EREDETI KÖZLEMÉNY

ORIGINAL ARTICLE

Perineural 5% dextrose versus corticosteroid injection in non-surgical carpal tunnel syndrom treatment

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Background and purpose – We aimed to investigate the difference of clinical and electrophysiological improvement between perineural corticosteroid injection therapy (PCIT) and perineural 5% dextrose injection therapy (5%PDIT) in carpal tunnel syndrome (CTS).
Methods – Total of 92 wrists that were diagnosed as mild-to-moderate idiopathic CTS and completed their follow-up were included in our study. The severity of pain, symptom severity and functional status were assessed by visual analog scale (VAS) and the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) scores for treatment effectiveness. Randomized wrists were administered PCIT or 5%PDIT accompanied by ultrasound guidance. VAS, BCTQ scores and the electrophysiological study repeated before and after treatment at the 1st and 6th months after perineural injection therapies (PITs) were recorded.
Results – Compared with baseline data, within groups there was significant improvement in VAS, BCTQ severity and function scores at 1st and 6th months follow-up (all $p < 0.001$). Considerable advance were detected in the median sensory nerve conduction velocity (SNCV) when pretreatment values were compared with posttreatment first month in both groups ($p = 0.01$; $p < 0.001$, respectively). No significant change occurred in median distal motor latency (DML) values between the 1st and 6th months in the groups ($p = 0.095$; $p = 0.113$, respectively). No significant difference was observed between 5%PDIT and PCIT groups.
Conclusion – Clinical and electrophysiologic improvement in CTS began from 1st month

Perineuralis 5%-os dextróz kontra kortikoszteroid-injekció a carpalis alagút szindróma nem sebészi kezelésében
Ocek O, MD; Guner D, MD

Háttér és cél – Tanulmányunk célja az volt, hogy megvizsgáljuk a klinikai és az elektrofiziológiai javulás közötti különbségeket perineuralis kortikoszteroid injekciós terápia (PCIT) és perineuralis 5%-os dextróz injekciós terápia (5%PDIT) alkalmazása során carpalis alagút szindróma (CTS) kezelése során.
Módszerek – Összesen 92 csuklót vontunk be a vizsgálatba, amelyeknél enyhe vagy közepes fokú idiopathiás CTS-t diagnosztizáltak, és terápiájuk nyomon követését befejeztük. A fájdalom súlyosságát, a tünetek súlyosságát és a funkcionális állapotot vizuális analóg skálával (VAS), míg a kezelés hatékonyságát a Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) pontszámaival értékeltük. A randomizált csuklókon PCIT-et vagy 5%PDIT-et alkalmaztunk ultrahangos irányítással kísérve. A perineuralis injekciós terápiák (PIT) előtt, majd a kezelés után az 1. és 6. hónapban rögzítettük a VAS- és BCTQ-pontszámokat, valamint az elektrofiziológiás vizsgálat eredményét.
Eredmények – A kiindulási adatokhoz képest a csoportokon belül szignifikáns javulás volt tapasztalható a VAS-, a BCTQ súlyossági és a funkcionális pontszámokban az 1. és 6. hónapos utánkövetéskor (mind $p < 0,001$). Mindkét csoportban jelentős javulást észleltünk a medián érzőideg vezetési sebességében (SNCV), amikor a kezelés előtti értékeket összehasonlítottuk a kezelés utáni első hónap eredményeivel ($p = 0,01$; $p < 0,001$). A medián distalis motoros latencia (DML) értékeiben nem történt szignifikáns változás az 1. és a 6. hónap között egyik csoportban sem ($p = 0,095$; $p = 0,113$). Az 5%PDIT- és a PCIT-csoportok között nem volt szignifikáns különbség megfigyelhető.

after PCIT and 5%PDIT. At the 6th month follow-up of the patients, 5%PDIT and PCIT had similar therapeutic effects. As a result, we can consider the replacement of PCIT with 5%PDIT in mild-to-moderate CTS patients especially in those who are hesitant because of the corticosteroid's adverse effects.

