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Electromyographic evaluation after endoscopic carpal tunnel release in idiopathic carpal tunnel syndrome

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Abstract: The purpose of this study was to electromyographically evaluate results in patients with carpal tunnel syndrome (CTS) who underwent endoscopic carpal tunnel release (ECTR). The subjects were 26 patients with idiopathic CTS (37 hands) who were followed for at least 6 months after ECTR. To compare results informatively, hands were classified into four groups: those with normal distal motor latency (DML) and sensory conduction velocity (SCV) were classified as group A, those with normal DML and abnormal SCV as group B, those with an abnormal DML and normal SCV as group C, and those with abnormal DML and SCV as group D. All but one of the hands were classified as group D on the basis of preoperative electromyographic evaluation, while one was classified as group C. The mean preoperative obtainable DML and SCV values were 7.2 m and 27.3 m/s, respectively. Postoperatively, 12 hands were in group A, 8 hands in group B, 2 hands in group C, and 15 hands in group D. The mean DML and SCV values at final follow-up were 4.3 ms and 40.8 m/s, respectively. Of the 25 hands with muscle atrophy before surgery, 6 hands were in group A, 5 hands were in group B, 1 hand was in group C, and 13 hands were in group D at final follow-up. Thenar muscle atrophy and denervation potentials were present before surgery in 13 of the 15 hands classified as group D at the final follow-up.

Key words: electromyography (EMG), endoscopic carpal tunnel release (ECTR), carpal tunnel syndrome (CTS)

Introduction

The diagnosis of carpal tunnel syndrome (CTS) is usually based on both clinical findings and electromyographic evaluation. Electromyography (EMG) is an important method for the assessment of surgical outcome, as clinical evaluation alone is insufficient for this purpose. A good therapeutic outcome has been reported for endoscopic carpal tunnel release (ECTR)[3–5,11] in recent years. However, an extensive review of the literature failed to find any reports on electromyographic evaluation of the outcome of ECTR. The purpose of this study was to electromyographically evaluate the outcome in CTS patients who underwent ECTR, and to investigate the causes of poor results after ECTR.

Subjects

The subjects were 26 patients with idiopathic CTS (37 hands) who were followed for at least 6 months after ECTR (Okutsu technique[11]) from 1993. There was one man (1 hand) and 25 women (36 hands). The mean age at the time of operation was 56.8 years (range, 19–93 years). ECTR was performed on 22 right hands and 15 left hands. In 11 patients, surgery was performed on both hands. The mean postoperative follow-up period was 14.2 months (range, 6–30 months).

Methods

The classification described by Kelly et al.[6] was used for postoperative clinical evaluation. The outcome was classified as excellent if the symptoms had completely resolved, good if symptoms occurred only occasionally, fair if some symptoms persisted, and poor if symptoms were unchanged or exacerbated.

EMG was performed at room temperature (22°), using a DISA 2000 M apparatus (Dantec, Tonsbakken, Denmark). The distal motor latency (DML) to the abductor pollicis brevis and the middle finger-to-wrist sensory nerve conduction velocity (SCV) were recorded

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by surface electrodes. Abductor pollicis brevis muscle atrophy was considered to be present if this muscle showed a distinct difference between the right and left sides on visual inspection, or if atrophy appeared to be present on visual inspection, although it was not distinct, and needle EMG showed clear signs of denervation. The criterion for the diagnosis of CTS at our department was a DML of more than 4.3 ms or an SCV of less than 45 m/s.[8] Surgery was indicated if the DML was 5.5 ms or more or if the SCV was less than 40 m/s. Measurements were done before surgery and at the time of the final follow-up. For informative comparison of results, we divided the hands into four groups: group A, with normal DML and SCV (DML $\leq$ 4.2 ms and SCV $\geq$ 45 m/s); group B, with normal DML and abnormal SCV; group C, with abnormal DML and normal SCV; and group D, with abnormal DML and SCV.

Statistical analysis was performed with Student's *t*-test. A P value of less than 0.05 was considered significant.

Results

Based on preoperative EMG evaluation, 25 of the 26 patients were classified as group D and 1 was classified as group C. DML was unobtainable in 4 hands and SCV was unobtainable in 12 hands. The mean obtainable DML and SCV values were 7.2 $\pm$ 2.2 and 27.3 $\pm$ 8.8 m/s, respectively. Thenar muscle atrophy and denervation potentials were identified in 25 hands on preoperative needle EMG.

Table 1. Clinical results of endoscopic carpal tunnel release (ECTR) for idiopathic carpal tunnel syndrome[a]

	No. of hands (%)
Excellent	25 (67.6%)
Good	8 (21.6%)
Fair	3 (8.1%)
Poor	1 (2.7%)
Total	37 (100%)

[a] Evaluated by the criteria of Kelly et al[6]

Clinical results were satisfactory for 33 of the 37 hands (89.2%) at the time of final follow-up; the results were excellent in 25 hands, good in 8, fair in 3, and poor in 1 (Table 1). Based on EMG evaluation, 12 hands (32.4%) were in group A, 8 hands (21.6%) in group B, 2 hands (5.4%) in group C, and 15 hands (40.5%) in group D (Table 2). at the time of the final follow-up after ECTR, DML was unobtainable in 1 hand, and SCV was obtained in all hands. The mean DML and SCV values at final follow-up were 4.3 $\pm$ 0.6 ms (n = 36) and 40.8 $\pm$ 6.7 m/s (n = 37), respectively. The difference between preoperative and final follow-up DML and SCV values was significant (Table 3). Of the 25 hands with muscle atrophy and denervation potentials before surgery, 6 hands (24.0%) were in group A, 5 hands (20.0%) were in group B, 1 hand (4.0%) was in group C, and 13 hands (52.0%) were in group D at the final follow-up (Table 4). Thenar muscle atrophy and denervation potentials were therefore present before surgery in 13 of the 15 hands classified as group D at final follow-up.

