The Effect of Cervical Radiculopathy on the Outcome of Carpal Tunnel Release in a Patient with Carpal Tunnel Syndrome

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Objective: The aim of this cross-sectional study was to elucidate the incidence of cervical radiculopathy among patients who have been diagnosed with carpal tunnel syndrome (CTS) and to evaluate the outcome of carpal tunnel release (CTR) in CTS patients with clinically diagnosed cervical radiculopathy.

Methods: Eighty-five patients who underwent CTR for their electrophysiologically and ultrasonographically diagnosed CTS from January 2013 to July 2015 were evaluated according to the presence of cervical radiculopathy or any condition proven by a radiological assessment of the cervical region. The outcome of CTR was graded from 1 to 4 by the degree of pain relief and evaluated according to clinical factors including cervical radiculopathy.

Results: CTR was shown to be effective in 70 (82.4%) patients, whereas 14 (16.5%) were categorized as a non-effective group. The outcome of CTR was significantly different in the presence of ipsilateral cervical radiculopathy, which was documented by an electrophysiological assessment (p=0.05). However, there was no significant difference in the outcome of CTR between patients with normal and abnormal findings in the cervical region in the radiological assessments.

Conclusion: CTR seemed less effective for the patients who had cervical radiculopathy. An electrophysiological study to identify cervical radiculopathy before performing a CTR is necessary to increase the success rate of the treatment by selecting the most appropriate patients.

Key Words: Carpal tunnel syndrome • Carpal tunnel release • Cervical radiculopathy

INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the most frequent compressive neuropathies of the upper extremities, accounting for 90% of all entrapment neuropathies²,12). In a recent surveillance study by Bland et al., the annual incidence was 139.4 cases per 100,000 in females and 67.2 cases per 100,000 in males, with a female to male ratio of 2.0717).

Carpal tunnel release (CTR), which consists of the division of the transverse carpal ligament to increase the space in the carpal tunnel, is indicated in patients with moderate to severe CTS. The success rate of CTR in patients with CTS has been reported to be 70 to 90%⁹,12). The outcome of CTR can be different between patients with isolated carpal tunnel syndrome and patients with coexisting cervical radiculopathy⁵). However, the correlation between co-existing double crush syndrome and the outcome of CTR still remains controversial.

The aim of this study is to elucidate the incidence of electrophysiologically proven cervical radiculopathy and its effect on the postoperative prognosis of CTR.

MATERIALS AND METHODS

1. Study Population

All patients with CTS admitted to our hospital to undergo CTR were recruited to this cross-sectional study from January 2013 to July 2015. We enrolled patients whose diagnosis of CTS was made by an electrophysiological assessment such as a nerve conduction study (NCS) or electromyelography (EMG) to document the presence and the severity of the CTS. The preoperative severity of the CTS was graded by using the following neurophysiologic grading suggested by Bland⁹: grade 1, very mild CTS, detected only in two sensitivity tests (e.g.,
Cervical Radiculopathy and Carpal Tunnel Syndrome

Table 1. Demographic and clinical data of the study population

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th>6 (7.1%)</th>
<th>79 (92.9%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)±SD</td>
<td>58.86±10.94</td>
<td>60.83±8.68</td>
<td>58.71±11.12</td>
<td></td>
</tr>
<tr>
<td>Underlying conditions</td>
<td>diabetes mellitus</td>
<td>13 (15.3%)</td>
<td>1 (1.0%)</td>
<td></td>
</tr>
<tr>
<td>C6, 7, 8 radiculopathy</td>
<td>17 (20%)</td>
<td>26 (30.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>central canal stenosis</td>
<td>2 (2.4%)</td>
<td>11 (12.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cervical spondylosis</td>
<td>4 (4.7%)</td>
<td>1 (1.2%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

inching, palm/wrist median/ulnar comparison, ring finger “double peak”); grade 2, mild CTS (orthodromic sensory conduction velocity from index finger to wrist <40 m/s with motor terminal latency from wrist to abductor pollicis brevis [APB] <4.5 ms); grade 3, moderately severe CTS (motor terminal latency >4.5 ms and <6.5 ms with preserved index finger SNAP); grade 4, severe CTS (motor terminal latency >4.5 ms and <6.5 ms with absent SNAP); grade 5, very severe CTS (motor terminal latency >6.5 ms); and grade 6, extremely severe CTS (surface motor potential from APB <0.2 mV, peak-to-peak).

