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CLINICAL RESEARCH

Endoscopic Carpal Tunnel Release Is Preferred Over Mini-open Despite Similar Outcome: A Randomized Trial

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Abstract

Background The decision to perform endoscopic versus the mini-open carpal tunnel release technique is most likely left to surgeons rather than patients with idiopathic carpal tunnel syndrome.

Questions/purposes We hypothesized that (1) at 3 months after surgery, the subjective outcomes of endoscopic release, performed on one hand, and mini-incision release, performed on the other, would not differ in patients with bilateral carpal tunnel syndrome; however, (2) each patient would likely prefer one technique over the other for specific reasons.

Methods Fifty-two patients with bilateral carpal tunnel syndrome had one hand randomized to undergo endoscopic release and the other to undergo mini-incision release. Each patient was assessed with the Boston Carpal Tunnel Questionnaire (BCTQ) and DASH preoperatively and at each followup. Three months after surgery, the patients commented on which technique they preferred and completed a questionnaire regarding the reasons for not preferring the other technique.

Results The mean BCTQ symptom/function score and DASH improved similarly in the endoscopic release group and the mini-incision release group. Thirty-four patients preferred endoscopic release and 13 preferred the mini-incision technique. Scar or pillar pain was the most commonly cited factor in not preferring either technique followed by postoperative pain for the open technique and transient worsening of symptoms for the endoscopic technique.

Conclusions Despite similar improvements in BCTQ and DASH scores after endoscopic and open techniques at 3 months postoperatively, the majority of our patients preferred the endoscopic technique. The most concerning reason for not preferring the other technique was scar or pillar pain.

Level of Evidence Level II, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

Carpal tunnel syndrome is diagnosed based on signs, symptoms, and electrodiagnostic tests. Nonoperative treatments often fail, including local steroid injections, splinting, oral steroids, and ultrasound therapy and a complete division of the transverse carpal ligament should be considered to treat this compressive neuropathy [9, 14, 28].

The most common techniques to release the transverse carpal ligament are the endoscopic and open (standard or

mini-incision) carpal tunnel releases. Many efforts have been made to prove the advantages of endoscopic release and open carpal tunnel release over the other treatment options for idiopathic carpal tunnel syndrome [1, 2, 4, 6–8, 10, 19, 20, 22, 24, 26, 28, 29]. Some surgeons favor endoscopic release, because it leads to less residual pain in the early postoperative period, faster return to work, and fewer wound complications (scar tenderness or hypertrophic scars or infection), but it historically is associated with a much higher risk for median nerve injury [24, 26]. Others, however, prefer open carpal tunnel release because of being less of a technically demanding procedure and the lower associated complications and costs [11]. To improve the early outcomes of open carpal tunnel release, the mini-incision technique was introduced as a minimally invasive surgery. Several studies have shown that the early and late outcomes of the mini-incision technique are either similar or superior to those of the endoscopic technique [22, 29].

Although some authors [3, 5] have emphasized the importance of incorporating a patient's preference into orthopaedic care, the preference for a carpal tunnel release technique is most likely left to the surgeons, not to patients with idiopathic carpal tunnel syndrome. Patients who experience both carpal tunnel release techniques would likely develop a preference for one technique over the other based on their personal postoperative progress. Patients who have bilateral carpal tunnel syndrome would be ideal candidates to investigate regarding which technique is better from the patient's perspective. We hypothesized that (1) at 3 months after surgery, the subjective outcomes assessed by the Boston Carpal Tunnel Questionnaire (BCTQ) symptom/function and DASH scores of the endoscopic carpal tunnel release that was performed on one hand, and the mini-incision carpal tunnel release that was performed on the other hand, would not differ in patients with bilateral carpal tunnel syndrome; however, (2) each patient would subjectively prefer one technique; and (3) have specific reasons for developing that preference.

