

The Comparison of Therapeutic Ultrasound and Local Steroid Injection in Treatment of Mild to Moderate Carpal Tunnel Syndrome: A Randomized Controlled Trial

Nighat Ansar,¹ Muhammad Adeel,² Sidrah Liaqat,³ Iqra Maqsood,⁴ Imran Ghafoor⁵

Abstract

Background: Carpal tunnel syndrome (CTS) is the most commonly known entrapment neuropathy in which median nerve of the body is compressed or traumatized. The problem is described by numbness and tingling sensation in the region of tangible dispersion of the nerve in the hand that is joined by torment as well as shortcoming of thumb muscles. The incidence rate of CTS is 139/100,000 per year for men and 506/100,000 per year for women.

Objective: To compare the difference in pre/post numeric pain rating scale scores (NPRS) and Boston Carpal Tunnel Syndrome Questionnaire Scores (BCTSQ) with the use of therapeutic ultrasound versus local steroid injection in the treatment of mild to moderate carpal tunnel syndrome.

Methodology: A randomized clinical trial was done at Mayo Hospital Lahore, after the approval of synopsis from March 2016 to August 2016. The sample size of 60 patients (30 subjects in every group) was assessed by utilizing 5% level of significance, 90% power of test with expected mean estimation of BCTSQ score of local steroid as 3.20 and therapeutic ultrasound as 2.39 using simple random technique. Patients were given treatment with therapeutic ultrasound along with tendon gliding exercises in one group and local steroid injection along with tendon gliding exercises in another group. Post treatment assessment was done after four weeks.

Results: Pre-treatment pain intensity mean \pm SD for group 1 was 2.900 \pm 0.80 and for group 2 were 2.77 \pm 0.82 that was changed to 1.67 \pm 1.18 and 21.63 \pm 1.07 after four week treatment respectively. The functional status score mean \pm SD before treatment was 2.51 \pm 0.30 on symptom severity scale, 2.42 \pm 0.32 on functional status scale for group 1 and 2.32 \pm 0.34 (SSS), 2.17 \pm 0.45 (FSS) for group 2 that were changed after four week treatment to 1.94 \pm 0.44 (SSS), 1.89 \pm 0.51 (FSS) and 1.97 \pm 0.27 (SSS), 1.78 \pm 0.42 (FSS) for group 2 respectively.

Conclusion: The patients who were treated with therapeutic ultrasound method (U/S Group) showed better recovery after treatment, in case of symptoms severity scale. In case of function status scales the patients who were treated with local steroid method (Injectable Group) recovered better after treatment.

Key words: Carpal tunnel syndrome, ultrasound therapy, local steroid injection, tendon gliding exercises

1. Physiotherapist, Department of Physiotherapy, Mayo Hospital, Lahore

2. Lecturer Physiotherapy, Shalamar Institute of Health Sciences, Lahore

3. Assistant Physiotherapist, Department of Physiotherapy, Mayo Hospital, Lahore

4. Physiotherapist, Department of Physiotherapy, Mayo Hospital, Lahore

5. Physiotherapist, Social Security Hospital, Islamabad.

Corresponding Author: Muhammad Adeel, Physiotherapist Lecturer Physiotherapy, Shalamar Institute of Health Sciences, Lahore
Email: adeelarshad215@yahoo.com

Received 20-12-2016 Accepted 20-09-2017

Introduction

Carpal tunnel syndrome (CTS) is the most usually known impingement neuropathy in which median nerve of the body is compressed or traumatized. The problem is described by numbness and tingling sensation in the region of tangible dispersion of the nerve in the hand that is joined by

torment as well as shortcoming of thumb muscles. The incidence rate of CTS is 139/100,000 per year for men and 506/100,000 per year for women.

The individuals at the most risk for developing carpal tunnel syndrome include workers that perform jobs requiring repetitive flexion of the fingers and wrist. There is no golden diagnostic standard for CTS and in practical guidelines, it is advised to establish the diagnosis by means of signs and symptoms, positive carpal tunnel provocative maneuvers (e.g., with Phalen's test and Tinel's test) and electrophysiological testing. The electrophysiological classification of the severity of CTS is defined by the American Association of Electro Diagnostic Medicine (AAEM) that differentiates between mild and moderate CTS. In mild CTS, sensory conduction velocity (SCV) is slowed in the fingerwrist tract with normal delayed motor latency (DML); and in moderate CTS, SCV is slowed in the finger-wrist tract with increased DML.