Keywords: carpal tunnel syndrome, perineural injection, corticosteroid, 5% dextrose, pain, ultrasound

Következtetés – A CTS klinikai és elektrofiziológiai javulása a PCIT és az 5%PDIT után az 1. hónaptól kezdődött. A 6. hónapos utánkövetésnél az 5%PDIT és a PCIT hasonló terápiás hatást ért el. Eredményünk azt mutatja, hogy megfontolható a PCIT 5%PDIT-tel való helyettesítése enyhe és közepesen súlyos CTS-betegeknél, különösen azoknál, akik tartanak a kortikoszteroid mellékhatásaitól.

Kulcsszavak: carpalis alagút szindróma, perineuralis injekció, kortikoszteroid, 5%-os dextróz, fájdalom, ultrahang

Carpal tunnel syndrome (CTS) is the most common compression neuropathy of the upper extremity, which occurs as a result of ischemia of the median nerve due to compression of the transverse carpal ligament in the wrist localization. It is often idiopathic, but it can occur due to systemic diseases, local factors, and excessive use of hands. Due to the results of nerve conduction studies (NCS) and the clinical manifestations, CTS can be graded as mild, moderate or severe. Treatment strategies are also determined according to this staging system. Surgical treatment is preferred in moderate-to-severe stages. Treatment of mild CTS can be planned by non-surgical methods such as night splint or perineural injection[1–3]. Nevertheless, there is no consensus on the treatment of mild-to-moderate cases of CTS.

Perineural injection therapy (PIT) is a potential and innovative treatment alternative for CTS. PIT can be performed in different ways in clinical practice, including long or short axis, proximal or distal and ulnar or radial approach. While there are studies that reported the ulnar approach as the most effective technique, there is also a study indicating that the pain reduction effectiveness of the radial approach lasts longer than that of the ulnar approach[3–5]. Due to its anti-inflammatory effect, perineural corticosteroid injection therapy (PCIT) is preferred frequently nowadays. Although the efficacy of surgery is higher than of PCIT, it could be delayed, because of the possible complications of surgery, high costs, longer recovery period and the possibility of revision surgery due to the 3% repetition of the entrapment in the future. Also the low complication risk and good treatment response at the rate of 70-90% of PCIT cause that it should be considered as the first-line treatment in mild-to-moderate stage[4–7]. PCIT can remain in the tissue for 1-4 weeks. Furthermore, recent studies indicated that its effects continue in long-term[8]. However, adverse effects, such as atrophy, hypopigmentation, pain, bleeding, and ulceration may occur after local PCIT.

Perineural 5% dextrose injection therapy (5%PDIT) is another local treatment option that is thought to be beneficial in reducing neuropathic pain originating from peripheral nerves[9]. While high dextrose concentrations trigger neurogenic inflammation and may have toxic effects, 5%PDIT increases peripheral nerve conduction[10]. Furthermore, 5%PDIT has similar osmolality as normal saline and its' injection is reported to be less painful than that of sterilized water. PIT of isotonic dextrose was not harmful in human and animal studies[9].

This study aimed to investigate the difference of clinical and electrophysiologic recovery between PCIT versus 5%PDIT, which performed under ultrasound guidance in our idiopathic mild-to-moderate CTS patients.

Materials and methods

Study groups and design

In this study, patients who applied to the neurology department with the diagnosis of idiopathic CTS were evaluated. A single neurologist examined patients for eligibility. Our inclusion criteria were to be 18-80 years old with mild-to-moderate CTS based on an electrophysiological confirmation and clinical symptoms persisting for more than a month. For clinical diagnosis, we based on American Association of Electrodiagnostic Medicine (AAEM) criteria; 1) paresthesia, pain worsening at night and subsiding after postural adjustment or hand shaking; 2) weakness or clumsiness exacerbated by repeated wrist use; 3) thenar muscle weakness with atrophy; and 4) positive Tinnel sign or Phalen test[11]. Demographic informations such as age, gender and body mass index were recorded. Patients with severe or extreme CTS, diabetes

