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Electrophysiological Assessment Before and After Carpal Tunnel release Surgery

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ABSTRACT

Background: CTS is the most well-known and frequent form of median nerve entrapment and accounts for 90% of all entrapment neuropathies. CTS is a neuropathy caused by entrapment of the median nerve at the level of the carpal tunnel, delimitated by the carpal bones and by the transverse carpal ligament.
Objective: The aim of this study was to assess the results of electrophysiological studies of the pre and postoperative carpal tunnel decompression and their relationship to severity of CTS.
Subjects and methods: Patients with a diagnosis of moderate to severe CTS and Severe CTS defined by electrodiagnostic were included in this study. All the patients with Moderate-severe and Severe CTS included in the study had open carpal tunnel release (CTR) under local anesthesia without upper arm tourniquet without sedation or any concomitant medication, and with-out a tourniquet.
Results: Total Number of patients in this study is thirty five**.** During the comparison between the two studied groups (before CTR and1month & 3months after CTR). In Moderate and severe CTS patients, There is a highly significant ($p<0.001$) decrease values in the distal motor latencies (DML) and onset distal sensory latency (DSL) of median nerves after CTR. In Extremely Severe CTS patients, there is a No significant ($p<0.5$) decrease values in the distal motor latencies (DML) after CTR and No response of sensory stimulation of Median nerves before CRT and after CTR.
Conclusion: CTS patients had higher sensory and motor latency values in preoperative period, which decreased at 1 month post-operatively; and further gradually improved in 3 month and 6 month follow up.
Key words: Carpal Tunnel Syndrome, Nerve conduction study, transverse carpal ligament, carpal tunnel release.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the most well-known and frequent form of median nerve entrapment and accounts for 90% of all entrapment neuropathies. CTS is a neuropathy caused by entrapment of the median nerve at the level of the carpal tunnel, delimitated by the carpal bones and by the transverse carpal ligament. Physiological evidence indicates increased pressure within the carpal tunnel, and therefore decreased function of the median nerve at that level.[(1)]

CTS characterized by paresthesia Although Provocative tests on physical examination such as the wrist flexion test (Phalen's sign) and the local percussion test over the median nerve (Tinel's sign) can be extremely helpful in supporting the diagnosis, Nerve conduction studies (NCS) as the most definite diagnostic tests for CTS with high degree of sensitivity and specificity, are performed to confirm the diagnosis, to determine the severity. [(2)]

Open carpal tunnel release has long been considered the gold-standard surgical treatment for CTS. This approach allows for direct visualization of the anatomy and possible anatomical variants. The technique involves placement of a longitudinal incision at the base of the hand. The length of the skin incision varies but typically is less 4 cm. The subcutaneous tissue, the superficial palmar fascia, and the muscle of the palmaris brevis are also incised in line with the incision, thereby exposing the transverse carpal ligament (TCL) With the incision of TCL longitudinally, the median nerve is exposed. The release is extended to the superficial palmar arterial arch distally and for a limited distance proximally beneath the wrist flexion creases For optimal outcomes, the TCL must be completely released while avoiding damage to the vital structures.

The flexor tendons can be retracted to inspect the floor of the canal for lesions.[(3)]

The aim of this study was to assess the results of electrophysiological studies of the pre and postoperative carpal tunnel decompression and their relationship to severity of CTS.

MATERIALS AND METHODS

Patients with a diagnosis of moderate to severe CTS and Severe CTS defined by electrodiagnostic were included in this study. Electro diagnostic evidence of CTS adhered to the American Association of Neuromuscular and Electro diagnostic Medicine (AANEM) criteria. Patients with mild severity on electrodiagnostic study, pregnant woman and patients with diabetes were excluded from this study.[4]

We conducted two years prospective study of 35 patients with CTS at Ibn Sena Teaching Hospital, Initially clinical diagnosis of CTS was made preliminarily based on symptoms and findings on physical examination.