A few treatment decisions for CTS can be extensively isolated into surgical and preservationist classifications. The different preservationist strategies incorporate hand propping, wrist bracing, ultrasound, laser treatment, steroids, non-steroidal anti-inflammatory drugs (NSAIDs), vitamin B6, local injections, work environment alterations and yoga. Discharging load operations have restorative impacts, yet difficulties and infrequently disappointment have been appeared to happen in 3-19 % of cases. Use of corticosteroid injections for carpal tunnel syndrome is evidenced in more than 40 years of age of patients and it reported effective treatment. Ultrasound is assumed to cause thermal effects on the affected tissue regeneration and also to reduce inflammation, edema and pain. Evidence suggests the efficiency of nerve and tendon gliding exercise in mild to moderate CTS by improving venous return, axonal transport, nerve conduction, stretching adhesions and decreasing pressure inside carpal tunnel. These exercises may maximize the pressure on median nerve in the restricted area. The aim of the present study was to compare clinical

parameters like pain, numbness, enhancement of symptoms and status of functions in both groups before and after treatment with therapeutic ultrasound, tendon gliding exercises and local steroid injection in carpal tunnel syndrome.

Methods

It was a randomized clinical trial. The study was conducted at Department of Physical Therapy, Mayo Hospital, Lahore. It was completed within 6 months after the approval of synopsis from March 2016 to August 2016. In this study, simple random sampling technique was used. Subjects were assigned randomly to one of two treatment protocols, using computer generated random number table. Group allocation and randomization was followed by CONSORT guidelines.¹³ Sample size of 60 patients (30 subjects in every group) was assessed by utilizing 5% level of significance, 90% power of test with expected mean estimation of BCTSQ score of local steroid as 3.20 and Therapeutic Ultrasound as 2.39.

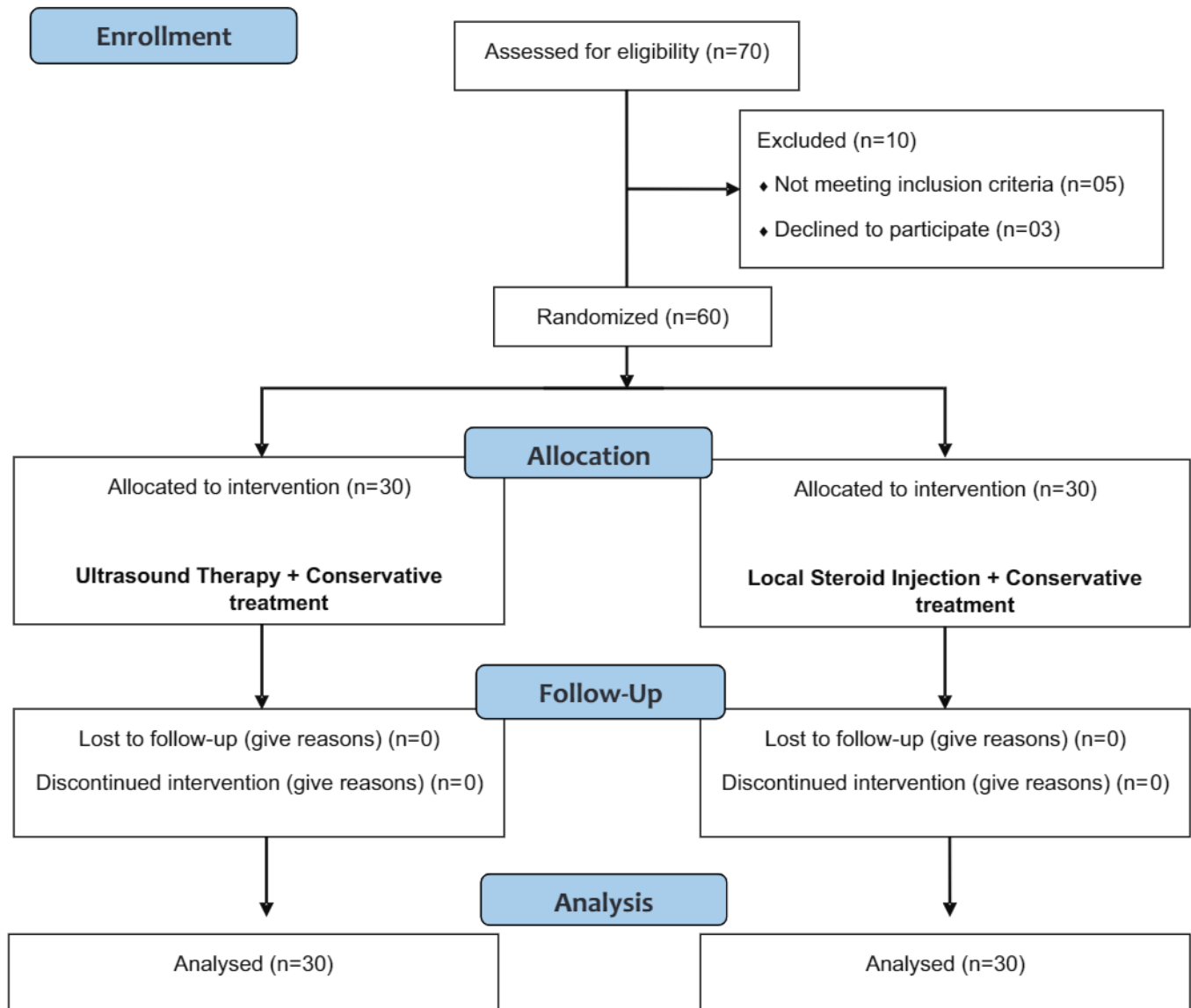
An informed consent was taken from each participant, all patients with carpal tunnel syndrome were initially evaluated objectively by an orthopedic surgeon or neurologist in Mayo Hospital Lahore. The diagnosis was confirmed with the help of nerve conduction study by a neurophysician. All participants who were having mild to moderate CTS in the left or right hand, which was either the dominant or the non-dominant hand, were included according to the following criteria: age above 18 years, presence of paresthesia, pain and vasomotor symptoms of the hand through the course of median nerve, Phalen's test positive and Tinel's test positive, mild to moderate intensity of median nerve lesion in nerve conduction studies. The exclusion criteria were: All pregnant women because the incidence of carpal tunnel syndrome in pregnant women reported in the literature is 62%, acute wrist trauma from last six months, history of wrist surgery from last six months and history of steroid injection into the carpal tunnel from last six months. Clinical parameters like pain, numbness, severity of symp-