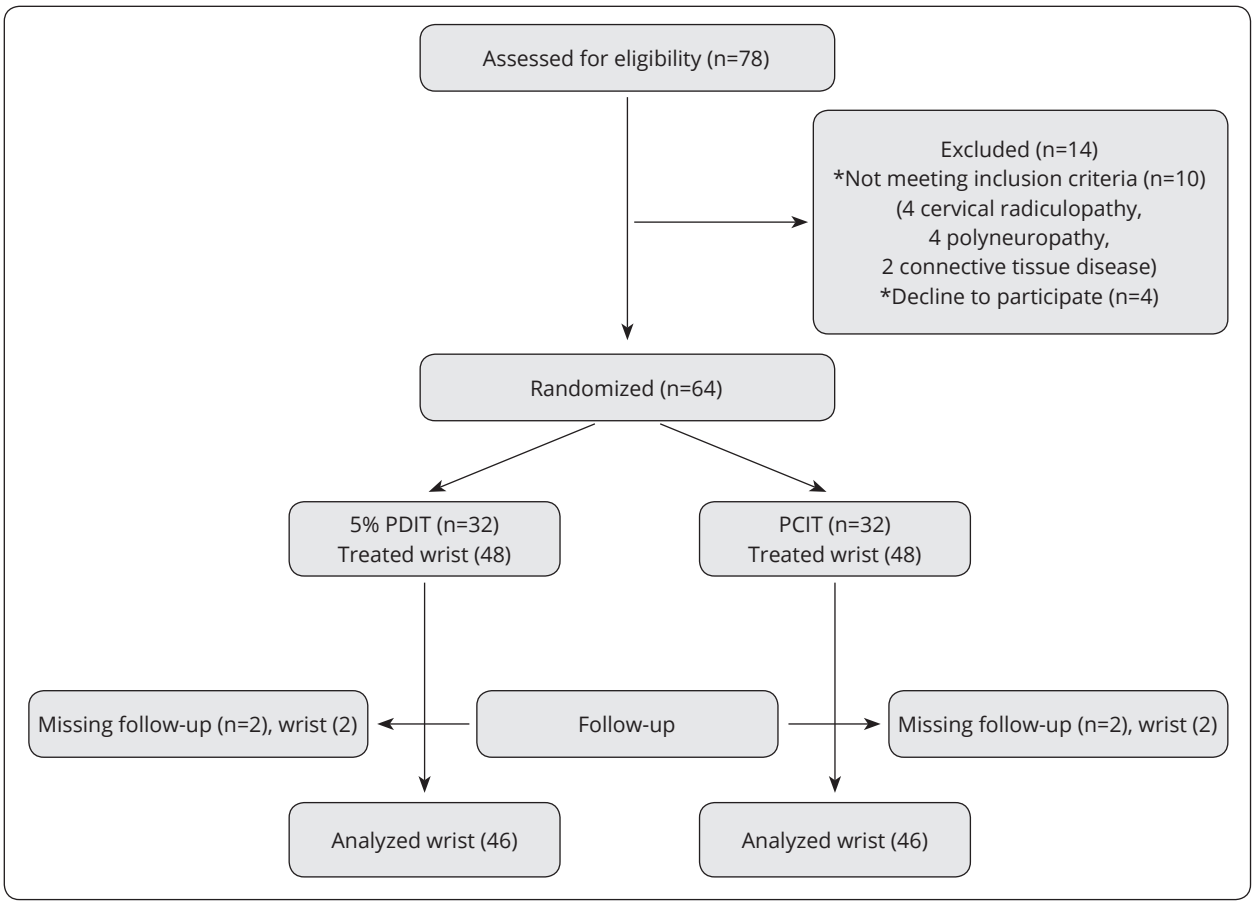

Figure 1. *Study flowchart. 5%PDIT: Perineural 5% dextrose injection therapy; PCIT: perineural corticosteroid injection therapy*

mellitus and other metabolic diseases, malignancy, polyneuropathy, renal failure, thyroid disease, cervical radiculopathy or brachial plexopathy, history of upper extremity surgery, motor neuron disease, trauma to the hand or wrist, connective tissue disease, rheumatic disease, active infection, pregnancy were excluded from the study. Seventy-eight patients diagnosed with mild-to-moderate CTS were enrolled into this study but 14 were excluded according to exclusion criteria. For the 64 included patients random numbers were generated using Microsoft Excel, Microsoft Inc., USA. Each generated number was sorted with the Rank function and randomly assigned to the groups. **Figure 1** illustrates the flowchart of study.