Of the four hands classified as fair and poor at the final follow-up, DML had been unobtainable in three hands and SCV had been unobtainable in one hand at the time of preoperative testing. Thenar muscle atrophy and denervation potentials were present in all four hands before surgery, with muscle atrophy being severe in two hands. The hand classified as poor at final follow-

Table 2. Results of ECTR by electromyographic evaluation pre- and postoperatively

	Number of hands	
	Preop	Postop
Group A	0 (0%)	12 (32.4%)
B	0 (0%)	8 (21.6%)
C	1 (2.7%)	2 (5.4%)
D	36 (97.3%)	15 (40.5%)
Total	37 (100%)	37 (100%)

Group A, Normal distal motor latency (DML) and sensory nerve conduction velocity (SCV); group B, normal DML and abnormal SCV; group C, abnormal DML and normal SCV; group D, abnormal DML and SCV. See text for normal values

Table 3. DML and SCV values preoperatively (preop) and at final follow-up (postop)

	Preop	Postop
DML	7.2 + 2.2 ms (Not obtainable in 4 hands)	* 4.3 + 0.6 ms (Not obtainable in 1 hand)
SCV	27.3 + 8.8 ms (Not obtainable in 12 hands)	* 40.8 + 6.7 ms (Obtainable in all hands)

Differences between the preop and postop DML and SCV values were significant (* $P < 0.0001$)

Table 4. ECTR results in patients with abductor pollicis brevis muscle atrophy (25 hands) before ECTR

	Number of hands	
	Preop	Postop
Group A	0 (0%)	6 (24.0%)
B	0 (0%)	5 (20.0%)
C	1 (4.0%)	1 (4.0%)
D	24 (96.0%)	13 (52.0%)
Total	25 (100%)	25 (100%)

Thenar muscle atrophy was present before surgery in 13 of the 15 hands classified as group D at the final follow-up.

up was that of a 19-year-old woman. In this patient, SCV was normal but no DML could be obtained. One of the other patients was 93 years old, while another had a long period (5 years) between the onset of symptoms and surgery.

Discussion

In our series of 37 hands with CTS, ECTR produced a good clinical result in 89% of the treated hands. These findings are supported by those of Atroshi et al.,[2] who reported a good clinical outcome in 89% of 255 hands after arthroscopic surgery. Many authors have reported surgical outcomes for ECTR comparable with the outcomes of conventional open carpal tunnel release (OCTR).[1,3,9,10,12] However, ECTR has shown advantages over OCTR in recent years, because of the postoperative scarring and delayed return to normal activity associated with the open procedure.[1,3,9,10,12] Nevertheless, ECTR has a drawback, in that it cannot be performed when the recurrent branch of the median nerve is involved, as it is not possible to visualize this branch during endoscopic surgery. Citing the results of the dissection of 100 cadaver hands by Poisel, Lanz[7] reported that the course of the recurrent branch of the median nerve was extraligamentous in 46% of hands, subligamentous in 31%, and transligamentous in 23%. In a study of 821 operated hands and 92 cadaver hands, Tountas et al.[13] reported that the course was extraligamentous in 96.7% of operated hands and 81.5% of cadaver hands, subligamentous in 2.1% of operated hands and 9.8% of cadaver hands, and transligamentous in 1.2% of operated hands and 8.7% of cadaver hands. When the course is transligamentous, the recurrent branch is sometimes compressed as it passes through the transverse carpal ligament. The existence of such anatomical variation needs to be taken into account in the treatment of CTS.

Only 12 of the 37 hands (32.4%) in our series recovered to the extent at which DML and SCV were normal on electromyographic evaluation after ECTR. These results were poorer than those obtained by clinical evaluation, and the outcome was often clinically satisfactory, despite the showing of abnormal DML and SCV values. EMG is an objective evaluation method that warrants further investigation for the assessment of ECTR. An extensive review of the literature failed to find any reports on electromyographic evaluation of the outcome of ECTR. The results of the present study showed that thenar muscle atrophy and denervation potentials were present before surgery in 13 of the 15 patients classified as group D postoperatively. In other words, electromyographic recovery tended to be slower when thenar muscle atrophy was present before surgery. In the four patients with the four hands with a fair or poor outcome, muscle atrophy was severe in two hands (in two patients) before surgery, and one of the other two patients was elderly (93 years old), while the other had symptoms of long duration (5 years). Of particular interest, among the patients with a fair or poor outcome was a 19-year-old woman with a normal SCV, unobtainable DML, and marked muscle atrophy before surgery. The origin and course of the recurrent branch of the median nerve were assumed to be anomalous in this patient. ECTR was performed, but the outcome was poor.

Preoperative electromyographic evaluation of CTS at our department has recently included needle electromyography of the first lumbrical muscle, in addition to the measurement of DML and SCV and needle electromyography of the abductor pollicis brevis muscle. The origin and course of the recurrent branch of the median nerve are likely to be anomalous if there are few indications of denervation and adequate muscle activity in the first lumbrical muscle, even in the presence of denervation and marked atrophy of the abductor pollicis brevis muscle. In such patients, OCTR is considered to be more appropriate than ECTR. A decision on whether to perform ECTR or OCTR can therefore be made on the basis of careful preoperative electromyographic evaluation.

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