Patients and Methods

This study was approved by our institutional review board, and all patients provided informed consent before participation. Patients with electrodiagnostically confirmed, idiopathic, bilateral carpal tunnel syndrome were included (Fig. 1). From June 2008 to December 2010, 94 consecutive patients (188 hands) with bilateral idiopathic carpal tunnel syndrome scheduled for bilateral carpal tunnel release were enrolled in the study. We recommended carpal tunnel release when clinical symptoms of tingling, pain, or weakness did not improve after at least 3 months of treatment with a splint, medication, and/or corticosteroid injections. The exclusion criteria were: (1) a considerable difference in preoperative DASH scores (more than 10 points) between the hands; (2) a history of wrist area fracture or dislocation; (3) previous carpal tunnel release; (4) associated cervical radiculopathy, cubital tunnel syndrome, thoracic outlet syndrome, diabetes mellitus, hypothyroidism, arthritis, or Buerger's disease; (5) cognitive impairment that affected the ability to complete questionnaires; (6) patients with workers compensation issues; (7) patient refusal to participate in this study; and (8) inadequate followup (less than 3 postoperative months).

Based on these criteria, 15 patients with considerably different symptom severities or functional statuses, two with distal radius fracture histories, two requiring revision carpal tunnel releases, seven with one of the associated diseases mentioned, four with workers compensation issues, and five who refused to participate in this study were excluded; seven patients were lost to followup. Consequently, 42 patients were excluded, but 52 patients (104 hands) were available for the study (Fig. 1). The subjects consisted of four men and 48 women with a mean age of 55 ± 10 years (range, 33–77 years) at the time of surgery. We classified our patients' occupations into three categories: office workers, manual laborers, and homemakers [21]. Eight of our patients were office workers, six were manual laborers, and 38 were homemakers. According to the American Association of Electrodiagnostic Medicine criteria for electrophysiologic test findings [25], 13 hands were graded as mild, 62 as moderate, and 29 as severe. Thirty-seven patients had the same grade for both hands after electrophysiologic testing, and the other 15 patients did not. All patients were right-handed. The right hand was released by using the endoscopic technique, and the left hand was released through mini-incisions in 27 patients, whereas the opposite was done in the other 25 patients. There were no major differences in the preoperative symptoms as indicated by the BCTQ, function scores, or DASH scores between the endoscopic release group (n = 52) and mini-incision release group (n = 52) (Table 1).

The carpal tunnel release procedures were performed by one hand surgeon (YRC). Randomization was conducted by a computer-generated table of random numbers to determine which side underwent endoscopic carpal tunnel release. The random numbers were blocked to ensure equal distribution. The contralateral side underwent open release using a mini-incision.

The bilateral carpal tunnel release was performed simultaneously, while the patient was under general anesthesia, using an upper-arm tourniquet on the right hand first. The endoscopic release was performed using the Agee technique described by Ruch and Poehling [23] (Fig. 2A). The open release was performed through a minimal