The severity of pain was assessed using Visual Analog Scale (VAS). The symptom severity and functional status of patients were evaluated with The Boston Carpal Tunnel Syndrome Questionnaire (BCTQ). The electrophysiological examination was done by the neurologist and then the patients were referred to the pain department. PITs were performed by a pain physician with ultrasound-guided injection therapy experience, who was blinded to the clinical or electrophysiological data of the subjects. All participants were blinded to the kind of PIT administered to them. If the patients were diagnosed with bilateral CTS, both wrists were assigned to the same group.

All patients avoided any other conservative treatments for CTS from least two weeks before the start of participation to the end of the study. The study was approved by the local ethics committee and was conducted in accordance with the Declaration of Helsinki (No: 242-09). All patients gave written informed consent after being given details about the study.

Electrophysiological examination

The electrophysiological examination was performed using surface electrodes with a Medelec Synergy electromyography device (ViaSys Healthcare, Madison, Wis., USA). The skin temperature was standardized between 32-36°C on all extremities. Routine electrophysiological tests were performed for all subjects according to AAEM guidelines of electrodiagnostical studies in CTS[11, 12].

All sensory NCS were performed antidromically. The sensory nerve conduction velocity (SNCV) was studied

when the stimulator was 14 cm proximal to the active electrode on the 2nd interphalangeal joint, and the DML stimulator was 8 cm proximal to the active electrode on the abductor pollicis brevis muscle[13]. In the median motor nerve study DML ≥ 4.2 ms, conduction velocity < 50 m/s, amplitude < 4mV; in median sensory nerve study a latency of >3.5 ms, amplitude < 17 μV, conduction velocity < 50 m/s, and 4th finger median-ulnar sensory latency difference > 0.5 ms were accepted as abnormal[12].

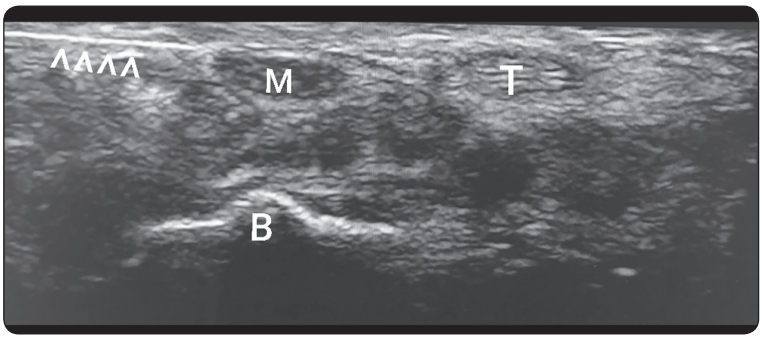

Figure 2. *Ultrasonographic view of perineural injection around the median nerve using the short-axis, ulnar approach, and in-plane method by preserving neurovascular structures after the median nerve was located. M: Median nerve; B: Bone; T: Tendon; Short arrowheads: Needle*

The electrophysiological severity of CTS was graded as mild, moderate, severe or extreme based on published data from AAEM[11]. Patients who were electrophysiologically diagnosed as having moderate-stage CTS (SNCV slowing and DML delay in finger-wrist segment) and mild-stage CTS (SNCV slowing and normal DML in finger-wrist segment) were included in the study. Extreme CTS (absence of sensory nerve action potential SNAP and CMAP) or severe CTS (absence of SNAP in digit-wrist segment and abnormal DML) patients were excluded[11, 13].

Ultrasound-guided perineural therapy

The treatment was performed in the local operating room under sterile conditions in the supine position. Firstly, the median nerve of all patients were visualized in the scaphoid pisiform (SP) plane (at the proximal entrance to the carpal tunnel) using a linear probe of a General Electric double-probe doppler-enabled ultrasonography device **(Figure 2)**. A 27 gauge 4 cm needle was used while preserving the neurovascular structures in all PIT groups. The total volume of injectates was prepared as 5 ml. The median nerve location was determined, in group PCIT, a mixture of 1 cc 40 mg triamcinolone, 2 cc 2% lidocaine and 2 cc saline around the median nerve in a short axis, ulnar approach and in-plane method was injected. On the other hand, in group 5%PDIT, under in-plane ulnar approach, 3 cc injectate was injected to hydrodissect the SP plane from the transverse carpal ligament, and the residual 2 cc injectate was then injected to hydrodissect the inferior SP plane away from the flexor tendons. Hydrodissection of the median nerve was observed ultrasonographically in both groups. All patients were observed for thirty minutes after injection for any complications.

