Effectiveness of Flexor tendon gliding exercise versus fore arm stretching to improve hand function among CTS (Carpal tunnel syndrome) patients

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Abstract: Carpal tunnel syndrome (CTS) is a medical disorder where the median nerve is squeezed in the wrist, causing paresthesia, numbness, and muscular weakness in the hand. The goal of treating CTS is to relieve the pressure on the median nerve. Exercise treatment is now one of the most effective ways to manage CTS. But there is a scarcity of evidence for the effectiveness of different exercise protocols.

Objective: To compare the effectiveness of flexor tendon gliding exercises versus forearm stretching in improving hand function among CTS patients.

Methodology: A Clinical trial was carried out on 54 CTS patients, included in this investigation by using simple random sampling technique. Subjects were selected who met the inclusion criteria. Then they were assigned into two Experimental groups. Group 1 were instructed to perform TGE while Forearm stretching were administered to group 2 (10 repetition twice a day) for six weeks. Patients were evaluated by using diagnostic measures, Goniometry ,BCTQ,VAS for assessment of WFROM and WEROM,FSS,SSS and pain intensity respectively before the interventions and after 6 weeks of follow up. Data were entered and analyzed through , Statistical Package for Social Sciences (SPSS) version 24 . Levene's test for homogeneity, Independent samples T- test and paired samples T- test were applied. All results were calculated at 95% interval of confidence and p-value $\leq$ 0.05 was considered as a significant value.

Results: Pre-post analysis showed that there were significant improvement in CTS patients After applying both interventions t-test analysis compared means between intervention groups . t-value,df p–value mean difference and 95% confidence interval of the difference with LL-UL for Post Wrist flexion Range of Motion were -2.15, 38.16, 0.03*,-4.45,(-8.62- 0.26) respectively as(p<0.05)that showed statistically significant difference in mean between both group in improving wrist flexion range.

Conclusion: Our study concluded that both Flexor tendon gliding exercise and Fore arm stretching proved equally effective in reducing pain, ,symptoms severity, improving function status,and WEROM. In contrast to Tendon gliding exercise, Fore arm stretching contributed more beneficial impact in improving wrist flexion range of motion .

Keywords: *Carpal tunnel syndrome, Tendon gliding exercise, Fore-arm stretching,*

INTRODUCTION

"CTS" is a medical disorder where the median nerve is squeezed in the wrist, causing paresthesia, numbness, and muscular weakness in the hand.[1] Carpal tunnel syndrome, the most common neuropathy, is caused by compression and pressure on the median nerve in the carpal tunnel of the wrist (CTS). .[2] In essence, this is a medical condition where the median nerve is pinched in the wrist, resulting in paresthesia, numbness, and hand muscle weakness.va Individual variables including age, gender, diabetes, hypothyroidism, obesity, complications from systemic disorders, cigarette use, accidents, and occupational conditions are included in the risk factors. Other contributing variables include uncomfortable postures, hard lifting, vibrations, and repetitive and excessive wrist and hand use. Individual predictors include feminine gender, obesity, advanced age, and smoking.[3,4]

In terms of anatomy, the transverse carpal ligament limits the carpal tunnel on the palmer surface, while the hemicircular carpal bones restrict it on the dorsal and lateral sides. The median nerve and nine digital and thumb extensor tendons pass via this tube. It's important to keep in mind that neither the radial nor ulnar arteries, nor the ulnar nerve, pass through the tunnel. The transverse carpal ligament attaches radially to the scaphoid and trapezium and ulnarly to the pisiform and hamate.[5]

The median nerve may be compressed by any condition that reduces the tunnel's size or enlarges

the inside structures. Following lecto diagnostic testing, the diagnosis of carpal tunnel syndrome is made using clinical symptoms and indicators. 15 In the median nerve area of the wrist, there is pain and paresthesia (pins and needles), either with or without numbness. are the most typical symptoms of CTS.[6]Patients with CTS frequently describe discomfort, paraesthesia, sensory abnormalities, and numbness in their hands and wrists, which reduces their physical function and makes it harder for them to do everyday tasks.[7,8]Because of the significant incidence of CTS, it is vital to find the appropriate treatment techniques based on effects on activities of daily living and medical expenses 8 Trauma, metabolic imbalances, infections, neuropathies, and other systemic disorders have all been implicated as secondary causes of CTS. But idiopathic CTS is the most frequent kind..[9,10]