toms and functional status were collected through numeric pain rating scale and Boston Carpal Tunnel Syndrome Questionnaire. The difference in improvement before and after 04 weeks were noted and compared.

The subjects were divided in to two groups randomly. Group 1:30 subjects (hands) of 30 patients were included in therapeutic ultrasound group (U/S group). The protocol was followed as median nerve flossing exercises 03 times daily 10 repetition holding each stretch 5 seconds per week for 04 weeks, wrist range of motion exercises (extension

15 repetitions, radial and ulnar deviation 15 repetitions) 03 times daily per week for 04 weeks, therapeutic ultrasound treatment with aqua gel was given for 2 times per week for 4 weeks, with intensity of 1.5 w/cm^2 for five minutes with treatment head of 4cm^2 . The frequency of U/S was 1-3 MHz. Group 2: 30 subjects (hands) of 30 patients were included in local steroid group (injectable group). The protocol was followed as: median nerve flossing exercises 03 times daily 10 repetition holding each stretch 5 second per week for 04 weeks, wrist range of motion exercises (extension

CONSORT Flow Diagram



15 repetitions, radial and ulnar deviation 15 repetitions) 03 times daily per week for 04 weeks provided by a senior physiotherapist, local steroid injection was given by a neurologist with 22- gauge needle at the proximal part of the carpal tunnel to the wrist crease just medial to the tendon of radial flexors involving Inj depomedrol 40mg/ml 1ml plus Inj bupivacaine HCl 1ml. It was given once a time in 04 weeks.

Using SPSS data were managed and analyzed. The quantitative data like age presented in form of mean \pm SD. The qualitative data like gender was presented in form of %age, frequency tables and appropriate charts where applicable. A student test was used to determine the difference between two groups in all clinical parameters (pain intensity, functional status score, symptom severity score and numbness) both before and after treatment. A p-value less than 0.05 were taken as significant.

