

Effect of Tendon Gliding Exercises with Grip Strengthening Exercises on Quality of Life in Patients with Unilateral Carpal Tunnel Syndrome: An Experimental Study

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Abstract: Background: 1 in 5 symptomatic subjects are expected to have Carpal Tunnel Syndrome (CTS), which has a negative effect on grip strength. Tendon-Gliding (TG) enhances blood flow, decreases tunnel pressure, and prevents the resistance of longitudinal/transverse tensile stresses with Grip-Strengthening (GS) this study will focus on Functional benefit in terms of Quality-Of-Life (QOL) as it is an important domain in daily living. Aim: To find the combined effect of TG and GS to improve the QOL in CTS patients. Methodology: 34 patients were selected based on the inclusion criteria, and informed written consent was taken. Pre and Post-treatment all 3 outcomes were measured. Patients were given TG, GS, and conservative treatment for 5 days/week for 3 weeks. Outcome measures: Pre and Post-treatment all 3 outcome measures BCTQ, Grip Strength, and EQ-5D-5L (for QOL) measured. Results: There was a significant improvement in Functional Status Score (FSS), Symptom-Severity Score (SSS), and Grip Strength at the end of treatment ($p < 0.05$). A comparison of data revealed significant improvements in the physical domain of EQ-5D-5L which might lead to a better QOL. Conclusion: The treatment combinations were significantly effective at 3 weeks of treatment duration. Overall, results suggest that a combination of TG, GS, and Ultrasound Therapy is a preferable and efficacious conservative type of treatment in CTS.

Keywords: Tendon Gliding, Grip Strengthening, Boston Carpal Tunnel Questionnaire, EQ5D5L

1. Introduction

Carpal tunnel syndrome is an entrapment neuropathy that can significantly affect a patient's quality of life.¹ CTS is the most common peripheral neuropathy, which affects 1% of the general population. Occurring more frequently in middle or advanced age, with 83% of 1215 study patients were older than 40 years, mean age of 54 years. The frequency of women affected is twice that of men. The cause of CTS is the compression of the median nerve at the wrist. Characteristics of the clinical syndrome- pain, numbness, or tingling in the distribution of the median nerve that supplies the palmar aspect of the thumb, index, and long finger. Symptoms may affect all or a combination of the thumb, index, long, and ring fingers. The common symptoms are pain and paraesthesia at night located in the palmar aspect of the hand. The prevalence of nocturnal symptoms is believed to be prolonged flexion or extension of the wrists under the patient's head or pillow during sleep. Conditions altering fluid balance are pregnancy, use of oral contraceptives, and haemodialysis, and may predispose to CTS, carpal tunnel syndrome in pregnancy is transitory and typically resolves spontaneously.²

Grip Strength

Causes of reduced hand strength in carpal tunnel syndrome are: Muscle tension-related grip strength loss may be a result of the loss of metacarpophalangeal (MCP) joint flexion power from de-innervation of the first and second lumbricals. CTS patients often have tightness of the lumbrical muscles that causes increased resistance/drag into extension. This prevents the distal interphalangeal (DIP)

and proximal interphalangeal (PIP) joints from achieving strong flexion. Another cause of strength reduction includes sensory disruption commonly seen in carpal tunnel syndrome which reduces the ability to accurately regulate force production. Compared to normative data patients with carpal tunnel syndrome have moderate to large deficits in grip strength.³

Gliding

CTS pathophysiology involves a combination of physiological/pathological processes that leads to chronic compression and ischemic damage to the median nerve which results in developing adhesions in the median nerve and loses its ability to "glide freely" during movements of the wrist joint within the carpal tunnel.⁴ According to Clark WL, et al. - Slow elongation of nerves has been shown to cause remodeling adaptations in myelin and axon regeneration and degeneration.⁵ Application of gliding exercises may influence "adhesion stretch in the carpal tunnel, which broadens at the transverse carpal ligament the longitudinal area of contact between the median nerve, this reduces tenosynovial edema and improves venous return from the nerve bundles, reducing the pressure inside carpal canal."⁶

Quality of Life (QOL)

There exist variety of functions of our hands, which includes activities of daily living and performance in job, which can be restricted by carpal tunnel syndrome and can have a negative effect on a patient's QOL.⁷ Activities of daily living (such as driving a car, holding a cup, and typing) aggravate pain.²

