

Study of Platelet-Rich Plasma Local Injection in Idiopathic Carpal Tunnel Syndrome

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is one of the most diagnosed disabling conditions of the upper extremities. Corticosteroid local injection is one of the traditional treatments. Platelet-Rich Plasma (PRP) local injection has emerged as a new treatment, promoting nerve regeneration.

Objectives: Comparison of the effectiveness of a single PRP local injection to a single corticosteroid local injection for treating idiopathic CTS using nerve conduction studies and Visual Analog Scale.

Patients and method: 40 patients with mild idiopathic CTS were diagnosed clinically and selected according to Padua's Neurophysiologic Severity Scale (PNSS) started the study. They were divided into 2 equal groups; the first group of patients received a single local corticosteroid injection, and the second group received a single local PRP injection. Nerve conduction studies (NCS) in the form of median nerve sensory conduction velocity and the Visual Analogue Scale (VAS) were compared in both groups before and three months after injection.

Results: Our study included 40 patients randomly grouped into two equal main categories. Group I (corticosteroid group) included 20 patients with a mean age of 41.50 ± 11.26 years, while Group II (PRP group) included 20 patients with a mean age of 39.10 ± 11.24 years. VAS and median nerve sensory conduction velocity were significantly reduced in group II compared to group I. **Conclusions:** PRP single local injection in the wrist proved to be better than corticosteroids single local injection for managing mild idiopathic CTS.

Keywords: CTS, Corticosteroids, PRP, VAS.

INTRODUCTION

CTS is the most common neuropathy diagnosed clinically [1]. Further confirmation of the diagnosis could be accomplished by NCS [2]. Different surgical and non-surgical treatment options are available [3].

Local corticosteroid injection is approved as an effective treatment, yet causes many complications [4,5]. PRP is a new treatment based on its regenerative and anti-inflammatory effects [6]. This study in patients with mild idiopathic CTS compares PRP local injection and corticosteroid local injection using subjective and objective tools in the form of NCS and VAS.

PATIENT AND METHODS

The current prospective interventional comparative study involved 40 patients with mild primary CTS. Patients complained of sensory issues in the area of the hand's median nerve distribution. Padua's Neurophysiologic Severity Scale (PNSS) for CTS was used to further select mild cases [7]. Patients were recruited from the Physical Medicine and Rehabilitation Clinic at Menoufia University Hospitals from 2017 to 2019.

Exclusion criteria included space-occupying lesions within the carpal tunnel, severe CTS diagnosed by NCS, traumatic causes, space-occupying masses, surgery, diabetes mellitus, rheumatoid arthritis, and pregnancy. The main pillars of detecting inclusion and exclusion criteria are history, examination, radiological findings, and NCS. Simple randomization was used to equally distribute patients into two groups with no statistical difference regarding demographics and clinical characteristics.

Single corticosteroid injection into the carpal tunnel was the treatment used for group I, and local PRP injection was used for group II. Patients provided a detailed history followed by clinical examination and NCS. The same investigator used a VAS, median, and ulnar NCS in the form of sensory conduction velocity [8] before and three months after local injection to report subjective and objective progress. Nihon Kohden (Japan) was the equipment used for NCS at the Electrophysiology Unit in the Physical Medicine, Rheumatology, and Rehabilitation Department, Faculty of Medicine, Menoufia University. Injection technique and precautions were the same in both groups, with rest and intermittent ice packing recommendations for 48 hours if there was any discomfort or swelling.

Local corticosteroid injection: 1 ml (millimeter) of triamcinolone acetonide (40 milligram/1.0 mL) was slowly administered locally using a 25-gauge needle, 1 cm (centimeter) proximal to the distal wrist crease just on the radial side of the palmaris longus tendon.

Local PRP injection after PRP preparation: Patients were instructed to avoid non-steroidal anti-inflammatory drugs two weeks before and after the procedure as they have platelet inhibitory effects.

A specific volume of blood from the patient (10 ml) was obtained via venous puncture into a tube containing an anticoagulant (sterile sodium citrated tubes). Two centrifugation steps were used to separate plasma from collected blood: 1800 rotations per minute (rpm) for 15 minutes to obtain platelet-rich supernatant, as shown in **figure 1**, then 3500 rpm for 10 minutes for the supernatant to get a concentrated platelet layer as shown in **figure 2**. The technique of corticosteroid injection in

the wrist was the same one used for local 2 ml PRP injection.

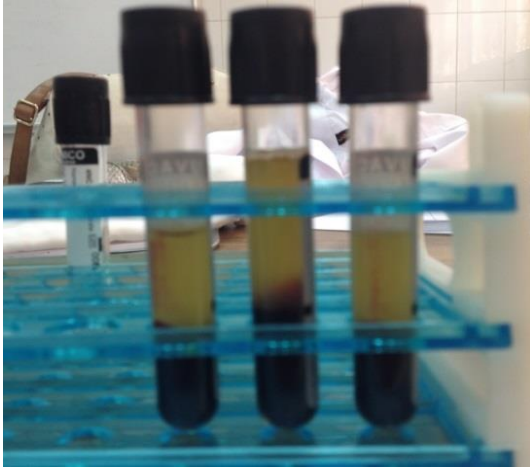


Figure (1): Product of first centrifugation of blood to obtain platelet-rich supernatant.