Then we evaluated the patient using NCS. The parameters used in NCS were sensory and motor latency of median. The neurophysiological tests graded the CTS into the mild, moderate, and severe categories, according to the American Association of the Electrodiagnostic Medicine (AAEM) criteria: (1) Mild CTS: prolonged distal sensory latency with ± decreased sensory amplitude; (2) moderate CTS: abnormal median sensory latency with prolongation of the distal motor latency; (3) severe CTS: prolonged motor and sensory distal peak latencies either with a low or absent SNAP or CMAP.

In the patients with bilateral CTS, the neurophysiological grade in the more severity affected hand was noted.[4]

After preoperative evaluation, patients with Mild CTS treated conservatively, all the patients with Moderate-severe and Severe CTS included in the study had open carpal tunnel release (CTR) under local anesthesia without upper arm tourniquet without sedation or any concomitant medication, and with-out a tourniquet. The idea is that the patient will only feel the first prick of the needle and should not feel any further pain or discomfort after this moment.

The patient receives an infusion of 22 mL of an anesthetic solution by means of a 20 mL syringe (these syringes actually hold 22 mL) with a30 mm × 0.7 mm needle. Initially, around 3–4 mL is infiltrated into the subdermal region of the distal portion of the forearm, between the paths of the median and ulnar nerves. Then, 8 mL is infiltrated into the subfascial layer of the distal portion of the forearm and the remaining 10 mL into the subdermal layer, anteriorly to the transverse ligament of the carpus.[5]

Nine patients did not have surgical intervention; and 4 patients did not undergo the post-operative NCS evaluation, after surgery, all the patients were evaluated at 1 month, 3 month and 6 month using NCS by the same examiner.

RESULTS

Total Number of patients in this study is thirty five with ratio of Female to male of 25:6. The age range was between 27-65 years with mean age of 44years. Right hand was involved in patients (78%) and left in (22 %). All patients were right hand dominant except of five patients who are left hand dominant.

Table 1 shows mean NSL (Nerve sensory latency), NML (Nerve motor latency), during the study period.

During the comparison between the two studied groups (before CTR and 1month & 3months after (CTR) the following results as shown in (table 1) were obtained. In Moderate CTS patients, There is a highly significant ($p<0.001$) decrease values in the distal motor latencies (DML) and onset distal sensory latency (DSL) of median nerves after CRT as shown in (Table 1 and Figure 1) .

Table 1: Comparison between DMS and SNL before operation and 1month and 6 months after operation of patients of moderate CTS.

Severity of CTS	Mean of DML Before op.	SD	Mean of DML 1month after op	SD	Mean of DML 3months after op	SD	P value
Mean of DML	4.6	0.4	3.7	0.5	3.3	0.4	0.001
Mean of SNL	3.2	0.3	2.7	0.3	2.3	0.2	0.001

In Severe CTS patients, There is a highly significant ($p<0.001$) decrease values in the distal motor latencies (DML) and onset distal sensory latency (DSL) of median nerves before CTR after CTR as shown in (table 2 and figure 1).

Table 2: Comparison between DMS and SNL before operation and 1month and 6 months after operation of patients of Severe CTS.

Severity of CTS	Mean of DML Before op.	SD	Mean of DML 1month after op	SD	Mean of DML 3months after op	SD	P value
Mean of DML	5.8	0.7	4.8	0.6	3.6	0.6	0.001
Mean of SNL	4.1	0.6	3.2	0.4	2.5	0.3	0.001

In Extremely Severe CTS patients, There is a No significant($p<0.5$) decrease values in the distal motor latencies (DML) after CRT and No response of sensory stimulation of Median nerves before CTR after 1 month, 3 months and 6 months after CTR as shown in (table 3 and figure 1).

Table 3: Comparison between DMS and SNL before operation and 1month, 3months and 6 months after operation of patients of Extremely Severe CTS.