Outcome measurements

VAS and BCTQ scores and the electrophysiological study were evaluated before and after PIT at the 1st and 6th months. VAS was used to evaluate the severty of pain or paresthesia. All patients were asked to indicate his/her perceived pain intensity along a 100 mm horizontal line, and then this rating is measured from the left edge (VAS score)[14]. The Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) is a patient-reported questionnaire that is used for determine the symptom severity and functional status of patients with CTS. It is a specific questionnaire for CTS developed by *Levine* et al.[15], and the Turkish version had been validated by *Sezgin* et al[16]. It is more frequently used as a standard in CTS patients. In the BCTQ, the symptom severity scale with 11 items and the functional status scale with 8 items are scored on a Likert scale with 1 point (mildest) to 5 points (most severe) and each scale generate a final score. Electromyographical tests are routinely used for the diagnosis of CTS. The detailed method of measurement is the same as described above.

Sample size

The sample size was calculated using the PASS V15.0.5 program. According to the results of non-inferiority test, with 95% statistical power (1-β), 5% significance level (1-α), and allowable difference was 1, and assuming a standard deviation of 1.2 for the BCTQ severity scale 6th month values and equality margin value was δ = 0,01 between the study groups, the sample size for showing non-inferiority was 62 wrists in total, 31 in each group for the study. However, when we considered possible case losses (%20 dropout), it was planned to include minimum 39 wrists for each group to the study. Since our study was completed with 92 wrists, 46 in each group, the power of test was 99.9% according to Posthoc power analyses[17].

Statistical analysis

The IBM-Statistical Package for the Social Sciences (SPSS) version 23 software program was used for sta-

Table 1. *The demographic data of our mild to moderate CTS patients*

	PCIT (n = 46)	5% PDIT (n = 46)
Age (mean ± sd)	47.11 ± 10.45	50.67 ± 10.20
Female (%)	41(89.1)	40(87)
Male (%)	5(10.9)	6(13)
BMI (mean ± sd)	27.22 ± 4.25	28.96 ± 4.09
Symptom Duration$_{(mo)}$ (mean ± sd)	7.28 ± 4.40	5.87 ± 3.54
Grading		
Mild	23(50)	23(50)
Moderate	23(50)	23(50)

BMI: body mass index; sd: standart deviation

tistical analysis. Independent t-test and chi-squared test were used to analyze continuous and categorical demographic data. SNCV, DML, VAS, BCTQ severity and function scores were compared with Generalized Lineer Models (GLMs) according to PITs, time and their interaction. We minimized the intra-individual correlation with this statistical methods. The results of the analysis were presented as mean ± standard deviation. A p value of < 0.05 was considered as significant.

Results

The study initially included 64 patients who met the inclusion criteria. However four patients (two from each group) had to be excluded from the study due to missing the follow-up. Ninety-two treated hands of 60 patients who were diagnosed as having mild or moderate CTS were included in the study. **Table 1** shows the demographic and clinical characteristics with no significant differences between the two groups.

The main effect of PITs did not presented statistical significance on the mean values of VAS ($p = 0.471$). The main effect of time was statistically significant on the mean values of VAS ($p < 0.001$). While the mean value of VAS was 7.95 ± 1.35 at pretreatment, it decreased to 1.15 ± 1.09 at the 1st month and was 1.41 ± 1.36 at the 6th month of posttreatment period in total. The mean VAS values at posttreatment 1st and 6th months' demonstrated significant difference from pretreatment, and no interaction effect between time and group was found ($p = 0.078$) **(Table 2)**.

Similar to VAS, the main effect of PITs did not show statistically significant difference on the mean values of BCTQ severity score ($p = 0.666$). The main effect of time was statistically significant on the mean BCTQ severity scores ($p < 0.001$). The mean value of this scores were 34.62 ± 6.99 at pretreatment, 14.12 ± 4.29 at the posttreatment 1st month and 14.09 ± 4.31 at the posttreatment 6th month in total. Pretreatment values of the BCTQ severity scores indicated significant difference from posttreatment 1st and 6th months. No interaction effect between time and group was found ($p = 0.259$) **(Table 2)**.

