The analysis of the neural electrophysiological examination on therapeutic effect of the complete carpal tunnel & palmar aponeurosis release(CTPAR) of carpal tunnel syndrome

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Abstract: Objective: To compare the therapeutic effect of the complete carpal tunnel & palmar aponeurosis release(CTPAR) of different severity carpal tunnel syndrome (CTS) patients using the neural electrophysiological examination before and 3 months after the surgery. Method: The median nerve sensory nerve conduction velocity (SCV) , latency of motor nerve terminal (M -lat), sensory nerve active potential (SNAP) and the compound muscle action potentials of the opponens pollicis (compound muscle action potential, CMAP) from three groups of different lesion levels of 87 patients were measured before and 3 months after the CTPAR. The results were analyzed with SPSS 17.0. Result: In the mild CTS patients, the differences of the SCV and SNAP before and after 3 months of CTPAR were statistically significant($P<0.05$), while the differences of the M-lat and CMAP displayed no statistical significance($P>0.05$)； In the moderate CTS patients, the SCV, M-lat, SNAP and CMAP improved significantly 3 months after the CTPAR, and the differences were statistically significant($P<0.01$)； In the severe CTS patients, the differences of the SCV, M-lat, SNAP and CMAP before and after the CTPAR had no statistical significance($P>0.05$). Conclusion: The recoveries of the mild and moderate groups of CTS patients were very well after the CTPAR, while the recoveries of the severe patients were not ideal. As a result, if CTS patients are mild or moderate ones, and the effects of the conservative treatment are not ideal, the operation treatment should be performed as soon as possible to avoid sensory and motor dysfunction, which will affect the quality of life.
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1. Introduction

Carpal tunnel syndrome(CTS） is one of the most common peripheral entrapment neuropathies[1], and the symptoms and signs are caused by an entrapment of the median nerve in the carpal tunnel at the wrist, which may be due to acute or chronic injury. It affects mainly middle aged men or women, often bilateral,the most common causes are tenosynovitis, synovitis and diabetes mellitus[2].The early symptoms of CTS are the dull, tingling and numbness feeling of the thumb, index finger and middle finger, which often influence patient 's life and work, so its early diagnosis and treatment is of great importance.

In our study, CTS patients were divided into three groups, mild, moderate and severe, according to the grading standard published by the United States of America electrophysiological diagnosis Association[3,4], and Combining with the clinical manifestation and the electrophysiological results[5-7].The study was designed to observe the changes of SCV, M-lat, SNAP and CMAP before and after the complete carpal tunnel & palmar aponeurosis release (CTPAR) [8]in CTS patients with different extent of lesions, and also to testify the great importance of CTS's early diagnosis and treatment.

2. Material and Methods

2.1 Subject

From March 2010 to March 2012, CTS patients who had a CTPAR in the department of surgery of the First Affiliated Hospital of Zhengzhou University were registered. A total of 87 individuals of both sexes with CTS voluntarily participated in the study. Informed consents were obtained from all participants. Inclusion criteria: CTS patients. Exclusion criteria: 1 .Numbness and pain in the hand caused by other diseases, such as diabetic peripheral neuropathy, alcoholic peripheral neuropathy, uremic peripheral neuropathy and other peripheral neuropathies. 2. Central nervous system diseases. According to the grading standard published by the United States of America electrophysiological diagnosis Association, the clinical manifestation and the electrophysiological results,87 CTS patients were divided into three groups, mild(20 patients),moderate (26 patients) and severe(41 patients).The grading

standard was listed as below(1)mild：The median nerve sensory nerve conduction velocity from digitus medius to wrist slowed down(＜44 m / s),the M -lat of the median nerve from wrist to the midpiece of thenar eminence was normal,(2)moderate:The median nerve sensory nerve conduction velocity from digitus medius to wrist slowed down(＜44 m / s),the M -lat of the median nerve from wrist to the midpiece of thenar eminence delayed(>4ms),(3) The median nerve sensory nerve conduction velocity was absent, the M -lat of the median nerve delayed or was absent.