Results

The mean age was 44.867 \pm 11.587 in group 1 ranging from 25 to 80 and 36.76 \pm 7.758 years ranging from 18 to 60 in group 2. It was observed that 11(18.3%) patients were male included in this study and 49(81.67%) patients were female, which shows that females were mostly affected by carpal tunnel syndrome. The baseline data on age, gender, pain intensity and functional status of hand were presented in Table.No.I.

Pre-treatment pain intensity mean \pm SD for group 1 was 2.900 \pm 0.80 and for group 2 was

2.77 \pm 0.82. Post-treatment pain intensity mean for group 1 changed to 1.67 \pm 1.18 and for group 2 1.63 \pm 1.07 (Table.No.II). The functional status score mean \pm SD before treatment according to BCTSQ was 2.51 \pm 0.30 on symptom severity scale, 2.42 \pm 0.32 functional status scale for group 1 and 2.32 \pm 0.34 (SSS), 2.17 \pm 0.45 (FSS) for group 2. And after four week treatment it were 1.94 \pm 0.44 (SSS), 1.89 \pm 0.51 (FSS) for group 1 and 1.97 \pm 0.27 (SSS), 1.78 \pm 0.42 (FSS) for group 2 (Table.No.II). The table.no.III represents the independent sample t-test results.

Figure.No.I and Figure.No.II showed the graphical representation of change in symptom severity scale and functional status scale of hand before and after four week treatment.

Table 1: Baseline demographic and clinical characteristics

	Group 1 (n=30)	Group 2 (n=30)
Age (years)	44.87(11.59)	36.77(7.76)
Gender:	1.73(0.45)	1.900(0.305)
Pain intensity before treatment (Numeric pain rating scale)	2.90(0.80)	2.77(0.82)
Functional status of hand before treatment (Boston Carpal Tunnel Syndrome Questionnaire):		
Symptom Severity Scale(SSS)	2.51(0.30)	2.32(0.34)
Functional Status Scale(FSS)	2.42(0.32)	2.17(0.45)

Table 2: Summary result for each study group

	Group 1		Group 2		p-value
	Baseline Mean(SD)	At 4 weeks Mean(SD)	Baseline Mean(SD)	At 4 weeks Mean(SD)	
Pain intensity (NPRS)	2.900 \pm 0.80	1.67 \pm 1.18	2.77 \pm 0.82	1.63 \pm 1.07	0.909
Functional status score(BCTSQ): Symptom Severity Scale(SSS)	2.51 \pm 0.30	1.94 \pm 0.44	2.32 \pm 0.34	1.97 \pm 0.27	0.773
Functional Status Score(FSS)	2.42 \pm 0.32	1.89 \pm 0.51	2.17 \pm 0.45	1.78 \pm 0.42	0.335

Table 3: *Independent sample t-test:*

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
QS_AVG_Bef	Equal variances assumed	1.126	.293	2.377	58	.021	.19687	.08282	.03108	.36266
	Equal variances not assumed			2.377	57.347	.021	.19687	.08282	.03104	.36270
QS_AVG_Aft	Equal variances assumed	7.292	.009	-.290	58	.773	-.02727	.09408	-.21559	.16106
	Equal variances not assumed			-.290	47.849	.773	-.02727	.09408	-.21644	.16191
QF_AVG_Bef	Equal variances assumed	8.980	.004	2.477	58	.016	.25000	.10094	.04794	.45206
	Equal variances not assumed			2.477	51.928	.017	.25000	.10094	.04744	.45256
QF_AVG_Aft	Equal variances assumed	3.936	.052	.973	58	.335	.11667	.11989	-.12331	.35664
	Equal variances not assumed			.973	55.806	.335	.11667	.11989	-.12351	.35685
NPRS_Bef	Equal variances assumed	.440	.510	.637	58	.526	.13333	.20918	-.28538	.55205
	Equal variances not assumed			.637	57.982	.526	.13333	.20918	-.28538	.55205
NPRS_Aft	Equal variances assumed	.548	.462	.115	58	.909	.03333	.29092	-.54901	.61568
	Equal variances not assumed			.115	57.373	.909	.03333	.29092	-.54915	.61581