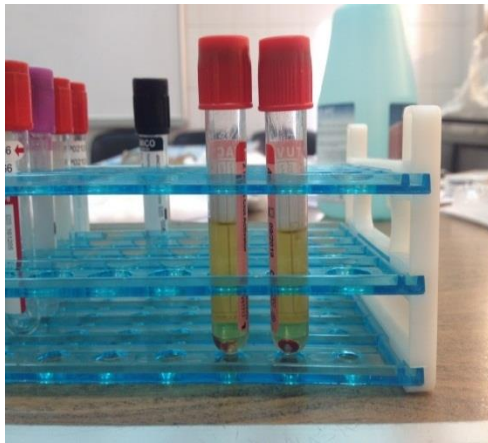


Figure (2): Product of second centrifugation of platelet-rich supernatant to obtain concentrated platelet layer.

CONSORT reporting guidelines were applied to this research project [9].

Ethical approval:

Menoufia Medical Ethics Committee of the Menoufia Faculty of Medicine gave its approval to this study. All participants gave written consent to participate in the study after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

SPSS version 20.0 was used to generate and analyze all of the data. For continuous variables, the presentation format was means ± standard deviation [SD], whereas percentages and relative frequency distributions were used for categorical variables. To compare continuous variables, the independent t-test was used to compare normally distributed data, and the Mann-Whitney (U) test was employed for abnormally distributed data. At $p \leq 0.05$, statistical significance was determined.

RESULTS

Patients [35 female (87.5%) and 5 male (12.5%)] with mild CTS following inclusion and exclusion criteria were grouped into two equal entities, one for corticosteroid and the other for PRP local injection. Group I (corticosteroid group) included 20 patients (17 females and three males). In comparison, group II (PRP group) included 20 patients (18 females and two males). Age, sex, and disease duration were comparable between study groups.

Improvement of VAS was significant in group I and highly significant in group II three months after injection. There was a highly significant VAS difference between groups three months post-injection, with better decrement in group II (Table 1).

Table (1): Comparison of VAS in both groups before and after injection.

| Parameters | | Groups | | P-value |
|---------------|--------------------|----------------|-----------------|----------|
| | | Group I (n=20) | Group II (n=20) | |
| VAS Mean ± SD | Baseline | 7.40±1.60 | 7.35±1.08 | 0.93 |
| | After three months | 6.75±1.86 | 3.60±1.23 | < 0.001† |
| | p-value | 0.01* | < 0.001† | |

*:Significant, †: Highly significant

Sensory conduction velocity of the median nerve showed highly significant improvement in both groups three months post-injection, with better improvement in group II (Table 2).

Table (2): Comparison of the motor and sensory nerve conduction velocities results of the median nerve in both groups before and after injection.

| Parameters | | Groups | | P-value |
|--|--------------------|---------------------------------|-----------------------|----------|
| | | Group I (corticosteroid) (n=20) | Group II (PRP) (n=20) | |
| Median nerve motor conduction velocity Mean ± SD | Baseline | 57.28±6.29 | 56.55±4.73 | 0.66 |
| | After three months | 57.24±6.3 | 57.6±4.67 | 0.76 |
| | p-value | 0.68 | 0.12 | |
| Median nerve sensory conduction velocity Mean ± SD | Baseline | 52.45±3.78 | 52.9±5.75 | 0.98 |
| | After three months | 56.30±3.5 | 64.54±3.53 | < 0.001† |
| | p-value | <0.001† | < 0.001† | |

†: Highly significant.

DISCUSSION

PRP therapy excelled and got significant attention recently as growth factors and platelets could help with nerve regeneration and healing, aiming for efficient and prolonged therapeutic effects [6].

The present study found that a single PRP injection into the carpal tunnel could improve Patients' symptoms even better than steroids; when compared to the baseline, VAS evaluation revealed a significantly significant decrease 3 months after injection.

Improvement of VAS following PRP injection goes ahead with **Malahias et al.** [10], who found that after a single injection of PRP, 32 patients with mild to severe CTS experienced substantial VAS improvement at 1 and 3 months of assessment. Furthermore, **Gao and colleagues** [11] discovered a substantial improvement in VAS after 1 and 3 months of PRP injection in the treatment of CTS.