The main effect of PITs was not statistically significant on the mean values of BCTQ function score ($p = 0.451$). The time effect was statistically significant on the mean values of BCTQ function scores ($p < 0.001$). While the mean value of BCTQ function score was 30.54 ± 7.1 at pretreatment, it was decreased to 10.6 ± 3.31 at the posttreatment 1st month and it continued to be 10.52 ± 3.29 at the 6th month of posttreatment period, which was similar with the 1st month's mean value. Pretreatment value of the BCTQ function scores obtained significant difference from posttreatment 1st and 6th months. No interaction effect between time and group was found ($p = 0.916$) **(Table 2)**.

The main effect of each PITs and time was statistically significant on the mean values of SNCV ($p = 0.010$, $p < 0.001$, respectively). However, time and PITs interaction was not statistically significant on mean values of SNCV ($p = 0.989$). While the mean values of the SNCV parameter was 40.84 ± 4.74 m/s at pretreatment, it increased to 45.18 ± 5.45 m/s at the 1st month significantly and measured 45.09 ± 5.13 m/s at the 6th month in total. In the %5PDIT group, the mean SNCV was 41.62 ± 4.08 m/s at pretreatment, 46.05 ± 5.15 m/s at 1st and 45.84 ± 4.57 m/s at 6th month of posttreatment. The mean SNCV was 40.06 ± 5.24 m/s at pretreatment, increased to 44.35 ± 5.65 m/s at 1st month and remained at 44.37 ± 5.56 m/s at 6th month of posttreatment period in PCIT group. The changes in the electrophysiological parameters in both groups are presented in **Table 2**.

The main effects of each PITs and time did not reach statistical significance on the main values of DML ($p = 0.095$; $p = 0.113$, respectively). No interaction effect between time and group was found ($p = 0.940$). The mean value of the DML parameter was 4.38 ± 0.56 ms at pretreatment, it was improved to 4.25 ± 0.42 ms at 1st month and was 4.28 ± 0.44 ms at 6th month of posttreatment in total. Similar with total, each PCIT and %5PDIT group, DML was decreased at 1st month according to pretreatment values **(Table 2)**.

Discussion

In this study the difference of the efficacies were evaluated between hydrodissections using 5%PDIT and PCIT for mild-to-moderate CTS. At the end of the study, we determined that VAS, BCTQ function and severity scores were significantly reduced after the first and sixth months in both PIT groups, compared to pretreatment scores. Furthermore, this scores did not differ signifi-

Table 2. *Outcome measurements of VAS, BCTQ, SNCV, DML among patients at different time points*

	Pretherapy	Posttherapy 1st mo	Posttherapy 6st mo	Total		Wald	p*
VAS							
%5PDIT	7.76 ± 1.39	1.35 ± 1.04	1.57 ± 1.22	3.56 ± 3.22	Treatment (Tr)	0.521	0.471
PCIT	8.13 ± 1.29	0.96 ± 1.11	1.26 ± 1.48	3.45 ± 3.57	Time(T)	1741.233	< 0.001
Total	7.95 ± 1.35[b]	1.15 ± 1.09[a]	1.41 ± 1.36[a]	3.5 ± 3.39	Tr*T	5.096	0.078
BCTQ (Severity)							
%5PDIT	33.78 ± 7.91	14.54 ± 4.2	14.09 ± 3.55	20.8 ± 10.74	Treatment (Tr)	0.187	0.666
PCIT	35.46 ± 5.89	13.7 ± 4.39	14.09 ± 5	21.08 ± 11.4	Time(T)	921.574	< 0.001
Total	34.62 ± 6.99[b]	14.12 ± 4.29[a]	14.09 ± 4.31[a]	20.94 ± 11.06	Tr*T	2.704	0.259
BCTQ (Function)							
%5PDIT	30.93 ± 8.04	10.76 ± 2.51	10.63 ± 2.59	17.44 ± 10.83	Treatment (Tr)	0.568	0.451
PCIT	30.15 ± 6.08	10.43 ± 3.97	10.41 ± 3.89	17 ± 10.46	Time(T)	1032.368	< 0.001
Total	30.54 ± 7.1[b]	10.6 ± 3.31[a]	10.52 ± 3.29[a]	17.22 ± 10.63	Tr*T	0.174	0.916
SNCV (m/s)							
%5PDIT	41.62 ± 4.08	46.05 ± 5.15	45.84 ± 4.57	44.46 ± 5.02	Treatment (Tr)	6.713	0.010
PCIT	40.06 ± 5.24	44.35 ± 5.65	44.37 ± 5.56	42.93 ± 5.81	Time(T)	44.939	< 0.001
Total	40.84 ± 4.74[b]	45.18 ± 5.45[a]	45.09 ± 5.13[a]	43.68 ± 5.48	Tr*T	0.023	0.989
DML (ms)							
%5PDIT	4.33 ± 0.56	4.21 ± 0.43	4.22 ± 0.43	4.26 ± 0.48	Treatment (Tr)	2.781	0.095
PCIT	4.44 ± 0.55	4.28 ± 0.42	4.33 ± 0.45	4.35 ± 0.48	Time(T)	4.369	0.113
Total	4.38 ± 0.56	4.25 ± 0.42	4.28 ± 0.44	4.3 ± 0.48	Tr*T	0.124	0.940