QS_AVG_Bef=Symptom severity score average before treatment

QS_AVG_Aft=Symptom severity score average after treatment

QF_AVG_Bef=Functional severity score average before treatment

QF_AVG_Aft=Functional severity score average after treatment

NPRS_Bef=Numeric pain rating scale score average before treatment

NPRS_Aft=Numeric pain rating scale score average before treatment

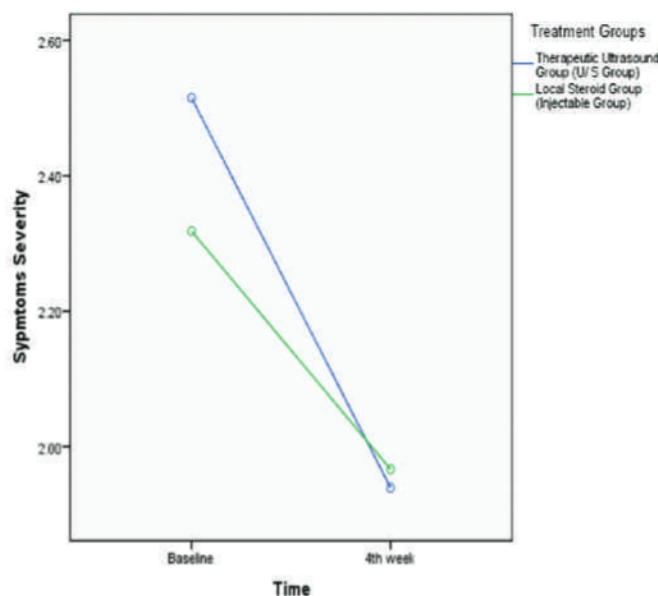


Figure 1: *Symptom Severity Scale*

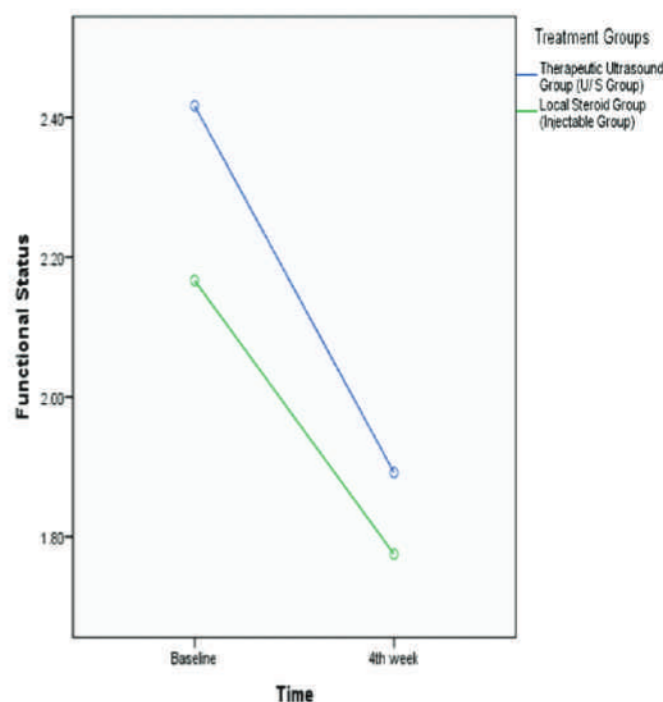


Figure 2: *Functional Status Scale*

Carpal tunnel syndrome is one of common disorder of hand. Many treatment methods are used for the management of the disorder but there is no particular agreement on the best management. The purpose of this study was to compare the effectiveness of therapeutic ultrasound group with local

steroid method (injectable group) in treatment of mild to moderate carpal tunnel syndrome.

There was found a significant improvement over time in all groups. The statistically significant improvements in symptoms severity, functional scores and pain were found as compared to the baseline values at the 4th week.

On symptom severity scale patients who were treated with therapeutic ultrasound method (U/S Group) showed better recovery due to treatment, because they had more severe symptoms before treatment but after treatment severity was equal to the patients treated with local steroid method (injectable group). On functional status scale, the patients treated by both methods were found to be on working level of efficiency according to function status scale. This implies that those patients who were treated with local steroid method (injectable group) recovered better after treatment. On numeric pain rating scale, it was found out that both groups of patients had equally improved after treatment. It was concluded that both methods are working with same efficiency considering "Numeric Pain Rating Scale".

