

Repeated Electrophysiologic Studies in Patients with Carpal Tunnel Syndrome following Local Corticosteroid Injection using a Novel Approach

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ABSTRACT: **Background:** Local corticosteroid injection (LCI) for the treatment of carpal tunnel syndrome (CTS), using the classic method, is usually associated with improvement in different electrophysiologic parameters of the median nerve. However, there is no correlation between the clinical response and these electrophysiologic parameters.

Objectives: To evaluate the effect of our novel approach of LCI for the treatment of CTS on repeated electrophysiologic studies of the median nerve.

Methods: Patients with symptomatic CTS with duration of symptoms of less than 1 year were offered an LCI of 12 mg methylprednisolone acetate using a novel approach and asked to repeat the electrophysiologic study one month later. Pearson correlation test was used to correlate between the difference of similar electrophysiologic parameters and duration of favorable clinical response and also between the differences among themselves.

Results: Thirteen patients completed the study and 25 hands were injected. Improvement in median distal sensory and motor latency was noted in 61% and 75% of the hands respectively. There was no correlation between duration of clinical response and the differences of either the distal latency (sensory or motor) or the amplitude. There was also no correlation between the differences of motor median distal latency and sensory median distal latency.

Conclusions: LCI at the carpal tunnel using our approach is also associated with favorable electrophysiologic results similar to what has been reported using the classic approach.

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KEY WORDS: carpal tunnel syndrome, local corticosteroid injection, electrophysiologic tests

Local corticosteroid injection is a proven modality for symptomatic relief of carpal tunnel syndrome [1]. The duration of this relief is variable, lasting in a significant proportion of patients for more than 18 months in some studies [2]. Even when compared with surgical decompression, some studies have shown that LCI is superior to surgical decompression for the symptomatic relief of CTS over the short term. After 1 year, LCI is as effective as surgical decompression [1].

Usually 15–40 mg of methylprednisolone acetate (Depo-Medrol®, Pfizer) is injected just ulnar to the tendon of the flexor carpi radialis at a distance ranging from 0 to 4 cm proximal to the first crease of the wrist [3–6]. Other types of steroids have also been used [7–10]. The procedure is relatively safe; however, although relatively rare, the feared risk is median nerve injury. In one study on the safety of the classic procedure, the authors, who work a busy service, did not find even a single case of median nerve injury during 10 years of applying this procedure [11]. There are several different recommendations in the literature for the avoidance of median nerve injury, such as injecting as close as possible to or even through the flexor carpi radialis tendon, and far from the palmaris longus tendon [12].

Repeated nerve conduction measurements after LCI using the classic method showed improvement in different electrophysiologic parameters [5–10]. These studies were performed at different times, including 0.5, 1.5, 2, 3, 4, 4.5 and/or 6 months following the injection, and at every time point the nerve conduction parameters were better than at baseline. In most of the studies there was no correlation between the clinical response and the electrophysiologic parameters.

We previously reported a novel approach with LCI for the treatment of CTS with comparable favorable effects in terms of relief of numbness [13]. With this approach we use a 29G needle and inject 12 mg of Depo-Medrol 2–3 cm distal to the wrist crease between the hypothenar and thenar prominences. The advantages of our approach is its simplicity, quickness, convenience for both patient and doctor, and far less pain severity – all of which enable even general practitioners to

use this approach after observing it once or twice. Another advantage of our approach is that much lower doses of Depo-Medrol are required. The median nerve lies deep below the site of the injection, and to date no median nerve injury has occurred at our service.

In the present study we evaluate prospectively the parameters of repeated electrophysiologic studies of recently diagnosed patients with symptomatic CTS who were treated with local steroid injection using our novel approach; we also correlate between the clinical response and the electrophysiologic parameters.