BCTQ: Boston Carpal Tunnel Syndrome Questionnaire, VAS: visual analog scale. DM: distal motor latency, mo: month. SNCV: sensory nerve conduction velocity.
*Parameters were analyzed with Generalized Linear Models (GLMs). Values were described using mean ± standard deviation (sd).
a-b: There is no difference between the same letters.

cantly between the 5%PDIT and PCIT groups at first and sixth months of posttreatment. Additionally, in electrophysiological study, SCNV was improved significantly at posttreatment 1st month compared to pretreatment values in both groups. However the mean values of DML scores were improved at posttreatment compared to pretreatment in both 5%PDIT and PCIT, this change was not significant. Electrophysiological parameters did not differ significantly between posttreatment 1st and 6th months. Based on our results, it appears that the efficacies of 5%PDIT and PCIT are similar in mild-to-moderate CTS.

Ultrasound-guided peripheral nerve administrations provide real-time imaging of the needle, improve accuracy and safety of the treatments. Complications such as peritendinous fibrosis and median nerve damage can be observed with blind injections. It is known that the adjuvant agent and technique which used for ultrasound-guided CTS injections, have different effects on functionality and pain in the short and long term[5]. Corticosteroids act by reducing perineural inflammation and soft tissue edema surrounding the neurons in CTS. According to previous studies, there were strong evidences that PCIT was superior to placebo[18]. However, there is no consensus about the duration of efficacy of PCIT in the literature. *Marshall S* et al.[19] reported that the therapeutic effects of PCIT for CTS began after one month from administration but did not significantly improve symptoms compared to either anti-inflammatory treatment and splinting after eight weeks. In contrast, *Lee* et al.[20] showed that, improvement in symptoms, functional and electrophysiological parameters still observed at three month follow-up by using ultrasound guided PCIT. Both *Makhlouf* et al.[21] and *Wang* et al.[22] revealed that the therapeutic effects extended up to six months. We observed that the therapeutic effects of PITs, which we administered to our mild-to-moderate CTS patients, began rapidly in the first

month and still continued after six monhts. It is thought that these changes in the duration of the therapeutic effects depend on the volume of the injectate, the administration method or the severity of the symptoms.

Nevertheless, the preference frequency of PCIT, which is known to be effective, has been decreasing in recent years due to the possibility of developing neurotoxicity and the adverse effects, which might develop especially in patients with diabetes and hypertension. Additionally, *Roghani* et al.[23] demonstrated that the combination of corticosteroids and local anesthetics was clinically and electrophysiologically effective in CTS patients, but corticosteroid was not superior to local anesthetics and saline combination. In another study conducted by *Nasiri* et al, 36 patients with mild to moderate CTS in one or both wrists were randomized to 5%PDIT (2cc) or PCIT (a mixture of 1 cc of methylprednisolone acetate and 1 cc of normal saline). VAS, BCTQ scores, electrophysiological parameters, and sonographic parameters of median nerve cross-sectional area were evaluated at baseline and at 1-month and 3-month follow-ups and they found that 5%PDIT perineural injection is an effective and safe treatment for mild to moderate CTS compared to short-term results from corticosteroids[24]. Similarly, in our study, VAS and BCTQ scores improved significantly in both the 5%PDIT and the PCIT groups at the 1st and 6th months compared with pretreatment. Consequently, it was thought that 5%PDIT had similar therapeutic effects with PCIT to improve clinical scores.