In some of the previous studies splinting was used as conservative treatment method as to keep the neutral angle of the wrist in CTS. But this method of treatment is not suitable mostly in today's working job environment. As patients might complain that splinting is making difficult doing daily activities or other working. There are studies showing effectiveness of splinting in reducing pain but due to its less efficiency and hindrance in the work alternative method of treatment was required that are most effective and efficient. Results of this study are also consistent with a study by Lamia et al in which 26 patients with CTS were included, revealed that nerve gliding exercises were more effective in decreasing pain and sensation changes as compared to the group given splinting. Patients in nerve gliding exercise group also showed greater functional improvement.

Another randomized clinical trial included 20 patients with CTS into two groups. These groups

were given routine physiotherapy with modalities including ultrasound and neuromobilization maneuver. The results of this study showed more improvement on functional status scale in the group treated with neuromobilization maneuver. Effect of these exercises is that these exercises remodel and stretch the adhesive tenosynovium around the structures that are present inside the tunnel. So nerve gliding exercises were also included in this study.

For alternative methods local steroid injections are commonly used as mode of treatment for CTS. Among some causes of CTS one of the cause is thickening of the synovium due to inflammation in the flexor tenosynovium and steroid injections are used for the reduction of this tenosynovitis. Short term uses of these injections have good results but in the long run the results are variable. This study suggests that local steroid injections work better in some conditions but ultrasound is also equally effective as an alternative mode of treatment. There are some studies that discuss the effectiveness of ultrasound therapy as conservative treatment.

Apart from its property to decrease inflammation and edema ultrasound therapy may also support the recovery of the tissue caused by nerve compression. Ultrasound is deep heating modality that heats up the deeper layers of the tissue and in this process nerve is heated selectively. A study suggests that combination of exercise and ultrasound therapy was most favored combination for the treatment.

This study shows improvement in the group that was treated with ultrasound therapy as compared to steroid therapy. Patients who were treated with therapeutic ultrasound method (U/S Group) showed better recovery due to treatment, because they had more severe symptoms before treatment but after treatment severity was equal to the patients treated with local steroid method (injectable group) in case of symptoms severity. In case of function status scales the patients who were treated with local steroid method (injectable group) recovered better after treatment. It means both methods work ably in our study.

Ultrasound therapy is also preferable method of treatment as some patients may not use injectable. So the ultrasound therapy is used in this study with minimal risks and comfortably for the management of CTS.

There are few limitations and weakness to this study. First, as only mild and moderate severity patients of CTS were included in the study. If more severe patients were included results might have been different. Second, the sample size was small and the duration of treatment was limited. If number of treatment sessions were altered, then results might have been different. So long term results cannot be defined. Third, Patients were included from only one setting that is Mayo Hospital Lahore. So the results of this study cannot be generalized. Fourth, other factors like age, occupation, ergonomics that were not considered in this study might also influence the parameters. Fifth, combinations of treatments are used so the origin of effects of treatment cannot be determined. So detailed studies with long term follow ups are required to further evaluate the findings.

References

1. Heidarian A, Abbasi H, Hoseinabadi MH, Hajjalibeyg A, Motamedi SMK, Seifirad S. Comparison of knifelight surgery versus conventional open surgery in the treatment of carpal tunnel syndrome. *Iranian Red Crescent Medical Journal*. 2013; 15(5):385-8.
2. Peters-Veluthamaningal C, Winters JC, Groenier KH, Meyboom-de Jong B. Randomised controlled trial of local corticosteroid injections for carpal tunnel syndrome in general practice. *BMC family practice*. 2010; 11(1):1.
3. Luckhaupt SE, Dahlhamer JM, Ward BW, Sweeney MH, Sestito JP, Calvert GM. Prevalence and work-relatedness of carpal tunnel syndrome in the working population, United States, 2010 national health interview survey. *American journal of industrial medicine*. 2013; 56(6):615-24.
4. Melchior M, Roquelaure Y, Evanoff B, Chastang J-F, Ha C, Imbernon E, et al. Why are manual workers at high risk of upper limb disorders? The role of physical work factors in a random sample of workers in France (the Pays de la Loire study).