Severity of CTS	Mean of DML Before op.	Mean of DML 1month after op.	Mean of DML 3months after op.	Mean of DML 6 months after op.	P value
Mean of DML	10.8	9	8.2	6	0.5
Mean of SNL	NR	NR	NR	NR	

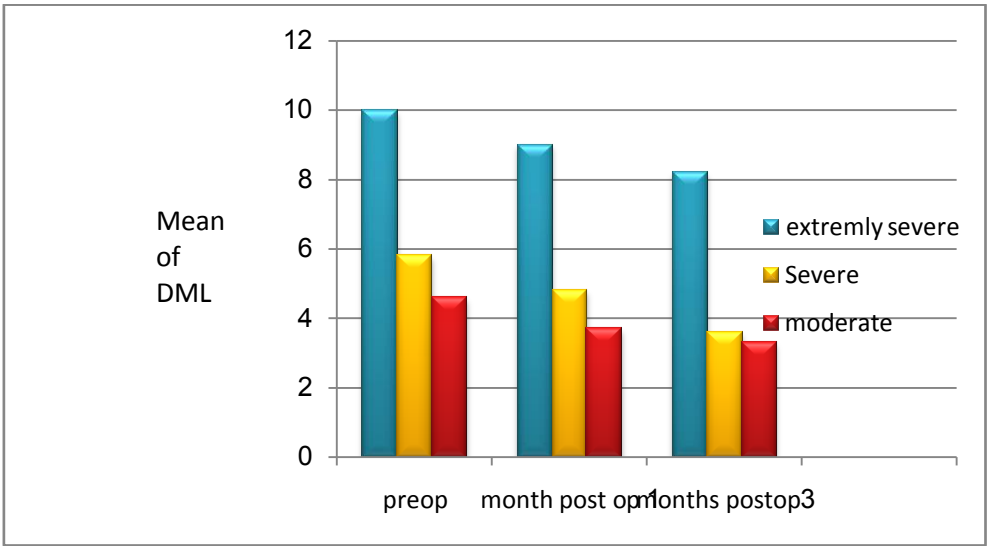

Figure 1: correlation between DML before CTR and after CTR in studied groups.

DISCUSSION

In 1933, Lear month presented the first article regarding the surgical treatment of CTS after releasing the transverse carpal ligament. In spite of the fact that this was the first official publication of surgical median nerve decompression, Galloway may be the first who performed surgical treatment for CTS in 1924.[6]

This study showed significant improvement in the DML and DSL 1months postoperatively in Moderate CTS as shown in (Table 1 and Figure 1) while in severe CTS the improvement in DML and DSL need 3 months to reach normal value. The improvement was proportional to the severity score at baseline.

In this study, patients after surgical release showed significant improvement in DSL and DML. These findings were consistent with study conducted by Federica Ginanneschi *et al* in 2008.[7] who found that shortly after CTR improved NSV and NML with further improvement at 6 month post operatively. Similar results were shown in study conducted by Mondelli M *et al* 2000 .[8]NMV and NSV were significantly improved as early as 1 month post operatively and the NSL and NML improve much at 3 month, 6 month respectively.[9]

Surgical decompression of the carpal tunnel may not improve symptoms if there is already a 'poor nerve'. This is when the timing of decompression follows an already prolonged duration of severe nerve compression and established axonopathy with loss of axons rendering the injury permanent.

The path physiology of CTS follows compression of the median nerve which is caused by an increased carpal tunnel pressure. The carpal tunnel pressure can be increased in patients with CTS when the wrist is positioned in either extension or flexion which is the bases for clinical tests such as Phalen's and reverse Phalen's test. Furthermore, the carpal tunnel pressure can be abnormally high even in a neutral position for some patients[(10)] this results agree with Conzen et al At baseline, 78.0 % of the patients had moderate to extremely severe scores of severity (based on NCV). Six months after surgery, this number had dropped to 32.2 %. The mean NCV had improved significantly post surgery, and the association between the pre-surgical value and the value six months after surgery indicated a proportional improvement with relation to the baseline measurement (Fig. 1 – while a more complex model was allowed by the statistical procedure, the linear model was supported by the data). [(11)]

CONCLUSIONS

CTS patients had higher sensory and motor latency values in preoperative period, which decreased at 1 month post-operative period; and further gradually improved in 3 month and 6 month follow up. CTS patients also showed lower sensory and motor conduction velocity which gradually improved in follows up.

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