An institutional database was reviewed according to sex, age, past medical history and degree of pain relief.

2. Radiologic Evaluation of the Cervical Region

For some patients in our study, an MRI or X-ray was performed on the cervical spine to evaluate the symptoms. The results of abnormal radiological findings fell into the following 3 groups: neural foraminal stenosis, central canal stenosis, and cervical spondylosis.

3. Outcome Assessment

All patients who underwent a CTR for their CTS were followed up in the outpatient clinic at least one week after the first procedure. The degree of pain relief was graded from 1 to 4 in the following order: “Excellent” (improvement >75 %), “Good” (50-70%), “Fair” (25-50%), and “Poor” (<25%). We defined the outcome of CTR to be effective when the pain was relieved by more than 50%. These were classified as the “Excellent” or “Good” pain relief groups. Non-effective was defined as pain relief of less than 50%.

4. Statistical Analysis

The difference in the outcome between endoscopic and open CTR was not considered to be different for long-term pain relief based on a previous study\(^\text{12}\). The outcome of CTR was available for assessment in 84 of 85 patients. Among these patients, CTR was shown to be effective for 70 (83.3%) of 84 patients.

The effect of CTR was assessed based on the patient’s clinical characteristics (Table 2 and 3). The mean age of the patients was not significantly different between the effective and non-effective groups. There was no significant difference in the preoperative severity of CTS between the effective and non-effective groups.

The mean value among the different groups according to each radiological abnormal finding was evaluated by chi-square test. SPSS 20 (IBM SPSS Inc., Armonk, NY) was used for statistical analysis, and significance was defined as \(p \leq 0.05\).

RESULTS

During the study period, 85 patients were treated by either open or endoscopic CTR for CTS. Of the study population, 79 were women and 6 were men. The mean age of the patients was 58.86±10.94 years (range, 31 to 86 years). The demographics of the patients are listed in Table 1. The preoperative clinical diagnosis of CTS was made in all 85 patients according to their history and the results from the combination of NCS, EMG and ultrasonographic evaluation of the carpal tunnel.

Forty-six (54.1%) of the 85 patients had an MRI or X-ray of the cervical region. The patients were divided into the following three groups based on the findings of the radiographic assessments of the cervical region: neural foraminal stenosis (26 patients), central canal stenosis (2 patients) and spondylosis (10 patients). Of the 85 patients, 17 were proven to have cervical radiculopathy on NCS and EMG.

The outcome of CTR was evaluated between the groups with and without cervical radiculopathy using chi-square methods. The outcome among the different groups according to each radiological abnormal finding was evaluated by chi-square test. SPSS 20 (IBM SPSS Inc., Armonk, NY) was used for statistical analysis, and significance was defined as \(p \leq 0.05\).
Table 2. Degree of pain relief according to the ipsilateral cervical radiculopathy

<table>
<thead>
<tr>
<th>Grade of the outcome</th>
<th>ipsilateral C6, 7, 8 radiculopathy</th>
<th>no radiculopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Excellent)</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2 (Good)</td>
<td>9</td>
<td>48</td>
</tr>
<tr>
<td>3 (Fair)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>4 (Poor)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>17</td>
<td>67</td>
</tr>
</tbody>
</table>

*Statistical analysis was performed by Chi-square test between effective (Excellent and Good) and non-effective groups (Fair and Poor).