The goal of treating CTS is to relieve the pressure on the median nerve. Although CTS is treated using a variety of surgical and non-surgical techniques, there is no evidence to support the efficacy of the treatments currently available.[11-13]For the management of CTS, There are many different therapy options available. In order to ease the strain on the median nerve, CTS is treated. Most instances are addressed cautiously in the minimal, mild, and moderate phases. On the other hand, individuals in the severe and extremely severe stages have surgical intervention.[14]There are several methods for nonsurgical CTS therapy. Exercise treatment is now one of the most effective ways to manage CTS symptoms, both in electrotherapy and in manual therapeutic exercises .[15]

Several approaches for manual therapy intervention have been developed and are used by professional clinicians. Recent studies have promoted forearm stretching and tendon gliding exercises as purely realistic alternatives to traditionally conceived therapy Exercises for tendon gliding include straight-hand, hook-fist, full-fist, tabletop, and straight-fist poses utic approaches in its conservative management. [16-18]

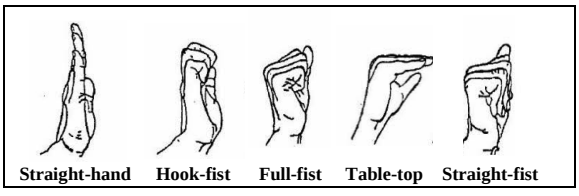

Figure 1: Five positions of Flexor Tendon gliding exercise

These movements are essential for the health of the hand because they provide the heart an aerobic workout while increasing the range of motion in each finger joint and the smoothness of the extensor and intrinsic tendons. In the fist position, superficialis excursion is at its greatest. Hook posture causes profundus tendon excursion. One flexor tendon, the flexor pollicis longus, is all that is needed to flex the thumb.[19]

Stretching is the process of elongating the muscles and associated soft tissue by placing certain sections of the body in a lengthening position. Stretching has several advantages, such as extending your range of motion, increasing your power, and decreasing weariness. It also boosts your vitality and, Stress relief.[20]Intermittent active wrist, Over time, flexion and extension exercises helped to relieve carpal tunnel syndrome symptoms. Through the ages vigorous wrist flexion and extension exercises lowered carpal tunnel pressure. It is believed that when these workouts are done, the investing adhesive tenosynovium remodels and stretches, reducing its adhesion to the structures inside the canal Over time, flexion and extension exercises helped to relieve carpal tunnel syndrome symptoms. [5]

Figure 2: Wrist Flexors stretching

Figure 3: Wrist Extensors stretching

METHODOLOGY

A clinical trial was carried out involving 54 CTS patients. . Data were collected from CTS diagnosed Patients from rehabilitation department of Combined Military Hospital Gujranwala and physiotherapy department of DHQ Hospital Gujranwala Pakistan. The study was conducted for 4 months from 1st August 2022 to 30th November 2022 with 6 weeks follow up (10 repetitions twice a day) period.CTS surgery recommended patients, Patients with the history of hand, neck, or shoulder trauma within last 3 months or any abnormalities that interfere with CTS, such as wrist discomfort, fractures, post-traumatic wrist stiffness, or cervical radiculopathy,. Osteoarthritis-related wrist pain, pregnancy, Patients with thyroid conditions, post-surgical wrist numbness, and rheumatoid arthritis were excluded.

The 54 participants who met the study's inclusion criteria were randomly Allocated into two

experimental groups (groups 1 and 2), each with(n= 27)participants. Each patient in both groups their anonymity and prevented any damage to them.

