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Evaluation of Clinical and Nerve Coduction Study for Surgical Treatment of Carpal Tunnel Syndrome

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Abstract: Background: Carpal tunnel syndrome (CTS)is very commonly encountered in surgical practice. The syndrome is more common in women ages 30-60 and for those with jobs that require frequent, repetitive hand movement. **Aim of the study:** To assess the improvement in the clinical and nerve conductivity in the first and six months after surgery. **Methods:** This prospective study was carried out in different hospitals in Iraq on 30 patients. Twenty - six of them were female, and four were male. Seventy-six percent were stay-at-home parents. The mean age was (38.56± 6.68). In 18 patients, the dominant hand was affected. All patients complained of pain, paraesthesia, and numbness in the distribution of the median nerve. The nerve conduction study was abnormal in 25 patients. The thenar muscle wasting was positive only in 12 patients; also two–point discrimination was abnormal in 12 patients. Those patients have long duration and severe symptoms. All the Patients were treated by surgical decompression of the median nerve. **Results and Discussion:** Twenty-three of them improved clinically in one month postoperatively, while the nerve conduction study became normal only in 12 patients. In six months postoperatively, only seven patients remained complaining about mild symptoms, and only five patients still have abnormal nerve conduction study. We conclude that adequate surgery usually gives an excellent result. The nerve recovery in a nerve conduction study takes time longer than clinical improvement. **Conclusion:** 1) CTS affect middle-aged female, especially in housewife. 2) The dominant hand is more affected than the other hand. 3) Nerve conduction study confirmed the diagnosis of CTS. 4) Adequate surgery usually gives good results. 5) Most of the patients with abnormal nerve conduction studies pre-operatively show excellent results and improve clinically post-operatively with nerve conduction study become completely normal. 6) Muscle wasting did not improve in most patients, especially those who had a long duration of symptoms.

Keywords: Carpal tunnel syndrome (CTS); Transverse carpal ligament (TCL); (CTS); and CTR.

INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the most common hand and wrist disorders and a serious occupational health problem. It affects people who use their hands in a repetitive, strenuous motion [. *et al*., 2019; . *et al*., 2019]. The syndrome is more common in women ages 30-60 and for those with jobs that require frequent, repetitive hand movement, such as a keyboard or working with a cash register. Sir James Paget first reported median nerve compression at the wrist following a distal radius fracture of 1854 [. *et al*., 2019]. In 1880, James Putnam presented the first series of patients with pain and paraesthesia in the median nerve distribution of the hand. 1913, Pierre Marie and Charles Foix described the pathology of median nerve compression underneath the transverse carpal ligament (TCL) [Karpitskaya, Y. *et al*., 2002]. In 1933, Sir James Learmonth reported the first TCL release to treat median nerve compression at the wrist. Since these early reports, much work has described the signs and symptoms of (CTS) as well as its treatment. The carpus is made of two rows of bones. It is a bony gutter deeply concave on its flexor surface. This gutter becomes a tunnel by the transverse carpal ligament [Palumbo, C.F. *et al*., 2000; Dale, A.M. *et al*., 2013]. In the cross-section, the carpal tunnel is oval at its proximal and with its radial pole more pointed than its ulnar pole. The major axis of the carpus is directed volary and radially. The median nerve is formed by two heads; the lateral head from the lateral cord of the brachial plexus (C6.7), the medium's head from the media cord (C6.7.8), and the two heads united in the axilla [Werner, R.A. *et al*., 2002]. The nerve passes beneath the Struthers ligament. In the cubital fossa, it disappears between the two heads of pronator teres, then becomes plastered to the dorsal surface of the flexor. digitorum superficialis [Jablecki, C.K. *et al*., 2002]. Then emerges from beneath the sublime's tendon 5cm proximal to the transverse carpal ligament, the median nerve gets flatted at about the entrance to the flexor retinaculum, being compressed in the anteroposterior diameter. The median nerve is nourished by the median artery, which is a branch of the anterior interosseous artery [O'Connor, D. *et al*., 2003]. The median nerve supplies the carpal bones and the capsule of