Ultrasound (US) is assumed to have thermal effects on the target tissue that results in an increase in blood flow, local metabolism and tissue regeneration and also reduces inflammation, oedema and pain, thereby facilitates the nerve compression recovery. Numerous clinical studies have described the effectiveness of ultrasound in different types of musculoskeletal disease to relieve pain. However, few studies report benefit of the ultrasound treatment in carpal tunnel syndrome under certain clinical conditions.⁷

2. Problem statement

Every 1/5 symptomatic (pain, numbness, and tingling in hands) subjects are expected to have carpal tunnel syndrome, an earlier literature describes that there are moderate to large deficits of grip strength and tendon gliding has a positive effect. However, as there is a lack of evidence the purpose of this study is to find the combined effect of tendon gliding and grip strengthening exercise and its functional benefit in terms of quality of life which is an important domain in daily living for patients with carpal tunnel syndrome.

3. Objectives

- 1) To find out the effect of grip strengthening exercises on the functional status of patients with carpal tunnel syndrome.
- 2) To find out the combined effect of tendon gliding exercises and grip strengthening exercises on quality of life in patients with carpal tunnel syndrome.

4. Materials and Methodology

Consent form, Chair with armrest, Gel ball, and Digital Hand dynamometer

4.1 Methodology

Type of study: Experimental study

Study duration: 6 months

Type of sampling: Purposive sampling.

Study setting: Tertiary care hospitals, Miraj

Inclusion Criteria

- 1) Age 18 - 40 years

- 2) Both males and females
- 3) Subjective symptoms such as pain and / or numbness within the median nerve distribution of digits.
- 4) Either a positive Phalen’s test or positive Tinel’s sign
- 5) Positive flick sign
- 6) Persons with mild to moderate unilateral carpal tunnel syndrome

Exclusion Criteria

- 1) Wrist trauma or arm fracture
- 2) Any radiculopathies
- 3) Peripheral polyneuropathy
- 4) Presence of underlying medical disorders like Diabetes mellitus, Renal failure

5. Outcome Measures

5.1 Boston Carpal Tunnel Questionnaire (BCTQ):

Although the results of BCTQ are based on subjective assessment, the questionnaire is highly reliable and valid and can be used as a tool for evaluating and analyzing a number of carpal tunnel studies. The Boston Questionnaire is highly reliable and can replace any other non-standard methods for assessing carpal tunnel syndrome severity.⁸For Symptom Severity Scale (SSS), ICC= 0.89 and for Functional Status Scale (FSS), ICC = 0.91

Boston Carpal Tunnel Questionnaire (BCTQ) The BCTQ comprises two subscales. The SSS yields PRO data on the level of symptoms, while the FSS assesses the level of hand function. The SSS consists of 11 items assessing pain, paresthesia, numbness, weakness, nocturnal symptoms, and difficulty grasping. The FSS contains eight items, which assess functional deficits in the following domains: writing, buttoning clothes, holding a book while reading, gripping a telephone handle, opening jars, performing household chores, carrying grocery bags, bathing, and dressing.

Interpretation

Each item is scored from 1 (no symptoms/difficulties) to 5 (the worst symptoms/cannot perform the activity at all). The mean score for each scale is calculated, resulting in a score between 1 and 5, with higher scores indicating worse symptoms or function.⁹

Symptom severity scale (11 items):

		1	2	3	4	5
1.	How severe is the hand or wrist pain that you have at night?	Normal	Slight	Medium	Severe	Very serious
2.	How often did hand or wrist pain wake you up during a typical night in the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
3.	Do you typically have pain in your hand or wrist during the daytime?	No pain	Slight	Medium	Severe	Very serious
4.	How often do you have hand or wrist pain during the daytime?	Normal	1-2 times / day	3-5 times / day	More than 5 times	Continued
5.	How long on average does an episode of pain last during the daytime?	Normal	<10minutes	10~60 Continued	>60minutes	Continued
6.	Do you have numbness (loss of sensation) in your hand?	Normal	Slight	Medium	Severe	Very serious
7.	Do you have weakness in your hand or wrist?	Normal	Slight	Medium	Severe	Very serious
8.	Do you have tingling sensations in your hand?	Normal	Slight	Medium	Severe	Very serious
9.	How severe is a numbness (loss of sensation) or tingling at night?	Normal	Slight	Medium	Severe	Very serious
10.	How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
11.	Do you have difficulty with grasping and use of small objects such as keys or pens?	Without difficulty	Little difficulty	Moderately difficulty	Very difficulty	Very difficult