Table 3. Degree of pain relief according to radiologically proven co-existing conditions

<table>
<thead>
<tr>
<th>Grade of the outcome</th>
<th>ipsilateral neural foraminal stenosis</th>
<th>central canal stenosis</th>
<th>cervical spondylosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Excellent)</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2 (Good)</td>
<td>15</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>3 (Fair)</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 (Poor)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>26</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

*Statistical comparison was performed by ANOVA among the radiologically proven conditions (neural foraminal stenosis, central canal stenosis and cervical spondylosis).

effective groups (p=0.186). The presence of cervical radiculopathy, which was proven by neurophysiological assessments (NSC and EMG), was the only factor that was significantly different between the effective and non-effective groups (p=0.05). The degree of pain relief that was graded from 1 to 4 based on each patient’s response was not significantly different among the groups with different findings on the radiological cervical evaluation (p=0.17). Abnormal findings in radiological assessment did not give the significant difference in outcome of CTR to both groups with and without cervical radiculopathy (p=0.571 and p=0.165, respectively). The outcome of CTR was not significantly different according to the presence of diabetes mellitus (p=0.13). The mean value of the preoperative severity of CTS in patients with diabetes mellitus was not significantly different from those without diabetes mellitus (p=0.81).

**DISCUSSION**

Upton and McComas first described double crush syndrome in 1973 based on their clinical observation that the majority of patients had median or ulnar neuropathy associated with evidence of cervicothoracic root lesions, suggesting that compression of an axon at one location makes it more sensitive to the effects of compression in another location because of impaired axoplasmic flow. They also observed a high association between diabetes and CTS.

The results of previous studies have shown discrepancies in the relationship between cervical pathology that can cause double crush syndrome and CTS.

In the one of the largest studies by Hurst et al., there was a significant correlation of bilateral carpal tunnel syndrome with cervical arthritis (p<0.05), whereas a recent study by Kwon et al. showed that double crush syndrome in CTS did not explain the correlation between the level of cervical radiculopathy and median nerve motor or sensory responses. In their study, the frequency of coexisting CTS was not significantly different according to the level of radiculopathy.

Of the neuropathic factors, it has been suggested that patients with diabetes mellitus have a higher tendency to develop CTS without necessarily increasing interstitial pressure within the carpal tunnel, due to a lower threshold for nerve damage.

Hurst et al. also showed a tendency for an increased incidence of bilateral CTS in patients with co-existing diabetes mellitus, although this increase was not statistically significant.

In our study, 13 (15.3%) of 85 patients had co-existing diabetes mellitus; however, neither the preoperative severity of CTS nor the postoperative outcome of CTR was significantly different from patients without diabetes mellitus (p=0.81 and 0.13).

Although the presence of ipsilateral cervical radiculopathy at C6, C7 or C8 did not have a significant correlation with the preoperative severity of CTS in our study, it was significantly related to a poorer postoperative outcome for CTR. However, our study showed that there was no significant difference in the outcome of CTR according to each radiological diagnosis in the cervical region, including neural foraminal stenosis, central canal stenosis and cervical spondylosis.
Hence, the results from our study support the concept of double crush syndrome in CTS patients. Based on the results of our study, preoperative neurophysiologic studies such as NCS and EMG are necessary to identify the patients with cervical radiculopathy who may be less likely to benefit from CTR for their symptom relief. In contrast to the utility of preoperative electrophysiological assessments to identify cervical radiculopathy, radiological evaluation seems insufficient to predict a patient’s prognosis after surgical decompression of carpal tunnel.

Thus, taking cost-effectiveness into consideration, preoperative neurophysiologic evaluation to determine the severity of CTS and evidence of cervical radiculopathy would occur prior to cervical radiographic evaluation, and radiologic evaluation may be omitted if cervical radiculopathy is not proven by neurophysiologic assessments.

**CONCLUSION**

The limitation of our study is that the factors of confounding potential that are known to be associated with poor surgical prognosis such as patient occupation, repetitive work and atrophy of the abductor pollicis brevis muscle were not considered in the preoperative evaluation.

Therefore, further clinical study should be performed while controlling for possible confounding factors.

**REFERENCES**

1. Alexandra Turner, Frank Kimble, Károly Gulyás and Jennifer Ball: Can the outcome of open carpal tunnel release be predicted?: a review of the literature. ANZ J Surg 80:50-54, 2010