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the wrist joint. Just above the flexor retinaculum, the median nerve gives off a palmer branch to the skin over the thenar eminence [Korthals-de Bos, I.B. *et al*., 2006]. The median nerve divides in the carpal tunnel and enters the hand as a medial and lateral branch. As the median nerve enters the retinaculum, it bears a constant relationship to the tendons. It is radial to the flexor sublimes of the ring fingers, volar and radial to flexor sublimes of the index, ulnar to the flexor carpi radialis, volar and ulnar to flexor pollicis longus. The tendon of the palmaris longus lies immediately volar to the nerve [Beck, J.D. *et al*., 2013; Ibrahim, I.K. *et al*., 2012]. The etiology of CTS is multifactorial, with both local and systemic factors contributing to varying degrees. Symptoms of CTS are a result of median nerve compression at the wrist, with ischemia and impaired axonal transport of the median nerve across the wrist [Iida, J.I. *et al*., 2008]. CTS is a clinical diagnosis representing the constellation of specific clinical symptoms & signs [Watchmaker, J.D. *et al*., 2017]. Electrodiagnostic evaluation of the median nerve can help to objectively confirm the nerve conduction slowing or conduction block. Laboratory studies may be useful to differentiate secondary from primary forms of CTS &to rule out other conditions mimicking this syndrome [Aghda, A.K. *et al*., 2020]. Patients complain of intermittent numbness, tingling, burning, &/or pain in the sensory median nerve distribution of the thumb, index finger, middle finger & radial half of the ring finger. Usually, the palm sensation is not affected as the palmar cutaneous branches of the median nerve does not pass through the carpal tunnel [Wellsss, G. *et al*., 2020]. Pain can be referred to any location in the upper limb because the median nerve has fibers from the C6 to TI nerve root levels. Subjective swelling of the hand & /or wrist is also an uncommon complaint. Nocturnal pain & Parasthesia are common due to increase pressure on the median nerve within the tunnel while sleeping, holding the wrist flexed. Discomfort is usually relieved by shaking, massaging, or actively moving the hand. Symptoms tend to affect the dominant hand, but several patients can experience bilateral symptoms [Werner, R.A. *et al*., 2011]. However, the dominant hand is usually more severely affected, especially in idiopathic cases. Typically, symptoms may become more severe and constant with activity & over time, progressing to clumsiness, weakness of the grip & pinch, dropping or difficulty holding items, & hyper aesthesia along the median nerve distribution; thenar atrophy is a sign of advanced or neglected chronic CTS [De Kleermaeker, F.G. *et al*., 2017]. The endoscopic treatment of CTS has become an alternative of treatment. It is a newer procedure that allows the division of TCL with overlying structures left intact. Use of this procedure purportedly lessens scar formation & allows an earlier return to work & activities of daily living. The most common complication of the endoscopic methods is the incomplete release of TCL [Sonoo, M. *et al*., 2018]. Persist ant, or recurrent symptoms may respond well to the open procedure to complete the release. The incidence of iatrogenic neurovascular injury during endoscopic CTR is low [Claes, F. *et al*., 2013]. This study aims to assess the improvement in the clinical and nerve conductivity in the first and six months after surgery.

PATIENTS AND METHODS

A prospective study on (30) patients with CTS who were treated operatively & completed follow-up at 1- and 6-months post–operatively. The study was carried out in the orthopaedic department of different hospitals in Iraq between 2nd November 2021 and 4th August 2022. The total number of patients with CTS operatively treated in our unit was (48) patients. Only (30) were completely followed–up, and the other (18) patients were excluded. The duration of symptoms of these patients was a minimum of three months & maximum of six years. Twenty of our patients were house wife's female; three were teachers; three were policeman, two were nurses, one was a driver, and one was an engineered. The ages of our patients ranged between 25 and 60 years old. The mean was (38.56) years. The dominant hand in (20) patients was the right. Twelve of them had a right hand affected, (2) had a left hand affected & the remaining (6) patients had both hands affected. In (10) patients, the dominant hand was left, (6) of them were left hand affected, and the other (4) had both hands affected. All patients were examined clinically, including general and detailed neurological examination, plans, tines, and two-point discrimination tests were performed. We performed a nerve conduction study pre-operatively & post-operatively first month & six months later. Thenar muscle wasting was found in (10) cases, and the wasting was seen in cases of the long-duration disease. All of our patients were primary (idiopathic) CTS. Two of our patients had cervical spondylosis; three patients had diabetes mellitus in association with CTS.