Functional status scale (8 items):

	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform the activity at all due to hands and wrists symptoms
1. Writing	1	2	3	4	5
2. Buttoning of clothes	1	2	3	4	5
3. Holding a book while reading	1	2	3	4	5
4. Gripping of a telephone handle	1	2	3	4	5
5. Opening of jars	1	2	3	4	5
6. Household chores	1	2	3	4	5
7. Carrying of the grocery basket	1	2	3	4	5
8. Bathing and dressing	1	2	3	4	5

5.2 Dynamometer

Method

When grip is measured, the arm should be at the patient’s side with elbow flexed at approximately 90 degrees and the forearm in neutral. The wrist should be at neutral but no more than 30 degrees of extension or 15 degrees of ulnar deviation. Both hands are tested alternately, and each force is recorded. Care must be taken to ensure that the patient does not fatigue. Usually, the first or second attempt is the strongest of the series. Reset the dial to zero after each attempt. Encourage the patient to squeeze as hard as possible. Record three squeezes for each hand, alternating hands. Record the mean of the three attempts.¹⁰



5.3 Quality of life - EQ-5D-5L

The EQ-5D-5L is a self-assessed, health related, quality of life questionnaire. The scale measures quality of life on a 5-component scale including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each level is rated on scale that describes the degree of problems in that area (i.e. I have no problems walking about, slight problems, moderate problems, severe problems, or unable to walk). This tool also has an overall health scale where the rater selects a number between 1-100 to describe the condition of their health, 100 being the best imaginable. Convergent validity was demonstrated by a correlation between EQ-5D-5L and the dimensions of WHO 5, (r=.43).¹¹ The Euro-Quol approach is reliable, average test re-test reliability using inter-class coefficients with mean of 0.78 and 0.73.¹²

	MOBILITY	SCORE
1.	I have no problems in walking about	
2.	I have slight problems in walking about	
3.	I have moderate problems in walking about	
5.	I have severe problems in walking about	
6.	I am unable to walk about	
	SELF-CARE	
1.	I have no problems washing or dressing myself	
2.	I have slight problems washing or dressing myself	
3.	I have moderate problems washing or dressing myself	
4.	I have severe problems washing or dressing myself	
5.	I am unable to wash or dress myself	
	USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)	
1.	I have no problems doing my usual activities	
2.	I have slight problems doing my usual activities	
3.	I have moderate problems doing my usual activities	
4.	I have severe problems doing my usual activities	
5.	I am unable to do my usual activities	
	PAIN / DISCOMFORT	
1.	I have no pain or discomfort	
2.	I have slight pain or discomfort	
3.	I have moderate pain or discomfort	
4.	I have severe pain or discomfort	
5.	I have extreme pain or discomfort	
	ANXIETY / DEPRESSION	
1.	I am not anxious or depressed	
2.	I am slightly anxious or depressed	
3.	I am moderately anxious or depressed	
4.	I am severely anxious or depressed	
5.	I am extremely anxious or depressed	

The best health you can imagine

<ul style="list-style-type: none"> • We would like to know how good or bad your health is TODAY. • This scale is numbered from 0 to 100. • 100 means the best health you can imagine. • 0 means the worst health you can imagine. • Mark an X on the scale to indicate how your health is TODAY. • Now, please write the number you marked on the scale in the box below. 	
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The worst health you can imagine

You're Health Today = _____

5.4 Physical examination

Phalen’s test

Sensitivity – 85%, Specificity – 90

The patient places her flexed elbows on a table, allowing her wrists to fall into maximum flexion. The patient is asked to push the dorsal surface of her hands together

and hold this position for 30-60 seconds. This position will increase the pressure in the carpal tunnel, in effect compressing the median nerve between the transverse carpal ligament and the anterior border of the distal end of the radius. **Positive test:** Phalen's test is considered positive when the patient's symptoms are reproduced; test gives the same symptoms as that experienced with carpal tunnel syndrome, namely paresthesia (burning, tingling and numbness) in the distribution of the median nerve. **Negative test:** Patient feels no pain or any other symptom, even if the motion is maintained for three minutes or longer.