The entire BCTQ questionnaire was briefly explained to the patients, which comprises two scales FSS and SSS. Which were then used to gather data from both groups. After that, group 1 and group 2 were each given an explanation of the flexor tendon gliding exercise and the forearm stretching exercise, and they were requested to execute them actively (10 repetitions twice day) in addition to continuing

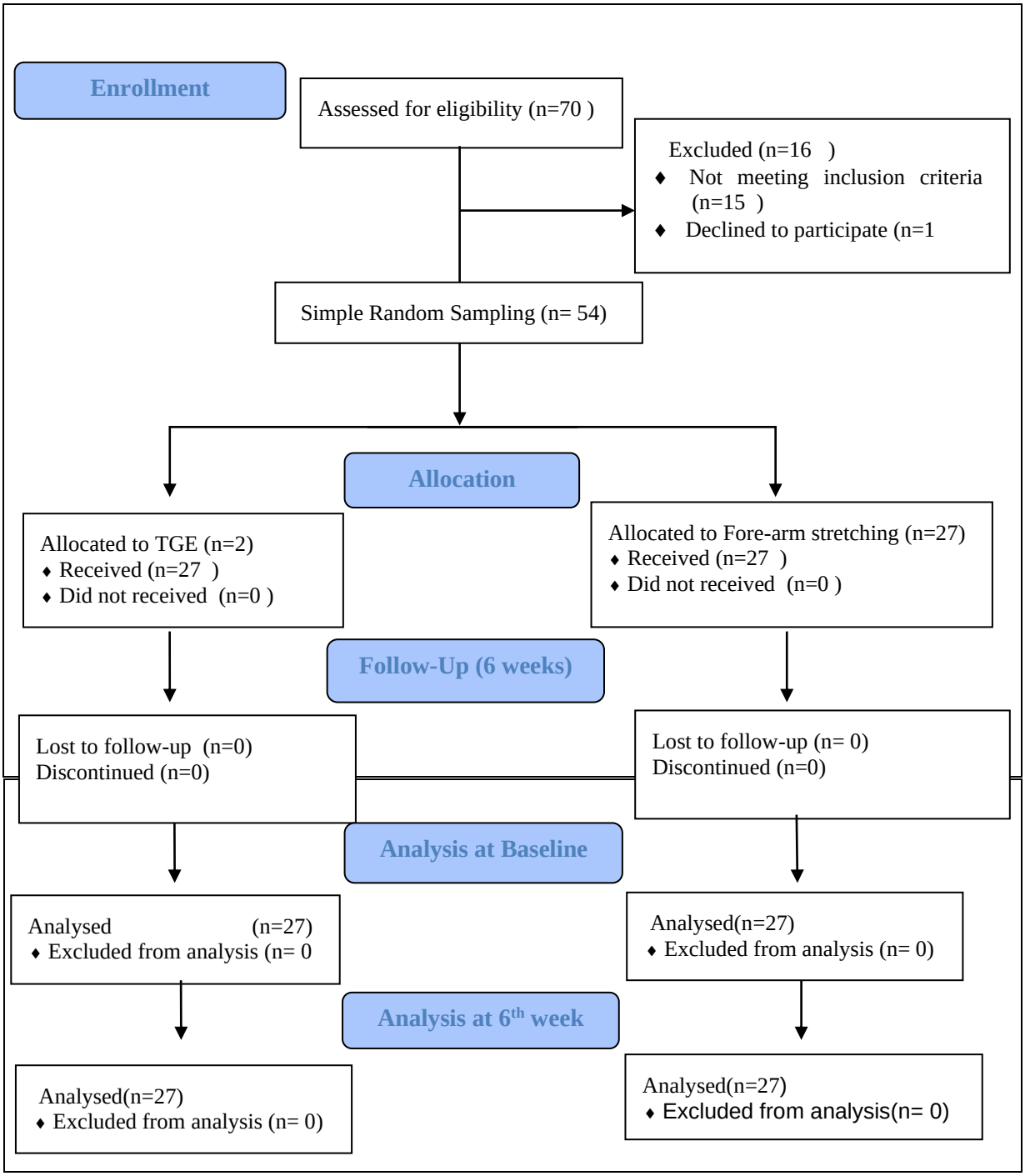

Figure 3: Consort Diagram

Which were then used to gather data from both groups. After that, group 1 and group 2 were each given an explanation of the flexor tendon gliding exercise and the forearm stretching exercise, and they were requested to execute them actively (10 repetitions twice day) in addition to continuing

with other conservative therapies.After six weeks, The BCTQ, was used once more to collect data from the patients in both groups. The BCTQ has construct validity and Cronbach's alpha values of 0.89 for the Symptom Severity Scale and 0.93 for the Functional Status Scale.1 (no symptoms/normal activity) to 5 (worst symptoms/ lost activity), each item is graded. Each scale is given a mean score that ranges from 1 to 5, with higher values indicating poorer symptoms or function. Goniometry and VAS were used before and after intervention to check wrist ROM and pain intensity respectively.

