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Background: Compared with the open technique, endoscopic carpal tunnel release has a shorter postoperative recovery period but has been associated with an increased risk of iatrogenic injury. Because of morbidity of the open method, including painful scars, pillar pain, tendon adhesions, scar entrapment of the median nerve, chronic regional pain syndrome, and a longer postoperative recovery period, many patients have been treated nonoperatively to circumvent or forego surgery, resulting in unrelieved median nerve compression and an increased risk of permanent nerve injury.

Methods: Inclusion criteria included a diagnosis of carpal tunnel syndrome based on history and physical examination and electrodiagnostic studies; failure of a short trial of conservative therapy; and advanced disease as evidenced by sensory, motor, or atrophic changes in the median nerve distribution. Exclusion criteria included prior surgery, wrist extension of less than 40 degrees, mass within the carpal tunnel, Guyon's syndrome, and bony carpal tunnel abnormalities. Patients meeting these criteria were treated by the Brown two-portal endoscopic technique.

Results: A total of 14,722 patients were treated with the Brown endoscopic procedure. Eleven patients (0.07 percent) required conversion to an open procedure. There was one iatrogenic injury. Postoperative results were inversely related to the severity of the preoperative electrodiagnostic studies and the duration of symptoms regardless of the method of nonoperative treatment given.

Conclusions: Operative decompression should be carried out promptly if symptoms have been present for 2 months or longer, as the occurrence of permanent nerve damage has been noted within this time frame. The authors advocate use of the two-portal endoscopic technique as previously described by Brown et al. for this purpose. (Plast. Reconstr. Surg. 120: 1911, 2007.)

For nearly two decades, there has been a lack of consensus regarding the operative intervention for the treatment of carpal tunnel syndrome (i.e., open versus endoscopic release of the transverse carpal ligament). The aim of this article is to present our experience in 14,722 patients using the two-portal endoscopic procedure as described by Brown et al.1-3 over a 12-year period and to discuss the evolution of the standard of care of those afflicted with this syndrome in the context of the findings of this study.

PATIENTS AND METHODS

This is a retrospective study of all consecutive patients treated at a tertiary hand surgery referral center staffed by four hand surgeons, with a large referral base both nationally and internationally, over a 12-year period from 1993 to 2005 inclusive. All patients with a definitive diagnosis of carpal tunnel syndrome based on history and physical examination, confirmed by electrodiagnostic studies and treated by endoscopic carpal tunnel release as described by Brown et al.1-3 were included.
with no change following endoscopic carpal tunnel release in both the non-workers’ and workers’ compensation patients.

3. Incidence of severe permanent nerve damage (e.g., in those patients with no change following open revision surgery in both the non-workers’ and workers’ compensation groups.

Brown Two-Portal Endoscopic Procedure

We prefer a short general anesthetic or regional intravenous anesthesia if there are medical contraindications to a general anesthetic. Two surgeons working together ensure a smooth and flawless execution of the procedure. Each surgeon has a dedicated video monitor. The technique of the Brown two-portal endoscopic procedure is illustrated in Figures 1 through 10.

**RESULTS**

Over the duration of the study, a total of 14,722 patients underwent endoscopic carpal tunnel release, using the technique described by Brown et al.1-3 Of this population, a total of 12,494 were non-worker’s compensation patients and 2228 were worker’s compensation patients.

The preoperative electrodiagnostic severity grade was positively correlated with the average duration of symptoms, regardless of the method of nonoperative treatment given, the incidence of permanent nerve injury following endoscopic release in both workers’ and non-workers’ compensation patients, and the incidence of severe per-

![Fig. 1. Instruments used in the Brown two-portal endoscopic procedure are manufactured by Instratek, Inc. (Houston, Texas). Pictured from the top downward are the synovial elevator, the obturator fitted with the slotted cannula, the probe, and the hook knife.](image)

![Fig. 2. Preoperative markings. The dotted lines denote the position of the palmaris longus tendon. The incision for the proximal portal is located 1 to 2 cm proximal to the distal wrist crease, is 1 cm in length, and is concealed within the proximal wrist crease when possible. The position of the distal edge of the transverse carpal ligament is estimated by the drawing of two points 3 to 3.5 cm and 4 to 4.5 cm distal to the distal wrist crease along a line from the palmaris longus tendon (or mid-palmar point if the tendon is absent) to the third web space. A 1-cm circle drawn around the distal portal denotes the position of the exit zone for the obturator.](image)

![Fig. 3. The synovial elevator is introduced into the proximal portal and used to separate the ulnar bursa and synovium from the undersurface of the transverse carpal ligament. The transverse fibers should be palpable at the end of this phase of the operation.](image)

manent nerve damage following open revision in both groups. In each case, the Spearman rank correlation coefficient \( r_s \) was 1 (i.e., \( p < 0.001 \) (Table 1).

Of the 12,494 non-workers’ compensation patients in the study, data regarding the method of nonoperative treatment was available for a total of
some component of permanent nerve injury (i.e., those improved and with no change) was positively related to increasing grade of severity Figure 12. Of the group as a whole, symptoms completely resolved in 10,326 patients (82.6 percent). A total of 1836 patients (14.7 percent) had marked improvement with incomplete resolution of their symptoms and 322 patients (2.6 percent) had no improvement, requiring an open revision and external neurolysis.