It is not clear how 5%PDIT has treated the CTS, yet multifactorial effect could be mentioned. It is thought that dextrose could suppress neurogenic inflammation and edema, which were especially important in the formation of CTS, by reducing pain mediators such as capsaicin-sensitive receptors, p-substance, or calcitonin gene-related peptides[10]. These effects might occur with inhibition of the transient receptor potential vanilloid receptor-1. Also, increasing in the level of dextrose in the extracellular fluid can reduce the transmission of pain signals by causing hyperpolarization of C fibers[25]. However, it is not clear what dose of dextrose could be administered for hydrodissection of PIT. The osmolality of 5%PDIT is similar to normal saline which does not damage nerve structures, so that it can be preferred for treatment. Administration of 10% or 20% dextrose, which are hypertonic solutions, are not recommended for PIT because they increase the local inflammation and may cause clinical worsening, as shown in animal experiments[10]. *Li* et al.[26] followed up for 1-3 years 185 patients who were treated with 10 mL 5%PDIT and noted that this treatment were effective and long-term effects were reliable.

Wu et al.[27] compared ultrasound-guided 5%PDIT with saline for PIT in CTS. They observed that pain and disability scores reduced and electrophysiological parameters improved more significantly in the 5%PDIT group than in the saline group. Afterward, the therapeutic effects of 5%PDIT and triamcinolone acetonide were compared in 54 patients with mild-to-moderate CTS. Intergroup difference was not significant until 4th month in all clinical and electrophysiological parameters. However, 5%PDIT was more benefical than PCIT at 4th and 6th months after PIT[17]. In another study, 52 CTS cases were examined retrospectively after 5%PDIT and SNCV was found to be a significant prognostic factor of treatment outcome for patients with mild-to-moderate CTS six months after 5%PDIT[28]. It was also reported that the long-term effects of 5%PDIT were reliable[26]. In our study, there were significant improvements in sensory conduction parameters in both groups at the end of the 1st and 6th months compared with pre-treatment; DML was decreased at 1st month due to pretreatment values, nevertheless this change was found significant. Additionally, no significant differences were observed in either group when the 1st and 6th months were compared in electrophysiological parameters. Because the changes in SNCV were compatible with VAS and BCTQ scores, we suggest that SNCV might be a sensitive indicator to follow-up of PIT's effectiveness.

Due to the many possible side effects of corticosteroid injection, such as axonal and myelin degeneration, the clinical benefit and recurrent injections are limited. *Peters-Veluthamaningal* et al.[29] reported that 38.8% of patients had side effects after injection of triamcinolone acetonide. On the contrary, no side effects were observed after dextrose injection by now. Similar with previous studies, no adverse effects were observed in our patients, whom were administered 5%PDIT. Consequently, we can consider the replacement of PCIT with 5%PDIT in the treatment of mild-to-moderate CTS. In the future, 5%PDIT may be the first choice for mild-to-moderate CTS patients especially who are hesitant about steroid therapy due to its side effects.

There are a few limitations of this study. Firstly, our study was single-centred. To study larger patient populations, to follow the patients for longer period should be considered in the future. Secondly, our study did not explore long term (12-24 month) outcomes of clinical and electrophysiological parameters that would be useful for more effective assessment of the treatment process. Despite these limitations, we believe our study provides benefical data, that can influence the future treatment strategies.

Conclusion

The clinical and electrophysiological improvements began early after both 5%PDIT and PCIT injections. In long-term, 5%PDIT and PCIT had similar therapeutic

effects. As a result, 5%PDIT should be kept in mind as an effective and safe treatment option for patients with mild-to-moderate CTS, especially who are hesitant about steroid therapy due to its side effects.

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STATEMENT OF ETHICS – This study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from each patient.This study was approved by the Ethics Committee of Uşak University Faculty of Medicine, Uşak, Turkey (No – 242-09).

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