The research was approved by Institutional review board (IRB),University of Lahore punjab pakistan.

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STATISTICAL ANALYSIS

Data were entered and analyzed through, Statistical Package for Social Sciences (SPSS) version 24 . To calculate the normality of data Shapiro wilk test was applied. For descriptive analysis, mean and standard deviation were calculated for numerical normal. Whereas categorical data were displayed in frequency and percentages. For the inferential statistics, Levene's test for homogeneity, Independent samples T- test and paired samples T- test were applied. All results were calculated at 95% interval of confidence and p-value ≤ 0.05 was considered significant.

RESULTS:

54 patients (13 Males,41 Females)diagnosed with Carpal tunnel syndrome were chosen for our study, By using Simple random sampling. Patients then assigned in two Experimental groups Group1 (n=27)and Group 2 (n=27).Demographic data showed more CTS ratio in females than males indicated the Frequency percentages for gender of patients of both groups.Out of total 27 patients 7 patients (25.90%)were male and 20 patients (74.10%) were females in tendon gliding exercise group while out of total 27 patients 6 patients (22.2%) were males and 21 patients (77.8%) were females in forearm stretching group. Mean±Std for the age of patients(years) in tendon gliding exercise group and forearm stretching group were 32.78±12.80 and 32.3±14.2 respectively.

Descritive analysis of all the variables with pre and post values for the mean and standard deviation between both intervention groups,showed that both interventions were positively effective as the mean and standard deviation values for FSS, SSS and VAS decreased while the values for Wrist flexion Range of Motion and Wrist Extension Range of Motion increased after applying the interventions

Hence,according to scoring system of each outcome measure all showed improvement in patients condition. But Forearm stretching was slightly more effective as compared to tendon gliding exercise as showen in Table 1.

Independent Samples t–test was used for comparison of means between intervention groups t-value,df p–value mean difference and 95% confidence interval of the difference with LL-UL for Post Wrist flexion Range of Motion were -2.15, 38.16, 0.03*,-4.45,(-8.62- 0.26) respectively as($p<0.05$) that showed significant difference in mean between both group in improving wrist flexion range. while other outcome measure values given in table 5.3 were not statistically significant (p value >0.05) Hence mean were almost similar decreased for Pair 1,2, and 3 from pre -post values while values increased for pair 4 and 5.Hence according to scoring system of all outcome measures it proved that there was significant improvement in all variables after applying interventions values given in Table 2.

Paired sample t- test was used for pair wise difference of Mean±Std.Deviation,95% interval of confidence LL-LU(lower limit to upper limit)also shows t-value, df ,p-value(2-tailed).In Pair 1 pre-Post Functional Status Scale indicated that true mean difference within a pair between pre and post measurement is not equal to zero. all values were highly significant (<0.001*)Hence proved that there were significant improvement in patients after applying both interventions in reducing symptoms (SSS),improving Hand Function (FSS)in pain reducing (visual analogue sacale)also showed improvement in ROM (wrist flexion and extension Rom).Values presented in table(3)

Table 1: Descriptive analysis of outcome measure between intervention groups :

	Treatment protocol	
	Mean ± S.D	
	Tendon gliding Exercise	**Fore arm stretching**
Pre Functional Status Scale scores	2.53±0.82	2.82±0.84
Post Functional Status Scale scores	1.56±0.82	1.45±0.58
Pre Symptom Severity Scale scores	2.35±0.67	2.62±0.58
Post Symptom Severity Scale scores	1.34±0.54	1.28±0.46
Pre Visual analog scale scores	48.96±17.57	57.23±14.72
Post Visual analog scale scores	6.1±7.50	12.26±17.23
Pre Wrist flexion Range of Motion scores	64.37±8.75	65.45±7.54
Post Wrist flexion Range of Motion scores	74.89±9.6	79.34±4.79
Pre Wrist Extension Range of Motion scores	65.81±3.42	65.0±2.86
Post Wrist Extension Range of Motion scores	70.26±3.95	71.81±2.0

(The mean and standard deviation values for FSS, SSS and VAS decreased while the values for Wrist flexion Range of Motion and Wrist Extension Range of Motion increased after applying the interventions)