Similarly, improvement of symptoms in those undergoing an open revision in the non–workers’ compensation group was also inversely related to increasing grade of severity, although all patients in the revision group had some component of permanent nerve damage (Table 4 and Fig. 13).

Of the 2163 patients in the non–worker’s compensation group who were followed for a 10-year period, 81 (3.7 percent) had recurrence of their symptoms and subsequently required an open revision.

A total of 591 patients in this group had undergone an open procedure of the carpal tunnel
Table 4. Results of Open Revision of Non–Workers’ Compensation Patients

<table>
<thead>
<tr>
<th>Grade</th>
<th>No. of Patients</th>
<th>Asymptomatic</th>
<th>Improved</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>27</td>
<td>0</td>
<td>22</td>
<td>5</td>
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<tr>
<td>II</td>
<td>190</td>
<td>0</td>
<td>137</td>
<td>53</td>
</tr>
<tr>
<td>III</td>
<td>77</td>
<td>0</td>
<td>41</td>
<td>36</td>
</tr>
<tr>
<td>IV</td>
<td>28</td>
<td>0</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Totals</td>
<td>322</td>
<td>0</td>
<td>209</td>
<td>113</td>
</tr>
</tbody>
</table>

elsewhere before having an endoscopic release of the contralateral hand at our center. Of these, a total of 588 patients (99.5 percent) recommended the endoscopic over the open procedure on a follow-up questionnaire.

Of the 2228 patients in the workers’ compensation group, a total of 512 were assessed to be grade I; 1315 patients, grade II; 334 patients, grade III; and 67 patients, grade IV. One patient required conversion to an open carpal tunnel release (Table 5). As in the non–workers’ compensation group, complete resolution of symptoms in the workers’ compensation group was inversely related to increasing grade of severity of preoperative electrodiagnostic test results, in a parallel but downwardly shifted distribution relative to the non–workers’ compensation group (Table 6 and Fig. 15).

We have noted no cases of infection postoperatively. In some patients, the proximal portal may take a few extra days to heal but has not been considered a complication per se, as only Steri-Strips (3M, St. Paul, Minn.) are used for closure of the portals. The primary complication of this procedure is failure of the procedure to relieve the patient’s symptoms of median nerve compression as noted above.

**DISCUSSION**

For nearly two decades, there has been a lack of consensus regarding the operative intervention for the treatment of carpal tunnel syndrome (i.e., open versus endoscopic release of the transverse carpal ligament). Successful treatment of carpal tunnel syndrome results in the elimination or improvement of the patient’s symptoms in addition to halting the progression of nerve injury caused by extrinsic compression.³

Open carpal tunnel release was originally described by Cannon and Love in 1946.⁶ The following year, Brain, a British neurologist, popularized the concept of carpal tunnel syndrome in a classic article detailing the pathophysiology of median nerve compression and the treatment of six patients with release of the transverse carpal ligament.⁷ Phalen, however, is credited with popularizing the technique of open carpal tunnel release because of his reports of treatment of carpal tunnel syndrome with this technique.⁸,⁹ Open carpal tunnel release has since been considered the standard of care in the operative treatment of carpal tunnel syndrome.

![Graph](image)

Fig. 13. Results of open revision in non–worker’s compensation patients. Note that no patients have complete resolution of symptoms. The severity of nerve damage is directly related to the grade of preoperative electrodiagnostic severity.
Table 6. Results of Open Revision in Workers' Compensation Patients

<table>
<thead>
<tr>
<th>Grade</th>
<th>No. of Patients</th>
<th>Asymptomatic</th>
<th>Improved</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>44</td>
<td>0</td>
<td>27</td>
<td>17</td>
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<tr>
<td>II</td>
<td>127</td>
<td>0</td>
<td>62</td>
<td>65</td>
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<tr>
<td>III</td>
<td>38</td>
<td>0</td>
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<td>23</td>
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<tr>
<td>IV</td>
<td>9</td>
<td>0</td>
<td>2</td>
<td>7</td>
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<tr>
<td>Totals</td>
<td>218</td>
<td>0</td>
<td>106</td>
<td>112</td>
</tr>
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</table>

endoscopic approach was not supported by a review of the literature.

There is no consensus in the grading of the severity of carpal tunnel syndrome. We designed a grading scale based on the severity of preoperative electrodiagnostic studies, as this is both reproducible and objective, whereas a scale based solely on clinical findings would have introduced subjectivity and interobserver variability. Although Bland et al.²¹ had drafted a similar six-tier scale, we felt that there was no benefit to having more than four tiers in a clinical grading system.

Nerve conduction studies have been cited as not being predictive of the results of surgery.²² However, there was a high correlation between the severity of the latency of nerve conduction and the results of surgery in our study. In addition, although there was a parallel association in workers' compensation patients to the results of preoperative nerve conduction studies, the results of surgery were not as good as the non-workers' compensation group. This finding agrees with that of Bland et al. (i.e., workers' compensation claims are consistently associated with a poorer outcome).²¹ The explanation for this finding may be attributable to factors that are nonphysiologic and are beyond the scope of this article.

As the results of surgery were inversely related to the duration of symptoms, we strongly recommend surgical intervention for those patients with early onset or mild carpal tunnel syndrome that does not respond to a short course of nonoperative therapy and for prompt endoscopic surgical intervention in all patients with more advanced disease, excluding