PATIENTS AND METHODS

Recently diagnosed symptomatic patients with CTS and hand numbness for less than 1 year were offered an injection of

Figure 1. Correlation between differences of values of median distal sensory latency (after and before steroid injection) (ms) (black bar), amplitude (mV) (white bar) and duration of favorable response (months) (grey bar) among the different hands (X-axis)

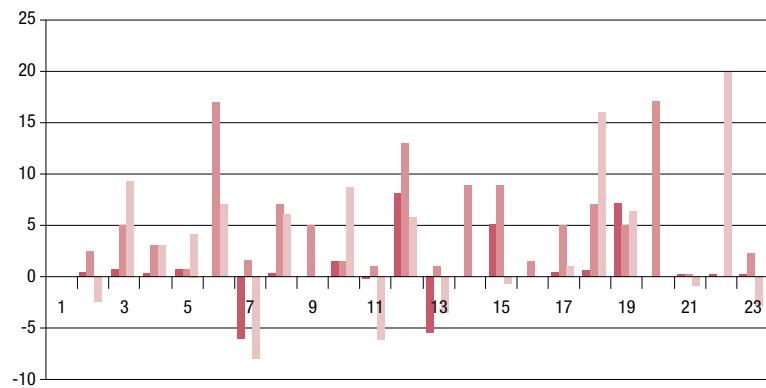
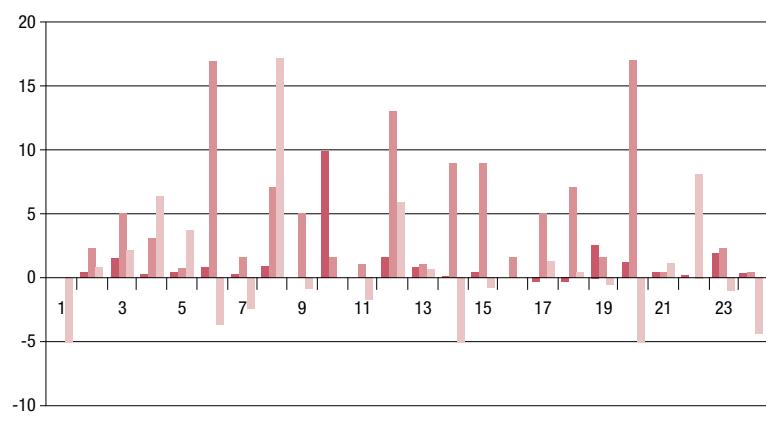


Figure 2. Correlation between differences of median distal motor latency (between values after and before steroid injection) (ms) (black bar), amplitude (mV) (white bar) and duration of favorable response (months) (grey bar) among the different hands (X-axis)



Depo-Medrol using the novel approach and asked to repeat the electrophysiologic study of nerve conduction 1 month after the injection. If the patient agreed and there was no evidence of inflammatory or mechanical joint problem at the wrist, and no hypothyroidism, diabetes mellitus, pregnancy, previous surgery or steroid injection at the carpal tunnel site, an injection of 12 mg Depo-Medrol was administered with 0.2 ml of 1% lidocaine about 2 cm distal to the wrist crease between the thenar and hypothenar muscles using a syringe with a 29 gauge 9/16" built-in needle (Insumed, Italy) [13]. These patients were followed prospectively and telephoned every week after the injection in the first month and every 4 weeks thereafter. They were questioned regarding amelioration of the numbness and asked to grade the numbness as follows: the same, mild improvement, remarkable improvement, disappearance of numbness, or worsening of numbness. An answer of either "remarkable improvement" or "disappearance of numbness" was considered a favorable response. These patients were asked to repeat the electrophysiologic study 1 month after the injection at the same institution using the same machine.

The electrophysiologic studies were performed with standard surface electrode placements. Nerve conduction studies were considered diagnostic for CTS if the median distal sensory latency was > 3.4 ms in some laboratories and > 3.7 ms in others, or if the median distal motor latency was > 4.5 ms. Since the conduction velocity of sensory median nerve in most of the labs (where our patients underwent their studies) was calculated indirectly, we did not include it in our results.

This study was approved by the Helsinki Committee of the Nazareth Hospital and a consent form was signed by all the patients.