Table 2: Between the groups Comparison.(Independent sample T-test analysis)

	t-test for Equality of Means				95% Confidence Interval of the Difference	
	t-value	**df**	**P-value**	**Mean Difference**	**LL**	**UL**
Pre Functional Status Scale scores	-1.28	52	0.20	-0.29	-0.74	0.16
Post Functional Status Scale scores	0.51	52	0.61	0.1	-0.29	0.49
Pre Symptom Severity Scale scores	-1.58	52	0.12	-0.27	-0.62	0.07
Post Symptom Severity Scale scores	0.40	52	0.68	0.05	-0.22	0.33
Pre Visual analog scale scores	-1.87	52	0.06	-8.26	-17.12	0.59
Post Visual analog scale scores	-1.71	35.52	0.09	-6.18	-13.52	1.15
Pre Wrist flexion Range of Motion scores	-0.48	52	0.63	-1.07	-5.54	3.38
Post Wrist flexion Range of Motion scores	-2.15	38.16	0.03*	-4.45	-8.62	-0.26
Pre Wrist Extension Range of Motion scores	0.90	52	0.37	0.78	-0.94	2.49
Post Wrist Extension Range of Motion scores	-1.82	38.74	0.07	-1.56	-3.28	0.17

(P value<0.05: statistical significant value, LL;Lower limit, UL:Upper limit)

Table 3:pair-wise comparison Within the groups (paired samples T-test analysis)

Treatment protocol			Paired Differences			t-value	df	p-value.
			Mean±SD	95% Confidence Interval of the Difference				
				LL	UL			
Tendon gliding Exercise	Pair 1	Pre Functional Status Scale scores - Post Functional Status Scale scores	0.97±0.64	0.72	1.23	7.94	26	<0.001*
	Pair 2	Pre Symptom Severity Scale scores - Post Symptom Severity Scale scores	1.02±0.41	0.85	1.18	12.87	26	<0.001*
	Pair 3	Pre Visual analog scale scores - Post Visual analog scale scores	42.88±17.32	36.03	49.74	12.86	26	<0.001*
	Pair 4	Pre Wrist flexion Range of Motion scores - Post Wrist flexion Range of Motion scores	5.62-10.52	-12.73	-8.29	9.74	26	<0.001*
	Pair 5	Pre Wrist Extention Range of Motion scores - Post Wrist Extention Range of Motion scores	-2.32±4.44	-5.28	-3.59	-10.8	26	<0.001*
Fore arm stretching	Pair 1	Pre Functional Status Scale scores - Post Functional Status Scale scores	1.36±0.65	1.10	1.62	10.91	26	<0.001*
	Pair 2	Pre Symptom Severity Scale scores - Post Symptom Severity Scale scores	1.35±0.57	1.120	1.57	12.26	26	<0.001*
	Pair 3	Pre Visual analog scale scores - Post Visual analog scale scores	44.96±17.13	38.18	51.74	13.63	26	<0.001*
	Pair 4	Pre Wrist flexion Range of Motion scores - Post Wrist flexion Range of Motion scores	6.90±13.89	-16.621	-11.156	-10.44	26	<0.001*
	Pair 5	Pre Wrist Extention Range of Motion scores - Post Wrist Extention Range of Motion scores	2.70-6.78	-7.84	-5.706	-13.0	26	<0.001*

("*"indicates statistical significant values, LL: Lower limit, UL:upper limit, df: degree of freedom)

DISCUSSION

Currently several conservative ,non operative ,non invasive and other exercise protocols are in practice to treat Carpal tunnel syndrome based on what we know thus far Since no prior research was undertaken, several studies have been published to assess its effectiveness. uch interventions for CTS[21,22].There is still scarcity of evidence about which protocol is appropriate one .Most of studies used manual therapies other used amalgamation of maneuvers to treat carpal tunnel syndrome which require admittance to specialized care that can be applied only by clinician but not by patient independently making it unfeasible for patients to do their self care.[23-26]

As far as we were aware no previous research has been undertaken appropriately to compare theses two protocols to treat CTS especially in Pakistan .

