and a

From Geisinger Orthopaedics, Danville, Pennsylvania.

Received for publication January 10, 2012; accepted in revised form November 14, 2012.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: John D. Beck, MD, 100 North Academy Lane, Danville, PA 17822; e-mail: jdbeck1@gmail.com.

0363-5023/13/38A02-0015$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2012.11.013

diagnosis of CTS was determined by history and physical examination consistent with compression of the median nerve at the wrist. When clinical history and physical examination were consistent with CTS, neurodiagnostic testing was not required for inclusion. All patients undergoing ECTR by a single surgeon between June 1, 2011, and August 1, 2011, were evaluated 2 weeks and 6 weeks after surgery. Patients who had complete resolution of numbness and pain by 6 weeks were offered participation in this study, with a goal of recruitment of 15 patients. Fifteen of the first 17 patients who met the inclusion criteria consented to participate. Two patients declined owing to difficulty with travel arrangements. Written informed consent was obtained for all participating patients. Inclusion criteria included patient age older than 18 years, failed conservative management of CTS, and ECTR with resolution of numbness and pain. Patients with prior hand surgery, comorbidities that predispose patients to CTS (eg, diabetes mellitus, inflammatory arthritis, or gout), and those who had not achieved complete symptomatic relief at 6 weeks were excluded from the study.

A single-incision endoscopic carpal tunnel release was performed in all patients (Micro-Aire uniportal system, Charlottesville, VA). Release was performed under local anesthesia with monitored anesthesia care sedation. The endoscopic release was performed as previously described by Ruch and Poehling.[12] Patients meeting the inclusion criteria and consenting to participate were scheduled for MRI at 3 months after surgery.

All scans were performed on a 1.5-T GE magnet (Fairfield, CT) with dedicated 8-channel wrist coil and the arm in an overhead, elbow-extended, wrist-pronated position. Two axial sequences performed along the long axis of the wrist were obtained from 1 cm proximal to the radiocarpal joint through 1 cm distal to the carpometacarpal articulations. The 2 sequences acquired included T1 non–fat-suppressed images (TR ~500, TE ~10, ET 3, matrix 288 × 192) and axial intermediate-weighted fat-suppressed images (TR ~2500, TE ~50, ET 10, matrix 288 × 192). Slice thickness was 4 mm with a 1-mm gap.

Images were analyzed by a musculoskeletal trained radiologist and an orthopedic hand surgeon. Discrepancies were resolved by consensus. First, we determined whether a discrete gap in the fibers of the flexor retinaculum could be appreciated on the axial images overlying the median nerve from the level of the pisiform to the hook of hamate. Second, we evaluated the postoperative appearance of the flexor retinaculum, including signal changes, thickening, and fibrotic changes superficial and deep to the flexor retinaculum. The primary goal was the ability to visualize division of the flexor retinaculum. Secondary outcomes of interest included median nerve cross-sectional area, shortest distance between skin and volar margin of median nerve, median nerve height, median nerve width, median nerve width-to-height ratio, transverse carpal ligament width, and anteroposterior dimension of the carpal tunnel. All measurements were made at the level of the pisiform and the hook of hamate and were obtained with picture archiving and communication system (iSite Enterprise; Philips Electronics, Andover, MA) electronic software on digital images. Fifteen asymptomatic patents, none with prior surgery, underwent MRI of the wrist and were evaluated for the previously discussed secondary outcome measures. The groups were compared using the paired *t*-test to see whether a significant difference was present.

RESULTS

There were 17 patients screened who met the inclusion criteria. Eleven women and 4 men with an average age of 55 years (range, 39–84 y) consented to the study protocol. No patient had a worker compensation claim.

The presenting complaints of study patients were numbness and tingling in 15 patients, pain in 11 patients, and weakness in 3 patients. On clinical examination, 10 patients had some degree of sensory changes in the median nerve distribution, and 2 had some degree of median nerve motor weakness. The Phalen test was positive in 12 patients, and the Durkan compression test was positive in 14 patients. No patients had thenar atrophy on physical examination. Four of the patients had neurodiagnostic testing before ECTR, all consistent with CTS. Eight patients had ECTR on their dominant hand.

MRI 3 months after ECTR demonstrated postoperative changes in the flexor retinaculum in all 15 patients. The typical MRI appearance of the native flexor retinaculum on T2-weighted sequences is a band of homogenously low signal fibers (Fig. 1). The post-ECTR patients demonstrated varying degrees of thickening and thinning of the flexor retinaculum with intermediate-intensity signal alteration (Fig. 2). No perineural fibrosis or fibrosis in the soft tissues overlying the flexor retinaculum was seen. In all 15 patients, although the flexor retinaculum was ill defined in places, no definitive gap or separation was appreciated from the level of the pisiform to the hook of the hamate.

Measurement of the median nerve cross-sectional area at the level of the pisiform and at the hook of the hamate were 14.1 mm^2 and 13.3 mm^2, respectively. The median nerve cross-sectional area at the level of the