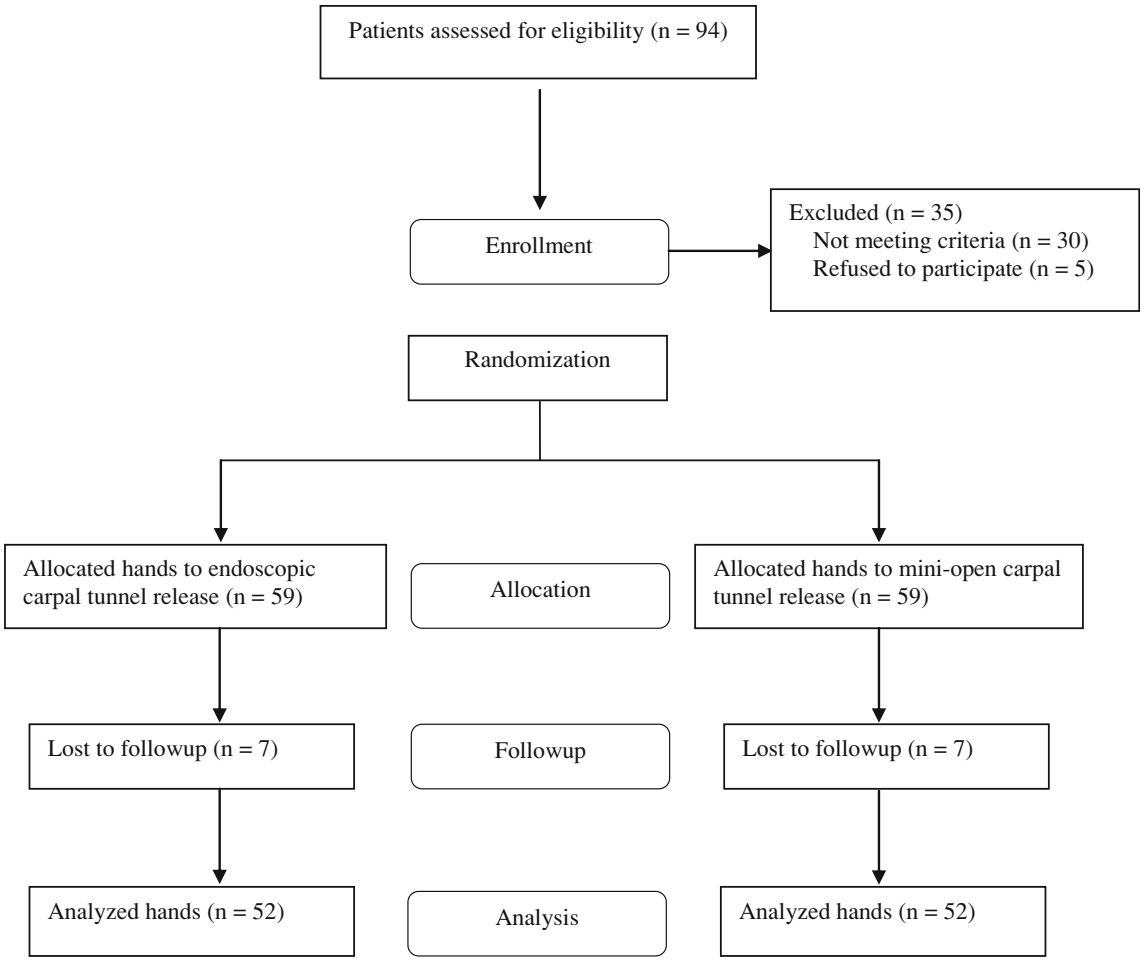

Fig. 1 A flow diagram of the patient enrollment procedure was prepared according to the Consolidated Standards of Reporting Trials guidelines.

Table 1. Outcome measures after endoscopic release and mini-incision carpal tunnel release

Outcome measures (95% CI)	Endoscopic carpal tunnel release		Mini-incision carpal tunnel release		p value
	Preoperative	3 months postoperative	Preoperative	3 months postoperative	
BCTQ-S	3.3 (3.1–3.5)	1.5 (1.4–1.6)	3.3 (3.1–3.5)	1.4 (1.4–1.6)	0.774
BCTQ-F	2.8 (2.6–3.1)	1.5 (1.4–1.6)	3.0 (2.6–3.0)	1.7 (1.3–1.5)	0.832
DASH	48 (44–53)	11 (9–14)	48 (43–52)	11 (8–14)	0.978

BCTQ-S = Boston Carpal Tunnel Questionnaire symptom severity score; BCTQ-F = Boston Carpal Tunnel Questionnaire functional status score; DASH = Disabilities of the Arm, Shoulder and Hand.

incision. Briefly, a 1.5-cm incision was made in the proximal palm over the transverse carpal ligament, beginning distally at the intersection of Kaplan's cardinal line, drawn with the thumb radially abducted and with a line drawn along the radial border of the ring finger. After skin incision, the subcutaneous tissue was incised with a Number 15 blade and retracted laterally. First, we divided the distal portion of the transverse carpal ligament. A subcutaneous tunnel was made over the transverse carpal ligament by using a curved mosquito hemostat, and a standard nasal speculum was introduced into the subcutaneous tunnel. The proximal portion of the transverse carpal ligament was released under direct vision (Fig. 2B). The distal portion of the transverse carpal ligament then was released.