For correlation between the favorable clinical response and the differences between the same parameters obtained after and before the local steroid injection we used Pearson's correlation test. The same test was used to correlate between the differences of similar electrophysiologic parameters in the sensory side with those on the motor side of the median nerve: patient # 22 in the sensory side [Figure 1] and patient # 8 on the motor side [Figure 2]; both were excluded from the test due to extreme results.

RESULTS

The study group comprised 13 patients and all of them completed the study. The patients included 11 females. The mean age of the patients was 51.01 ± 13.6 years (range 30–73 years). A total of 25 hands were injected. In one hand, the study on sensory median nerve was not completed and in another patient the study was not repeated on the left hand; thus, complete studies on sensory median nerve were done on 23 hands and on the motor component on 24 hands. The mean duration of hand numbness at the time of injection was 5.76 ± 4.01 months

(range 1.5–12 months); however, the mean time period from the first electrophysiologic study to the time of injection was 19.77 ± 12.01 days (range 2–39). In all the hands except for two (92%) there was a favorable response (remarkable or complete resolution of hand numbness) after the injection for different periods. The favorable response rate after 1 month was 74%. The mean duration of this favorable response was 4.62 ± 5.11 months (range 0.3–17). One patient reported remarkable pain following the injection at the injection site that lasted for 2 days only. There was improvement in mDSL in 14 hands (61%) and of mDML in 18 (75%); however, normalization of mDSL was obtained in 5 hands (22%) and normalization of mDML in 6 (25%). In three of five hands that had no recordable median sensory response at baseline, there were recordable responses at 1 month follow-up. Also, one of two hands that had no recordable median motor response at baseline had recordable response at 1 month follow-up. Figure 1 shows the values of difference of distal latency and amplitude at the sensory median nerve between the second and the first electrophysiologic studies compared to the duration of favorable clinical response of each hand. Figure 2 shows the same values but at the motor median nerve. Using the Pearson test there was no correlation between the difference of any electrophysiologic parameters that were measured (sensory or motor) and duration of favorable clinical response. Neither was there a correlation among the differences of distal latency between the sensory and motor sides of the median nerve [Table 1]; however, a correlation was found between amplitudes.

DISCUSSION

Our results again show the favorable clinical effects (in terms of hand numbness at least) of LCI for the treatment of carpal tunnel syndrome using our approach. Yet in this study and for the first time, our findings also demonstrate improvement in most of the electrophysiologic study parameters. The rate response of electrophysiologic studies is similar to the results of previous studies using the classic approach [9,10].

Although spontaneous electrophysiologic improvement does occur, it happens in a small percentage of patients [14,15]. There was no significant change in the electrophysiologic parameters in the placebo arm in controlled studies where placebo was used as a control for LCI for the treatment of CTS. These findings support the fact that electrophysiologic improvement in our study is related to the LCI. Therefore, injection distal to the tunnel or ligament induces a favorable clinical and electrophysiologic response similar to that seen following the classic approach.

The mechanism behind the electrophysiologic improvement following steroid injection is believed to be a result of

mDSL = median distal sensory latency

mDML = median distal motor latency

Table 1. Pearson coefficient correlation between duration of clinical response and electrophysiologic parameters and between similar parameters from sensory and motor median nerve measurements

		mDML	m-amplitude	mDSL	s-amplitude
Response	Pearson correlation Significance (two-tailed) N	0.191 0.382 23	-0.238 0.274 23	0.344 0.117 22	0.059 0.796 22
mDML	Pearson correlation Significance (two-tailed) N			0.483 0.026 21	
m-amplitude	Pearson correlation Significance (two-tailed) N			0.577 0.009 21	

m-amplitude = motor median nerve amplitude, s-amplitude = sensory median nerve amplitude

pressure release. The similar improvement in electrophysiologic parameters following surgery supports this notion. We do not yet know the range of spread of these steroids along the carpal tunnel, but it seems that with our approach at least some of the injected steroids reach the entrapment area of the median nerve. Studies addressing the spread of injectable steroids along the carpal tunnel are needed.

As with our previous experience, our approach was well tolerated and safe. One patient reported remarkable pain at the site of the injection without symptoms or signs of median nerve injury, which resolved spontaneously after 2 days.