- Occupational and environmental medicine. 2006; 63(11):754-61.
5. Peters-Veluthamaningal C, Winters JC, Groenier KH, Meyboom-deJong B. Randomised controlled trial of local corticosteroid injections for de Quervain's tenosynovitis in general practice. BMC musculoskeletal disorders. 2009; 10(1):131.
6. Ghasemi-rad M, Nosair E, Vegh A, Mohammadi A, Akkad A, Lesha E, et al. A handy review of carpal tunnel syndrome: From anatomy to diagnosis and treatment. World journal of radiology. 2014; 6(6): 284.
7. Duymaz T, Sindel D, Kesiktas N, Muslumanoglu L. Efficacy of some combined conservative methods in the treatment of carpal tunnel syndrome: a randomized controlled clinical and electrophysiological trial/Karpal tunel sendromunun tedavisinde bazi kombine konservatif yontemlerin etkinligi: randomize, kontrollu, klinik ve elektrofizyolojik bir calisma. Turkish Journal of Rheumatology. 2012; 27(1):38-47.
8. Vahi P-S, Kals M, Kõiv L, Braschinsky M. Preoperative corticosteroid injections are associated with worse long-term outcome of surgical carpal tunnel release: A retrospective study of 174 hands with a mean follow-up of 5.5 years. Acta orthopaedica. 2014; 85(1):102-6.
9. Bilgici A, Ulusoy H, Kuru O, Canturk F. The comparison of ultrasound treatment and local steroid injection plus splinting in the carpal tunnel syndrome: a randomized controlled trial. Bratislavske lekarske listy. 2009; 111(12):659-65.
10. Bakhtiary AH, Rashidy-Pour A. Ultrasound and laser therapy in the treatment of carpal tunnel syndrome. Australian Journal of Physiotherapy. 2004; 50(3):147-51.
11. Carlson H, Colbert A, Frydl J, Arnall E, Elliott M, Carlson N. Current options for nonsurgical management of carpal tunnel syndrome. International journal of clinical rheumatology. 2010; 5(1):129-42.
12. Pinar L, Enhos A, Ada S, Güngör N. Can we use nerve gliding exercises in women with carpal tunnel syndrome? Advances in therapy. 2005; 22(5):467-75.
13. Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. BMC medicine. 2010; 8(1):1.
14. El Miedany Y, Aty S, Ashour S. Ultrasonography versus nerve conduction study in patients with carpal tunnel syndrome: substantive or complementary tests? Rheumatology. 2004; 43(7):887-95.
15. Ma H, Kim I. The diagnostic assessment of hand elevation test in carpal tunnel syndrome. Journal of Korean Neurosurgical Society. 2012; 52(5):472-5.
16. Ablove RH, Ablove TS. Prevalence of carpal tunnel syndrome in pregnant women. Wisconsin Medical Journal (WMJ). 2009; 108(4):194.
17. Bhatia DN. Direct "Cystoscopic" Approach for Arthroscopic Decompression of an Intraosseous Ganglion of the Lunate. Arthroscopy Techniques. 2015; 4(3):e223-e9.
18. Gerritsen AA, de Krom MC, Struijs MA, Scholten RJ, de Vet HC, Bouter LM. Conservative treatment options for carpal tunnel syndrome: a systematic review of randomised controlled trials. Journal of neurology. 2002; 249(3):272-80.
19. Marshall SC, Tardif G, Ashworth NL. Local corticosteroid injection for carpal tunnel syndrome. The Cochrane Library. 2007.
20. Hobson-Webb LD, Massey JM, Juel VC, Sanders DB. The ultrasonographic wrist-to-forearm median nerve area ratio in carpal tunnel syndrome. Clinical neurophysiology. 2008; 119(6):1353-7.
21. Oskouei AE, Talebi GA, Shakouri SK, Ghabili K. Effects of neuromobilization maneuver on clinical and electrophysiological measures of patients with carpal tunnel syndrome. Journal of physical therapy science. 2014; 26(7):1017-22.
22. Walker JA. Management of patients with carpal tunnel syndrome. Nursing Standard. 2010; 24(19): 44-8.
23. Kramer JF. Effect of therapeutic ultrasound intensity on subcutaneous tissue temperature and ulnar nerve conduction velocity. American Journal of Physical Medicine & Rehabilitation. 1985; 64(1): 1-9.
24. Baysal O, Altay Z, Ozcan C, Ertem K, Yologlu S, Kayhan A. Comparison of three conservative treatment protocols in carpal tunnel syndrome. International journal of clinical practice. 2006; 60(7): 820-8

Conflict of Interest : None
Funding Source: None