When we consulted the literature concerning the effects of stretching and tendon gliding exercises, significant improvement was observed in many parameters including mass and strength, a scale for symptom severity, and a measure for functional status [27,28]. All these indicators significantly improved in our research. with their additional significant effects on wrist Range of motion in both groups..[29]

An Indonesian research was also done to see the effects of different exercise in combination.[30]But this research was unclear about the individual improvement by these two intervention group as only BCTQ and NPR was used to evaluate the combined efficacy. In current investigation we used,Goniometery to see the effect on hand ROM and VAS scale in addition to BCTQ that proved most validate about their efficacy.

Another investigation compared tendon gliding exercise with nerve gliding exercise while giving conventional treatment in both groups.It proved that tendon gliding is more effective than nerve gliding being significantly effective in FSS.[31]In contrast our results proved stretching can be equally and slightly more effective than tendon gliding especially in improving ROM.

In turkey an research was done to compare the therapeutic effect of tendon gliding exercise in combination of other conventional treatments ,result was not much statistically significant and their investigation was restricted to females only.[16] while in our research we saw the effects of intervention on both gender..

USA evaluated the effect of stretching in an investigation for the purpose of treating Carpal Tunnel Syndrome.Although there was a significant improvement by this intervention their sample size was limited 17 patient in one group and 19 in other one.[18]In our study we compare stretching with another effective exercise tendon glidings (proved by many other researches)on a large sample size as compared to their research .our research confirmed the equal effectiveness of both reporting more effects of stretching on ROM wrist.

Limitations: Outcomes of our research were only applicable to patients with mild to severe CTS. Therefore, these findings cannot be extrapolated to other severe CTS.There was no control group in our study.

Recommendations: For severe and post-operative CTS conditions, additional associated investigations are advised. Control group might be involved for more appropriate comparison.

.CONCLUSION

Our study concluded that both Flexor tendon gliding exercise and Fore arm stretching proved equally effective in reducing pain, symptoms severity, improving function status, and wrist extension,ROM

In contrast to Tendon gliding exercise, Fore arm stretching contributed more beneficial impact in improving wrist flexion range of motion.

Conflict of interest:

There was no any conflict of interest.

Financial Statement:

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Data Availability:

Data will be provided on the demand by corresponding author.

REFERENCES

1.Guan W, Lao J, Gu Y, et al. Case-control study on individual risk factors of carpal tunnel syndrome. 2018; **15**(3): 2761-6.

2.Urits I, Gress K, Charipova K, et al. Recent advances in the understanding and management of carpal tunnel syndrome: a comprehensive review. 2019; **23**(10): 1-8.

3.Hulkkonen S, Shiri R, Auvinen J, et al. Risk factors of hospitalization for carpal tunnel syndrome among the general working population. 2020.

4.Lund CB, Mikkelsen S, Thygesen LC, Hansson G-Å, Thomsen JFJO, medicine e. Movements of the wrist and the risk of carpal tunnel syndrome: a nationwide cohort study using objective exposure measurements. 2019; **76**(8): 519-26.

5.Wilson J, Sevier TJD, rehabilitation. A review of treatment for carpal tunnel syndrome. 2003; **25**(3): 113-9.

6.Wipperman J, Goerl KJAfp. Carpal tunnel syndrome: diagnosis and management. 2016; **94**(12): 993-9.

7.Caliandro P, La Torre G, Aprile I, et al. Distribution of paresthesias in carpal tunnel