28 males and 59 females were included.Age ranging from (27~74) years old, and the average age was 54.7 years old. Course of disease ranging from（ 1 month~2years）.

2.2 Methods

2.2.1 Electrophysiological detection method

The instrument was the Oxford Medelec Synergy nerve EMG / evoked potential instrument.The parameters were set as follows: the band-pass range was from 3Hz to 10kHz， the scanning speed was 3ms/Div ,the stimulus intensity was 0 ～100mA (adjustable),and the pulse width was 0.1~1.0ms.

The SCV, M-lat, SNAP and CMAP of all patients were measured and recorded before the surgery for the first time, then the patients were divided into three groups, and the SCV, M-lat, SNAP and CMAP of all patients were measured and recorded again 3 months after the CTPAR.

2.2.2Procuring the SCV, M-lat, SNAP and CMAP

When the patient's skin temperature was＞ 32℃， he/she lay down on the bed with supine position，and the anterograde stimulation method[9] was adopted.

Procuring the SCV and SNAP:First, the thumb and middle finger dominated by the median nerve sensory fiber were stimulated respectively with a ring electrode, second, the distance from the stimulus point to the record point was measured with a tape rule, the amplitude of SNAP was also measured, third, the SCV was calculated.

Procuring the M-lat and CMAP:The median nerve was stimulated at the wrist with a saddle-shape electrode, then CMAP was recorded at opponens pollicis with another surface electrode, at last the median nerve M -lat and the amplitude of CMAP were measured.

2.2.3 Statistical analyses

The statistical analyses were performed using SPSS 17.0. The measurement datas were expressed as $\bar{x}\pm s$, and paired t-test was used, the difference was statistically significant (P<0.05).

3. Results

3.1 The SCV and M -lat of the median nerve

The SCV and M-lat of of the median nerve of each group before and 3 months after the CTPAR (Table 1). In the mild CTS patients, the difference of the SCV before and 3 months after the CTPAR was statistically significant(P<0.05),while the difference of the M-lat displayed no statistical significance(P>0.05)；In the moderate CTS patients, the SCV and M-lat improved obviously 3 months after the CTPAR, and the differences were statistically significant (P<0.01)；In the severe CTS patients, the differences of the SCV and M-lat before and after the CTPAR had no statistical significance (P>0.05).

3.2The SNAP and CMAP of the median nerve

The SNAP and CMAP of the median nerve of each group before and 3 months after the CTPAR(Table 2). In the mild CTS patients, the difference of the SNAP before and 3 months after the CTPAR was statistically significant(P<0.05),while the difference of the CMAP showed no statistical significance(P>0.05)；In the moderate CTS patients, the SNAP and CMAP improved obviously 3 months after the CTPAR, and the differences were statistically significant(P<0.01)；In the severe CTS patients, the differences of the SNAP and CMAP before and after the CTPAR had no statistical significance(P>0.05).

Table 1. SCV,M-lat before and after the CTPAR

Groups	Mild		Moderate		Severe	
	SCV（m/s）	M-lat（ms）	SCV（m/s）	M-lat（ms）	SCV（m/s）	M-lat（ms）
Before CTPAR	40.35±1.62	3.34±0.75	25.83±4.63	4.28±0.67	0※	6.11±0.98
After CTPAR	47.61±2.35	3.48±0.76	38.25±2.11	3.67±0.86	0※	5.98±1.37
P	＜0.05	＞0.05	＜0.01	＜0.01	＞0.05	＞0.05

※： SCVs weren't evoked before and after the CTPAR in the severe patients group.

Table 2. SNAP,CMAP before and after the CTPAR

Groups	Mild		Moderate		Severe	
	SNAP（μv）	CMAP（mv）	SNAP（μv）	CMAP（mv）	SNAP（μv）	CMAP（mv）
Before CTPAR	3.16±0.96	4.57±1.45	2.25±1.23	2.91±1.78	0※	1.55±1.31
After CTPAR	3.65±1.14	4.62±1.42	3.12±1.45	3.78±1.62	0※	1.52±1.27
P	＜0.05	＞0.05	＜0.01	＜0.01	＞0.05	＞0.05

※： SNAPs weren't evoked before and after the CTPAR in the severe patients group.