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Patients' Evaluation

1. Clinical:

Symptoms; Parasthesia, numbness in the distribution of the median nerve, and pain, which was classified according to the "system of pain grading" into;

a. Grade 1 mild
b. Grade 2 moderate
c. Grade 3 sever
d. Grade 4 excruciating
e. Signs: Phalen's test.

Tinel's test

Thenar muscle wasting

Two points discrimination tests: the shortest distance between the two separated points of a compass or calipers at which the patients perceive two stimuli is compared for homologues area of the body. (normal; fingertip, 0.3 - 0.6 cm)

2. Radiological:

To exclude lesions in cervical spines.

3. Nerve conduction study:

We depend on; motor distal latency (MDL), motor conduction velocity (MCV), sensory conduction velocity (SCV), and sensory amplitude. The range of normal values of these parameters was: (3.2 – 4.2 mes), (50.0 – 67.3 m / sec), (48 – 64.9 m/sec), and (10 – 90 µv), respectively.

RESULTS

Table 1: Demographic characteristics of 30 patients with CTS

Parameters	Number of patients
Gender	
Male	4
Female	26
Age group	
20-30 years	5
31-40	13
41-50	8
51-60	4
Job	
Housewives	20
Policeman	3
Teacher	3
Nurse	2
Driver	1
Engineerer	1

Table 2: Clinical characteristics of 30 patients with CTS

Variables	Values
Duration of symptoms in the month (Mean ±SD)	13.80±11.90
Associated disease (%)	
Non	80 %
Cervical spondylosis	12 %
Diabetus mellitus	8 %
Thenar muscle wasting (%)	40 %
Abnormal two point discrimination (%)	40 %

Table 3: Present mean and SD of age, duration of symptoms, and grade of pain for patients with CTS

Gender	Age (Year) Mean ± SD	Duration of symptom (month) Mean ± SD	Grade of pain Mean ± SD
Female N=26	40.05±8.57	12.77±17.82	2.41±0.66
Male N=4	38.33±13.01	13.67±9.60	2.49±0.57

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Total N=30	37.34±8.86	13.85±16.90	2.46±0.67

Table 4: Present mean & SD of abnormal two-point discrimination of CTS

Number of patients	Two-point discrimination (Mean ± SD)
12	7.8±1.02

Table 5: Electrophysiological changes (Mean ±SD), pre-operative and 1-month post-operative

Parameter	Pre-operative Mean ±SD	1-month pos t- op Mean ±SD	T-value	P-Value
DML	5.4±1.6	4.2±1	7.95	0.000
SCV	32.1±12	37.3±10.2	-10.26	0.000
S.A.	16±4.9	18.8±2.8	-4.32	0.000

Table 6: Electrophysiological changes (Mean ±SD), pre-operative and Six-month post-operative

Parameter	Pre-operative Mean ±SD	Six months Postoperative	T-value	P-Value
DML	5.4±1.6	3.6±0.5	8.06	0.000
SCV	32.1±12	46.5±5	-8.3	0.000
S.A.	16±4.9	2±0.2±2	-4.56	0.000