syndrome reflects the degree of nerve damage at wrist. 2006; **117**(1): 228-31.
8.Eslami S, Fadaei B, Baniasadi M, Yavari PJAJoC, Immunology E. Clinical presentation of carpal tunnel syndrome with different severity: a cross sectional study. 2019; **8**(4): 32.
9.Padua L, Coraci D, Erra C, et al. Carpal tunnel syndrome: clinical features, diagnosis, and management. 2016; **15**(12): 1273-84.
10.Barcenilla A, March LM, Chen JS, Sambrook PNJR. Carpal tunnel syndrome and its relationship to occupation: a meta-analysis. 2012; **51**(2): 250-61.
11.Kim S-DJJopts. Efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome: a systematic review of randomized controlled trials. 2015; **27**(8): 2645-8.
12.Lee HS, Park SB, Lee SH, Chung YS, Yang H-J, Son Y-JJTN. The effect of cervical radiculopathy on the outcome of carpal tunnel release in a patient with carpal tunnel syndrome. 2015; **1**(1): 11-4.
13.Piazzini DB, Aprile I, Ferrara PE, et al. A systematic review of conservative treatment of carpal tunnel syndrome. 2007; **21**(4): 299-314.
14.Ali A, Sh NUHJJoPOA. The Carpal Tunnel Syndrome: An experience in District and Tertiary Care Hospital Karachi. 2014; **26**(2): 4-.
15.Abdolrazaghi HA, Khansari M, Mirshahi M, Ahmadi Pishkuhi MJH. Effectiveness of tendon and nerve gliding exercises in the treatment of patients with mild idiopathic carpal tunnel syndrome: A randomized controlled trial. 2021: 15589447211006857.
16.Baysal O, Altay Z, Ozcan C, Ertem K, Yologlu S,Kayhan AJIjocp. Comparison of three conservative treatment protocols in carpal tunnel syndrome. 2006; **60**(7): 820-8.
17.Michlovitz SLJJoo, therapy sp. Conservative interventions for carpal tunnel syndrome. 2004; **34**(10): 589-600.
18.Shem K, Wong J, Dirlikov BJJoHT. Effective self-stretching of carpal ligament for the treatment of carpal tunnel syndrome: a double-blinded randomized controlled study. 2020; **33**(3): 272-80.
19.Wehbé MAJTAJoOT. Tendon gliding exercises. 1987; **41**(3): 164-7.
20.Walker B. The stretching handbook: The Stretching Institute; 2007.
21.Wolny T, Saulicz E, Linek P, Myśliwiec A, Saulicz MJJoHT. Effect of manual therapy and neurodynamic techniques vs ultrasound and laser on 2PD in patients with CTS: A randomized controlled trial. 2016; **29**(3): 235-45.
22.Khosrawi S, Dehghan FJJoRiMSTOJoIUoMS. Determination of the median nerve residual latency values in the diagnosis of carpal tunnel syndrome in comparison with other electrodiagnostic parameters. 2013; **18**(11): 934.
23.Burke DT, Burke MM, Stewart GW, Cambré AJAopm, rehabilitation. Splinting for carpal tunnel syndrome: in search of the optimal angle. 1994; **75**(11): 1241-4.
24.Burnham T, Higgins DC, Burnham RS, Heath DMJJoOM. Effectiveness of osteopathic manipulative treatment for carpal tunnel syndrome: a pilot project. 2015; **115**(3): 138-48.
25.FINESTRONE H, Woodbury GM, Collavini T, Marchuk Y, Maryniak OJM, nerve. Severe carpal tunnel syndrome: clinical and electrodiagnostic outcome of surgical and conservative treatment. 1996; **19**(2): 237-9.
26.Gelberman R, Aronson D, Weisman MJTJoB, Volume JsA. Carpal-tunnel syndrome. Results of a prospective trial of steroid injection and splinting. 1980; **62**(7): 1181-4.
27.Sheereen FJ, Sarkar B, Sahay P, et al. Comparison of Two Manual Therapy Programs, including Tendon Gliding Exercises as a Common Adjunct, While Managing the Participants with Chronic Carpal Tunnel Syndrome. 2022; **2022**.
28.Marryam M, Yasmeen R, Malik TM, Malik AN,Amjad IJP. A comparision of the effectiveness of neurodynamics versus nerve and tendon gliding exercises alone for carpal tunnel syndrome. 2018; **68**(4): 924-29.
29.Hesami O, Haghighatzadeh M, Lima BS, Emadi N, Salehi SJJoer. The effectiveness of gabapentin and exercises in the treatment of carpal tunnel syndrome: a randomized clinical trial. 2018; **14**(6): 1067.
30.Anggraini C, Astari RWJJHS. Efektivitas Wrist Stretching, Tendon and Nerve Gliding Exercise dalam Menurunkan Nyeri dan Meningkatkan Fungsional Wrist pada Kasus Carpal Tunnel Syndrome. 2021; **2**(11): 1434-8.
31.Horng Y-S, Hsieh S-F, Tu Y-K, et al. The comparative effectiveness of tendon and nerve gliding exercises in patients with carpal tunnel syndrome: a randomized trial. 2011; **90**(6): 435-42.

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