After complete release of the retinaculum with each technique, the tourniquet was released and the tourniquet time was recorded. The mean tourniquet time (95% CI) was 7.5 minutes (range, 6.5–8.5 minutes) in the endoscopic release group and 6.8 minutes (range, 6.1–7.5 minutes) in the mini-incision release group ($p = 0.552$). The wound

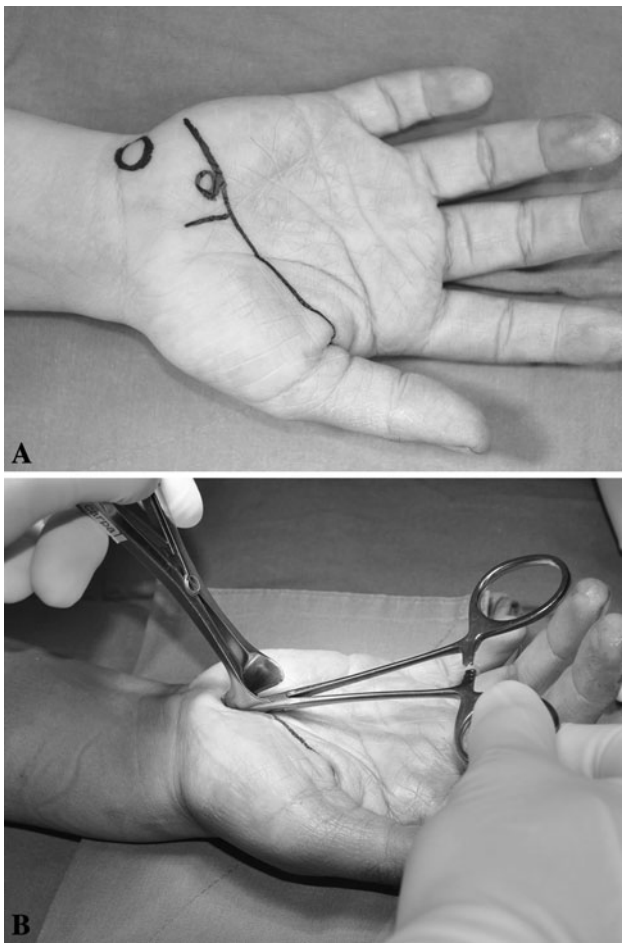

Fig. 2A–B A mini-incision open carpal tunnel release procedure is shown. (**A**) A 1.5-cm incision was made, beginning distally at the intersection of Kaplan's cardinal line and a line drawn along the radial border of the ring finger. (**B**) After dividing the distal portion of the transverse carpal ligament, a standard nasal speculum was introduced into the subcutaneous tunnel that was made between the retinaculum and palmar fascia. The proximal portion of the retinaculum was released under direct vision.

was closed with 4-0 nylon sutures, and a soft bulky dressing was placed; no splint was applied. No local anesthetic was infiltrated at any time during the carpal tunnel release procedure. The patients were encouraged to move their hands immediately after surgery.

An independent observer (BRK), blinded to the method of operation, performed preoperative and postoperative assessments using the BCTQ [17] and DASH scores [13]. The BCTQ is a disease-specific status scale that incorporates a symptom severity scale and a functional scale. The symptom severity scale (BCTQ-S) is comprised of 11 items that address severity, frequency, and duration of symptoms, whereas the functional status scale (BCTQ-F) is comprised of eight questions that assess the difficulty of performing eight daily tasks. Each question offers five possible responses of increasing severity, which are scored from 1 (none) to 5 (most severe); the mean values of all the items in the BCTQ were calculated. The DASH quantifies general disabilities related to the upper extremity. The questionnaire contains 30 items: 21 questions that assess difficulties with specific tasks, five that evaluate symptoms, and four more questions that evaluate social function, work function, sleep, and confidence (one for each). The DASH scores are scaled between 0 and 100 with higher scores representing greater upper extremity disability. Three months after surgery, each patient identified a preferred technique for carpal tunnel release and completed a questionnaire regarding why they did not prefer the other technique. The questionnaire started with, "I did not choose the endoscopic (or minimal-incision) technique because of the following reasons…" Our questionnaire was based on one designed by Trousdale et al. [27] for preoperative concerns of patients undergoing THA or TKA and one by Gong et al. [12] for preoperative concerns of patients with carpal tunnel syndrome. The patients in this study responded by using a 4-point descriptive scale with 1 indicating not concerned, 2 indicating somewhat concerned, 3 indicating very concerned, and 4 indicating extremely concerned (Table 2).

