EDITOR'S CHOICE

Evaluation of Carpal Arch Widening and Outcomes After Carpal Tunnel Release

Yong Eok Kwon, MD,* Hyun Sik Gong, MD,* Han Sol Shin, MD,* Hyung Rae Lee, MD,* Ka Hyun Kim, MD,* Goo Hyun Baek, MD*

Purpose The purpose of this study was to compare the carpal arch widths between baseline and 6 months after open carpal tunnel release, and to determine whether any increase in the carpal arch width was associated with clinical outcomes of surgery.

Methods We measured carpal arch widths in standardized carpal tunnel radiographs before, and 6 months after, open carpal tunnel release in 76 patients with carpal tunnel syndrome. Clinical outcomes were assessed for grip strength change and perceived disability using the Disabilities of the Arm, Shoulder, and Hand questionnaire at 6-month follow-up. We correlated the clinical outcomes with carpal arch width changes.

Results The mean change of the carpal arch width was 1.8 mm (standard deviation, 1.4 mm; range, −0.3 to 5.2 mm). There was no significant correlation between the amount of carpal arch width widening and the clinical outcomes in terms of grip strength change and the Disabilities of the Arm, Shoulder, and Hand scores.

Conclusions This study found that the change of carpal arch width was minimal at 6 months after open carpal tunnel release, and that the increase, if any, was not associated with clinical outcomes such as grip strength change or the Disabilities of the Arm, Shoulder, and Hand scores. *(J Hand Surg Am. 2017;42(2):113−117.*

Type of study/level of evidence Prognostic IV.

Key words Carpal tunnel release, carpal tunnel syndrome, carpal arch, clinical outcome.

CARPAL TUNNEL SYNDROME (CTS) is the most common compressive neuropathy in the upper extremity.[1] The compression of the median nerve can occur by conditions that decrease the cross-sectional area of the carpal tunnel or increase the volume of the carpal tunnel contents, although in most instances the cause of the compression is not known.[2] The roof of the carpal tunnel is composed of the transverse carpal ligament (TCL), which extends from the scaphoid tuberosity and the trapezium ridge radially to the pisiform and the hook of hamate ulnarly. Surgical release of the TCL is the definitive treatment for CTS when nonoperative treatments fail to resolve symptoms.

The TCL maintains the concavity of the carpal tunnel and the carpal arch, and serves as a pulley for the long flexors and the origin of most of the thenar and hypothenar muscles.[3] After its division, the concave arch can flatten and the distance between the borders of the tunnel can increase as the normal geometric relationship between the carpal bones changes.[4,5] Therefore, there is a possibility that the widening may become a source of biomechanical alterations that may be associated with postoperative

*From the *Department of Orthopedic Surgery, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seoul, Korea.*

Received for publication May 14, 2016; accepted in revised form November 23, 2016.

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

Corresponding author: Hyun Sik Gong, MD, Department of Orthopedic Surgery, Seoul National University Bundang Hospital, Seoul National University College of Medicine, 300 Gumi-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-707, Korea; e-mail: hsgong@snu.ac.kr.

0363-5023/17/4202-0007$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2016.11.030

complaints such as wrist pain or grip weakness.[3,6] Furthermore, studies have suggested that endoscopic carpal tunnel release or reconstruction of the TCL may provide a biomechanical advantage by reducing carpal arch widening and flexor tendon bowstring.[7,8]

However, it is uncertain whether changes in the carpal arch are transient, and whether any widening is associated with clinical outcomes. A few studies have observed widening of the carpal arch during surgery or in the postoperative period;[5,7] however, others have shown no change 8 months postoperatively.[9] Gartsman et al[4] reported a mean 10.4% increase in the width of the carpal arch in a retrospective review of 50 patients at a mean follow-up of 16.3 months. They found no relationship between carpal arch widening and the symptom of "pillar pain." Preoperative evaluations were unavailable in most cases, and thus contralateral radiographs were used as controls.[4] The purpose of this study was to compare carpal arch widths at baseline and 6 months after open carpal tunnel release, and to determine whether any increase in the carpal arch width was associated with outcomes of surgery.

MATERIALS AND METHODS

Subjects

We obtained approval from our institutional review board to conduct this study. We screened all patients with CTS who underwent open carpal tunnel release, between January 2012 and March 2014 at our hospital, an urban referral center. All study cases required both clinical and electrodiagnostic support for the diagnosis of CTS. We excluded those with a history of injury to the wrist and those with associated diseases that may affect outcomes, such as cervical radiculopathy, cubital tunnel syndrome, diabetes mellitus, arthritis of the wrist, and Buerger's disease. We also excluded those who underwent bilateral carpal tunnel release, because the other side in bilateral cases could affect the outcome measurement as reflected by the Disabilities of the Arm, Shoulder, and Hand (DASH). Initially we screened 200 patients; 84 were excluded because of simultaneous or staged bilateral surgeries, 22 because of associated conditions, and 18 were lost to follow-up. Finally, 76 patients were enrolled in the study. There were 12 men and 64 women, with a mean age of 53 years (range, 28–73 y). All patients were ethnic Koreans.

A single surgeon performed an open carpal tunnel release under local anesthesia in all patients. A skin incision of 3 cm was made in line with the third web space from 1 cm distal to the wrist crease to Kaplan's cardinal line, and the superficial palmar fascia and the TCL were divided in line with the skin incision. Only the skin was sutured at the end of the procedure. The hand was immobilized in a short-arm orthosis for 3 days, and then changed to a light dressing until the stitches were taken out at 2 weeks after surgery. We did not perform any supervised therapy.

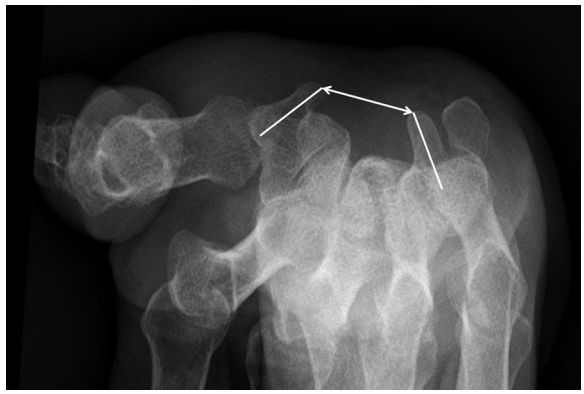

FIGURE 1: Carpal arch width measurement (line with arrows). The reference points were located in line with the long axis of the trapezium ridge and the hook of the hamate in the carpal tunnel view.

Radiological measurements

We obtained standardized carpal tunnel views before surgery and at 6-month follow-up. We positioned the wrist in a rigid dorsal orthosis in 50° of extension with the volar aspect of the forearm placed flat on the film table to maintain each wrist in the same degree of extension, as described by Gartsman et al.[4] We positioned the middle finger metacarpal vertically, parallel to the beam to control rotational position. A standard distance of 75 cm between the beam and the table was maintained to reduce magnification error. All radiographic images were acquired digitally using a picture archiving and communication system, and the radiographic parameters were measured using the tools in the picture archiving and communication system. We defined the carpal arch width as the distance between the palmar tips of the trapezium ridge and the hook of the hamate.[4] The reference points were located in line with the long axis of the bones in the carpal tunnel view (Fig. 1). Widening of the carpal arch width was calculated as the percentage of the widening over the preoperative value.[4]

Two hand surgeons, who were unaware of the outcomes at 6 months, measured the radiographs twice with a 2-week interval between readings and