4. Discussions

CTS is one of the most common upper extremity compressive neuropathies[10],and the incidence of CTS is increasing in recent years[11]. The disease occurs in the population who repetitively use their wrists, a significant proportion of patients have onset bilaterally successively, and the right side was more serious.The United States statistics showed an annual incidence of 506 cases per 100,000 in females and 139 cases per 100,000 in males[10].CTS is closely related to the specificity of carpal tunnel anatomy. The carpal tunnel is located in the root of palm, and it is made of bone and ligament that together form the tunnel like structure, in which the median nerve passes through.Because the carpal tunnel structure arranges tightly,the gap is very limited, and the organization of carpal tunnel is relatively tough and lack of flexibility, consequently, acute or chronic carpal tunnel pressure increased induced by any reasons may cause the median nerve compression, ultimately resulting into CTS[5].The typical symptoms of CTS are numbness and the sensory abnormalities of thumb, index finger and middle finger , which often exacerbated at night, therefore early diagnosis and treatment can avoid occurrence of disabilities[12].

Due to the patients' or doctors' reasons, as well as other reasons such as the limitations of CT and X ray, CTS was often confused with cervical vertebra diseases, peripheral neuritis and so on, however,neural electrophysiological examination can provide CTS an objective and effective diagnostic basis. Some reports showed that the sensitivity of CTS diagnosed by neural electrophysiological examination was high, reached from 80% to 92%, as a result, most clinicians make the final diagnosis rely on electrophysiological examination for the clinical doubtful CTS patients[13].Currently, CTS electrophysiological diagnosis is mainly based on the median nerve motor and sensory latency delay at wrist, and that the sensory latency delays (or SCV steps down) is not only more sensitive than motor latency dose, but also the must condition to diagnose CTS[3,14].The electrophysiological examination of early CTS is that only median nerve SCV slows down and evoked potential amplitude decreases, that the M-lat prolongs and the clinical symptoms gradually worsen are considered as the disease progresses[15].

In the experiment, 87 CTS patients had a preoperative neurophysiological detection, the result showed that CTS occured in female patients easily, with a female to male ratio of 2.11.The abnormality rate of the median nerve sensory conduction was 100%, and the abnormal form was that different degrees of sensory conduction velocity slowed down or / and sensory action potential amplitude decreased or sensory conduction was absent, while the rate of the median nerve M-lat prolonged and the opponens pollicis CMAP amplitude decreased was 65.5%, the rate of the median nerve M-lat absent was11.5%. In 3 months follow-up after the CTPAR,the clinical symptoms of mild and moderate CTS patients improved significantly,and the neural electrophysiological examinations after the CTPAR were compared with the ones before the CTPAR, the result showed that SCV(mild and moderate),M-lat(moderate),SNAP(mild and moderate)and CMAP(moderate)improved obviously, the differences were statistically significant($P<0.01$ or $P<0.05$).While the clinical symptoms of 68.5% severe CTS patients were unchanged or deteriorated after the CTPAR, and neural electrophysiological examinations showed that SCV,M-lat,SNAP and CMAP didn't improve obviously, the differences weren't statistically significant($P>0.05$).

From the information above, the neural electrophysiological examination was used to assess the therapeutic effect of the CTPAR and was helpful to judge the improvement of clinical symptoms after the surgery.Although the postoperative recovery was correlated to the severity of CTS, the therapeutic effects of mild and moderate CTS patients were good without considering the severe CTS patients, especially the muscle atrophy patients, whose therapeutic effects were slow and poor. On the whole, the operation treatment is safe and reliable for carpal tunnel syndrome patients, and it can alleviate

the distress of patients and prevent further neurological damage.Therefore when the conservative treatment is invalid or the effect of the conservative treatment is not ideal, the neural electrophysiological examination should be done to judge the severity of CTS patients. If the patients are mild or moderate ones, the operation treatment should be performed as soon as possible to avoid muscular atrophy resulting in sensory and motor dysfunction, which will affect the quality of life.

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