SPSS Statistics Version 18.0 (SPSS, Inc, IBM®, Chicago, IL, USA) was used for statistical analyses. A difference of 10 points in the DASH scores between the two groups was considered to be the minimal clinically important difference. Based on a preliminary study of the first 11 cases in this series, the SD was calculated. A sample size analysis with a power of 95% and an alpha of 0.05 showed that 39 cases (hands) were required for each group.

The preoperative BCTQ-S, BCTQ-F, and DASH scores were compared with the values at 3 months after the procedures by using the linear mixed model for repeated measures for each technique. The Fisher's exact test or chi square test was used to compare the patients' occupations, hand dominance, and grade of electrophysiologic test findings with the preferred surgical technique. The degree of concern for each issue that affected patient preference for one of the carpal tunnel release techniques at 3 months postoperatively was compared using the Mann-Whitney U test. The level of significance was set at $p < 0.05$.

Results

The BCTQ and DASH scores greatly improved in both groups at 3 months postoperatively. The mean BCTQ-S score (95% CI) improved from 3.3 (3.1–3.5) preoperatively to 1.5 (1.4–1.6) in the endoscopic release group and from 3.3 (3.1–3.5) preoperatively to 1.4 (1.4–1.6) in the mini-incision group. The mean BCTQ-F score (95% CI) improved from 2.8 (2.6–3.1) preoperatively to 1.5 (1.4–1.6) in the endoscopic release group and from 3.0 (2.6–3.0)

Table 2. Level of concern for issues after carpal tunnel release

Variable (95% CI)	Patients who disliked the mini-incision technique (from 1 [not concerned] to 4 [extremely concerned])	Patients who disliked the endoscopic technique (from 1 [not concerned] to 4 [extremely concerned])	p value
Pain immediately after surgery	1.76 (1.42–2.11)	1.85 (1.25–2.44)	0.727
Pain after discharge from the hospital	2.12 (1.72–2.52)	1.77 (1.33–2.21)	0.459
Transient worsening of symptoms	1.29 (1.13–1.46)	2.38 (1.62–3.15)	0.004
Weakness of the hand	1.56 (1.22–1.89)	1.85 (1.16–2.54)	0.366
Length of time to use hand	1.59 (1.24–1.93)	1.38 (0.99–1.78)	0.740
Persistent symptoms	1.12 (1.00–1.23)	1.08 (0.91–1.24)	0.689
Scar or pillar pain	2.82 (2.41–3.23)	2.23 (1.53–2.94)	0.114
Unsightly scar	1.47 (1.12–1.82)	1.92 (1.30–2.55)	0.069

preoperatively to 1.7 (1.3–1.5) in the mini-incision release group. The mean DASH score (95% CI) also improved from 48.3 (43.7–52.9) preoperatively to 11.3 (8.6–13.9) after endoscopic release and from 47.8 (43.1–52.4) preoperatively to 10.8 (8.1–13.6) after mini-incision release (Table 1). There were no major differences in subjective outcomes at 3 months when compared with the baseline between the endoscopic and mini-incision techniques ($p > 0.05$) (Table 1). There also were no serious operation-related complications such as deep wound infection, median nerve injury, or need for revision carpal tunnel release.

At 3 months postoperatively, 34 patients preferred the endoscopic technique and 13 preferred the mini-incision technique. The remaining five patients did not find any advantage of one technique over the other. These choices were not affected by the patients' occupations ($p = 0.694$), hand dominance ($p = 0.289$), or grade of electrophysiologic test findings ($p = 0.393$).

The most common reason for not preferring the mini-incision or the endoscopic carpal tunnel release was scar or pillar pain followed by pain after being discharged from the hospital, pain immediately after the mini-incision technique was performed, transient worsening of symptoms postoperatively, and an unsightly scar (hypertrophic or pigmented scar) from the endoscopic technique. There was a trend that the degree of concern for scar or pillar pain was higher in patients who disliked the mini-incision technique than those who disliked the endoscopic technique, but this difference was insignificant ($p = 0.114$). The degree of concern for transient worsening of symptoms postoperatively was higher in patients who disliked the endoscopic technique ($p = 0.004$) (Table 2).