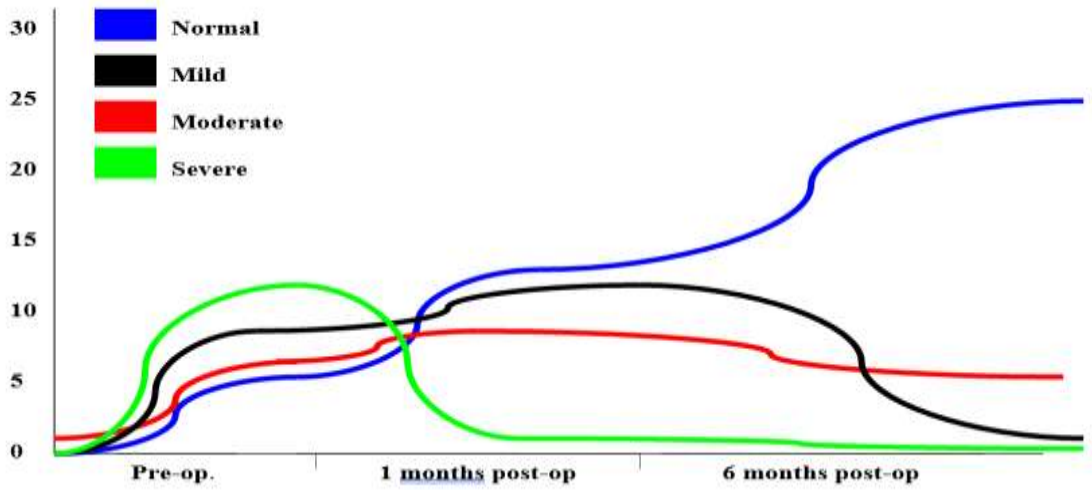

Figure 1: The changes in NCS pre-operative, 1-Month post-operative, and six months postoperative

DISCUSSION

Carpal tunnel syndrome, the most common focal peripheral neuropathy, results from compression of the median nerve at the wrist [Fowler, J.R. *et al*., 2015]. The syndrome affects an estimated 3 percent of adults. It is more common among women between the ages of 30-60, and three to six times as many women as men suffer from CTS [Rivlin, M. *et al*., 2017]. High prevalence rates have been reported in persons whose occupations combine force and repetition of the same motion in the finger and hand for a longer period; this motion may cause swelling within the wrist and a tightening around the median nerve. Individuals with CTS feel numbness or tingling in the fingers, disabling pain, or weakness of the hand or wrist muscles (from sustained pressure on this nerve); In this study, we found that CTS affects women in middle age. The mean age of patients was (38.56). It is common in housewives. This is because housewives are subjected to a severe load in their house jobs [Basiri, K. *et al*., 2015; Kortlever, J.T. *et al*., 2020]. The male-to-female ratio is 1:7. These results were similar to those observed by Kamadhenu, who worked on 668 cases of CTS; 91.% were female the age ranged from 17 to 83 (mean 47.5).In other studies, it was found that male to female ratio was 1:6. Median sensory and motor distal latencies (SDL/MDL) were correlated with age and duration of symptoms in 1498 CTS patients by previous authors [Miyaji, Y. *et al*., 2020]. The ages correlated more positively than the duration of complaints with the severity of SD /MDL in CTS. This may be because of increasing

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median blockage in CTS are more severe as longer as patients became older regardless of the duration of the symptom. In our study, we observed that 34% of 30 patients had bilateral affected hands and 56% dominant affected hands, while only 10% had other affected hands [Inukai, T. *et al*., 2013]. The grade of pain increased when the patients complained about other conditions, such as cervical spondylosis. Kouyoumjian observed that 72% of 668 patients had bilaterally affected hands.

In contrast, other authors found that the bilateral affected hands were 10.6% of 357 patients. Our patients were in mid of these ranges. In this study, all patients complained of pain, paraesthesiae, and numbness in the distribution of the median nerve [Inukai, T. *et al*., 2013]. Tinel 's and platen's tests were positive in all patients pre-operatively. In patients with severe symptoms, the nerve conduction study also increased in severity, and this might be explained by the fact that most of our patients presented late. Our results are similar to those found by You et al. [Kasius, K.M. *et al*., 2019], in which there was a significant relationship between symptom severity and nerve conduction abnormlity. Singh *et al*. found that 38% of 357 patients complained from numbness or sensory disturbance in median nerve distribution; Tinel's test and Phalen's test were positive in about two–thirds of the patients. Pavesi et at. Observed a highly significant correlation between sensory deficit (hypoesthesia to touch and /or pain) and the amplitude of sensory action potential (SAP) and a significant correlation between motor deficit (weakness and atrophy) and distal motor latency. In our unit, all the patients that are proved to be suffering from CTS are treated by surgical decompression because most of these patients are treated previously with conservative treatment without benefit. Many patients with CTS improved by conservative treatment with avoiding repetitive wrist and had motions. However, the symptoms recur in 80% of these patients after one year.

CONCLUSION

1. CTS affects middle-aged females, especially in housewife.
2. The dominant hand is more affected than the other hand.
3. Nerve conduction study confirmed the diagnosis of CTS.
4. Adequate surgery usually gives good results.
5. Most of the patients with abnormal nerve conduction studies pre-operatively show good results and improve clinically post-operatively with nerve conduction study become completely normal.
6. Muscle wasting did not improve in most patients, especially those who had a long duration of symptoms.

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