As in the classic approach we also found no correlation between the clinical response and the difference in electrophysiologic parameters. The pathophysiology of symptoms of CTS and its relation to the electrophysiologic findings is still poorly understood [16] and more studies are needed to better understand the mechanism behind the symptomatology of CTS. Lack of correlation was also found between the differences in distal latencies of the sensory and motor sides of the median nerve in contrast to amplitudes.

There are two main shortcomings of our study: the small sample of hands and the lack of statistics regarding sensory conduction velocity measurements of the median nerve. However, due to the uniqueness of our approach and the usefulness of other electrophysiologic parameters, we believe that the data obtained in our study are important enough to be reported.

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References

1. Ly-Pen D, Andreu JL, de Plas G, Sanchez-Olaso A, Milan I. Surgical decompression versus local steroid injection in carpal tunnel syndrome: a one-year, prospective, randomized, open, controlled clinical trial. *Arthritis Rheum* 2005; 52: 612-19.
2. Agarwal V, Singh R, Sashdev A, Wiclaff A, Shekhar S, Goel D. A prospective

- study of the long-term efficacy of local methyl prednisolone acetate injection in the management of mild carpal tunnel syndrome. *Rheumatology (Oxford)* 2005; 44: 647-50.
3. Helwig AL. Treating carpal tunnel syndrome. *J Fam Pract* 2000; 49: 79-80.
 4. Entrapment neuropathies. In: Klippel J, Dieppe P, eds. *Rheumatology*. London: Mosby, 1994: 5.10.8
 5. Hagebeuk EE, de Weerd AW. Clinical and electrophysiological follow-up after local steroid injection in the carpal tunnel syndrome. *Clin Neurophysiol* 2004; 115: 1464-8.
 6. Hui A, Wong S, Leung C, et al. A randomized controlled trial of surgery vs. steroid injection for carpal tunnel syndrome. *Neurology* 2005; 64: 2074-8.
 7. Demirci S, Kutluhan S, Koyuncuoglu H, et al. Comparison of open carpal tunnel release and local steroid treatment outcomes in idiopathic carpal tunnel syndrome. *Rheumatol Int* 2002; 22: 33-7.
 8. Aygul R, Ulvi H, Karatay S, Deniz O, Varuglo A. Determination of sensitive electrophysiologic parameters at follow-up of different steroid treatment of carpal tunnel syndrome. *J Clin Neurophysiol* 2005; 22: 222-30.
 9. Giannini F, Passero S, Cioni R, et al. Electrophysiologic evaluation of local steroid injection in carpal tunnel syndrome. *Arch Phys Med Rehabil* 1991; 72: 738-42.
 10. Armstrong A, Devor W, Borschel L, Contreras R. Intracarpal steroid injection is safe and effective for short-term management of carpal tunnel syndrome. *Muscle Nerve* 2004; 29: 82-8.
 11. Kay NR, Marshall PD. A safe, reliable method of carpal tunnel injection. *J Hand Surg Am* 1992; 17: 1160-1.
 12. Dubert T, Racasan O. A reliable technique for avoiding the median nerve during carpal tunnel injections. *Joint Bone Spine* 2006; 73: 77-9.
 13. Habib GS, Badarny S, Rawashdeh H. A novel approach of local corticosteroid injection for the treatment of carpal tunnel syndrome. *Clin Rheumatol* 2006; 25: 338-40.
 14. Manente G, Torrieri F, Di Plasio F, et al. An innovative hand brace for carpal tunnel syndrome: a randomized controlled trial. *Muscle Nerve* 2001; 24: 1020-5.
 15. Oztas O, Turan B, Bora I, Karakaja K. Ultrasound therapy effect in carpal tunnel syndrome. *Arch Phys Med Rehabil* 1998; 79: 1540-4.
 16. Nora DB, Becker J, Ehlers JA, Gomez I. Clinical features of 1039 patients with neurophysiological diagnosis of carpal tunnel syndrome. *Clin Neurol Neurosurg* 2004; 107: 64-9.