In harmony, **Atwa et al.** [12] documented a significant decrease in scores on the VAS and the Boston Carpal Tunnel Questionnaire (BCTQ) in PRP groups 1 and 3 months after local PRP injection. This study's findings on clinical improvement 3 months after PRP local injection are somewhat consistent with those of **Raeissadat et al.** [13], who found a substantial improvement in VAS ratings in the tenth week following PRP injection in a group of 21 mild and moderate idiopathic CTS patients. After 10 weeks of therapy, all of the variables were much lower. The discrepancy might be related to the fact that they employed 1 ml PRP injections, whereas we used 2 ml PRP injections in our study.

Our study revealed significant improvement in VAS three months after local steroid injection in group I. Similar clinical results in group I were concluded by **Karjalainen and his colleagues** [14], who investigated the effects of local corticosteroid injection therapy using a distal approach for patients with mild CTS. They declared significant improvement in pain severity measured by VAS 3 months after injection. **Davey et al.** [15] also reported noteworthy improvement in VAS and BCTQ at 1, 3, and 4 months follow-up visits compared to baseline after ultrasound-guided local injection of 3 ml triamcinolone. This improvement did not last throughout the 6-month follow-up appointment.

So et al. [16] discovered improved patient satisfaction with pain relief one month after local injection of corticosteroids in 25 individuals with mild to severe CTS. However, their study used BCTQ rather than VAS to evaluate symptom improvement. In favor of these results regarding clinical improvement in group I, **Karimzadeh and colleagues** [17] investigated the impact of local injections of 20 or 40 mg triamcinolone and 20 or 40 mg methylprednisolone in 80 patients with mild or moderate CTS, randomly assigning them to four groups. Using the traditional method, each patient received a single injection of steroids. After three months, they saw a considerable improvement in VAS. **Abdel-Aziz and his colleagues also** [18] declared similar results and reported that ultrasound-guided local injection of corticosteroids caused significant

improvement in the VAS score and symptom severity scale of BCTQ score after one month from injection.

In contrast to the current clinical results in group I, another recent study done by **Atthakomol and his colleagues** [19] recorded no statistically significant difference in VAS reduction between 3 and 6 months following a single local injection of corticosteroids. The difference in pharmaceutical strength could explain this as they injected 1 ml of 10 mg triamcinolone.

Jiang and his group [20] systemically searched different electronic databases and finally included eight randomized controlled trials involving 220 CTS patients who got local PRP injection, until December 2021. Their systemic review revealed significant effectiveness of local PRP injection regarding VAS 3 months post-injection compared to control groups, which included local steroid injection and conservative treatment.

Both groups of our study showed a highly significant improvement in median sensory nerve conduction velocity (SNCV) after 3 months of injection, with better improvement in the PRP group. It was not the case with median motor conduction velocity 3 months post-injection compared to the baseline.

In agreement, **Davey et al.** [15] observed that PRP injection significantly raised SNCV after 1 and 3 months of injection in 30 individuals with mild to severe CTS. **Uzun et al.** [21] found a substantial increase in median SNCV 3 months after PRP injection in individuals with moderate CTS, which coincided with our NCS findings in the PRP group. The current results go ahead with a comparative study between corticosteroid and PRP local injection for the treatment of CTS done by **Dong et al.** [22], who found that SNCV showed significant improvement after 3 months of local injection for both groups (corticosteroid and PRP).

On the other hand, **Karimzadeh et al.** [17] partially agreed with our NCS results by documenting that all NCS parameters, including sensory and motor conduction velocity significantly improved 3 months after local injection of 40 mg triamcinolone. Their different NCS values than ours may be attributed to the additive effect of local anesthesia as they locally injected 1 mg corticosteroid plus 1 mg of local anesthetic agent. **Senna and his colleagues** [23] concluded that PRP injection outperformed steroid injection in terms of enhancing median motor conduction velocity, sensory delay, and sensory conduction; this superiority was observed in the third month of follow-up, indicating that PRP may have better long-term results. The improvement of motor conduction velocity in the PRP group, which is different from our study, could be due to the precision of the ultrasound-guided injection.

In the present work, a highly significant improvement of sensory conduction velocity was noted in group II injected with PRP compared to the improvement of the same parameters in group I injected with corticosteroids 3 months post-injection. These results were different from another study done by **Atwa**

and his colleagues^[12]. They found that only median distal motor latency, not conduction velocity, significantly improved in the PRP injection group after 1 and 3 months compared to those injected with corticosteroids. **Dong *et al.***^[22] could not demonstrate any significant difference between corticosteroids and PRP groups regarding median sensory conduction velocity and distal motor latency at any time in the follow-up periods (3 and 6 months post-injection). The discrepancy could be attributed to different techniques used in PRP preparation as they did a single centrifugation step (4000 rpm for 10 minutes) rather than two.

CONCLUSION

PRP, as well as steroid local injection, can be considered for short-term mild CTS management. PRP single local injection in the wrist proved better efficacy than triamcinolone acetate local injection for treating mild idiopathic CTS, improving pain and median nerve sensory conduction velocity. We encourage prolonged follow-up studies in this evolving, promising field.

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