Discussion

Numerous articles [1, 2, 4, 6–8, 10, 19, 20, 22, 24, 26, 28, 29] have compared the safety, effectiveness, and cost of endoscopic carpal tunnel release with those of standard or mini-incision carpal tunnel releases. Despite these numerous reports, the reliability and comparability of these results are controversial as a result of heterogeneity of the outcome assessments, a variety of modified endoscopic and open techniques, and uneven timing of the outcome evaluations. For these reasons, there is no consensus regarding which technique is most suitable for patients with uncontrolled idiopathic carpal tunnel syndrome. The decision to perform endoscopic versus the mini-open carpal tunnel release technique is most likely left to surgeons rather than patients with idiopathic carpal tunnel syndrome. We hypothesized that (1) at 3 months after surgery, the subjective outcomes of endoscopic release, performed on one hand, and mini-incision release, performed on the other, would not differ in patients with bilateral carpal tunnel syndrome; however, (2) each patient would likely prefer one technique over the other for specific reasons.

This study had several limitations. First, the BCTQ and DASH scores of each patient were assessed repetitively for both hands at the same time preoperatively and 3 months after carpal tunnel release. To compensate for this, we used the linear mixed model to analyze the BCTQ and DASH scores. Second, the BCTQ functional status score entails items such as writing and knife use that were difficult to assess for the nondominant hands; patients were given the option to not respond to these items, and we did not include them in the calculation of the overall score, as previously recommended [17]. In addition, we used the DASH questionnaire, evaluating upper-limb disability and symptoms. Although we recognize that the DASH measures bilateral upper extremity function and that the patient can compensate for a one-sided disability for the purposes of the DASH, we believe it still captures a change in function postoperatively. The DASH questionnaire queries some activities (such as turn a key, push open a heavy door, place an object on a shelf above your head, carry a shopping bag or briefcase, carry a heavy object, change a light bulb overhead, and wash your back) and five items that evaluate

symptoms to measure each limb disability separately in patients with bilateral carpal tunnel syndrome. Third, all of our patients underwent carpal tunnel release while receiving general anesthesia. Carpal tunnel release generally is performed under local or regional anesthesia; however, local or regional anesthesia of each hand could have affected their preferences of a technique, biasing the investigation. Finally, we subjectively decided on evaluations at 3 months postoperatively to investigate the factors that influenced patient preference of a surgical technique. Some authors [15, 16, 18] have reported that scar or pillar pain might subside approximately 3 months after the operation. Thus, we chose 3 months postoperatively as the time of evaluation to include scar pain as a possible factor that was affecting patient preference.

Our first aim was to investigate whether subjective outcomes would differ between hands at 3 months after bilateral carpal tunnel release performed through endoscopic release on one hand and through mini-incision release on the other hand. In this study, no large difference was found in the outcome measures between the endoscopic and mini-incision carpal tunnel release techniques. This shows that patient-based outcomes at 3 months might not influence a patient's subjective preference for either of the surgical techniques.

We also surveyed preference for the endoscopic release or the mini-incision carpal tunnel release in each patient at 3 months postoperatively. More patients preferred the endoscopic technique over the mini-incision open carpal tunnel release (34 of 52 versus 13 of 52). Those choices, however, were not affected by the patients' occupations, hand dominance, or grade of electrophysiologic test findings. Based on the questionnaire, the highest ranked reasons for not preferring mini-incision carpal tunnel release were scar or pillar pain, pain after being discharged from the hospital, and pain immediately after surgery. The highest ranked reasons for not preferring endoscopic carpal tunnel release were scar or pillar pain, transient worsening of symptoms after surgery, and an unsightly scar (hypertrophic or pigmented scar). The degree of concern for scar or pillar pain was higher in patients who disliked the mini-open technique, but this finding was only a trend because the difference was not statistically significant. Only the degree of concern for transient worsening of symptoms after endoscopic release was substantially higher in patients who disliked the endoscopic technique. The most important factors affecting patient displeasure after carpal tunnel release were operation-related pain issues such as scar or pillar pain, whereas postoperative pain was reported from patients of the mini-incision and the endoscopic techniques.

Endoscopic and mini-incision open carpal tunnel releases seem to have comparable early subjective outcomes after carpal tunnel release has been performed in patients who had idiopathic carpal tunnel syndrome. A patient's preference for a surgical technique is likely to be determined by scar or pillar pain followed by postoperative pain from an open technique and transient worsening of symptoms from the endoscopic technique.

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