Tinel's sign

Sensitivity – 62%, Specificity – 93%

It is performed by lightly tapping (percussing) over the nerve to elicit a sensation of tingling or "pins and needles" in the distribution of the nerve. The Tinel sign is the tingling or prickling sensation elicited by the percussion of an injured nerve trunk at or distal to the site of the lesion. The sign also indicates nerve regeneration. **Positive test:** The test is positive when a tingling or prickling sensation is felt in the distribution of the nerve.

Intervention

Tendon gliding exercises:

Start with the fingers straight every time while doing these exercises. Make a tabletop with the fingers by keeping them straight and then bending only at the wrist and at the knuckles. Relax and repeat.

Make each type of fist, one at a time, with your fingers.

- 1) Hook Fist
- 2) Straight Fist
- 3) Full Fist

- 4) Straight Fist
- 5) Platform Position

Curl your thumb into your palm as far as possible then stretch it out as far as possible.

By Wehbe and Hunter,

During these exercises, the neck and shoulder should be in the neutral position, elbow in supination and 90 degrees of flexion. Each position was maintained for 5 seconds, 10 times in each session, 5 sessions daily for 3 weeks.¹³

Grip strengthening exercises

- 1) Egg ball grip (Wrist down) - Grip the egg ball in the palm. Turn hand out so it faces up. Squeeze the egg ball with your palm.
- 2) Pinch - Place egg ball between the thumb and index finger. Squeeze together.
- 3) Side squeeze - Place egg ball between any two fingers. Squeeze the two fingers together.
- 4) Extend out - Place egg ball on a table. Put tips of the fingers on the egg. Roll the egg ball outward on the table. Repeat.
- 5) Grab - Place egg ball between two fingers. Squeeze the two fingers together.
- 6) And squeeze the thumb slowly. Repeat. Try not to drop the egg ball.
- 7) One by one - Place egg ball in the palm of the hand with only one finger pressed into the egg ball. Hold and relax. Repeat. Switch the fingers one by one. Repeat
- 8) Opposition - Place egg ball in the palm of the hand. Keep between thumb and finger being exercised. Squeeze thumb and finger together.
- 9) Finger bend - Place egg ball in the palm of the hand with fingers pressed into the egg ball. Push fingers into the egg ball as if you are bending your fingers.

After each exercise, hold, relax and repeat for 10 times in one session. 3 sessions daily for 3 weeks.



Ultrasound

Ultrasound treatment was administered 15 min per session to the palmar carpal tunnel area at a frequency of 1 MHz and

intensity of 1.0 W/cm², pulsed mode 1:4, with a transducer of 5 cm² and with aquasonic gel as the couplant. A total of 15 ultrasound treatments were performed once a day, five times a week, for 3 weeks.⁷



means and standard deviations were calculated for each parameter. The significance level was defined as $P < 0.05$.

6. Results

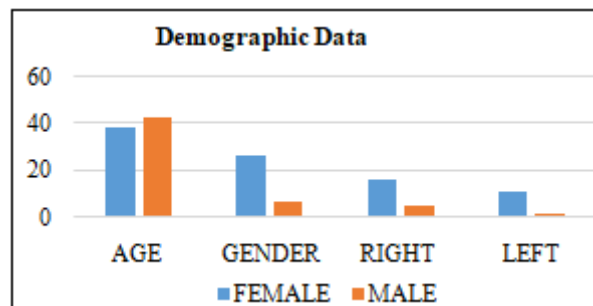
Thirty four patients with unilateral carpal tunnel syndrome (34 wrists) fulfilled all inclusion criteria. Thirty-four wrists were treated with tendon gliding exercises, grip strengthening exercises with ultrasound therapy and completed a 3-week treatment protocol. The demographic characteristics and basic information about the patients are presented in Table 1. The study involved thirty-four patients with carpal tunnel syndrome (27 women, 7 men; mean age 39.67 ± 6.5 years). The comparison of mean values of variables in the group, before treatment and after end of treatment at 3rd week are summarized in Table 2 and 3. Measures of grip strength showed significant improvement in the group at 3 weeks follow-up ($p < 0.05$) Table 2. There was significant improvement in functional status score and symptom-severity score at the end of the treatment follow-up in group ($p < 0.05$). A comparison of the initial and follow-up data revealed significant improvements in the physical domain of EQ 5D 5L in the group which might lead to a better quality-of-life Table 3.

Statistics

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software 23. Symptom Severity Scale, Functional Status Scale, Grip Strength, and the five domains of the EQ5D5L pre-treatment and post-treatment values were compared within group using paired t-tests. The

Table 1: Demographic Characteristics

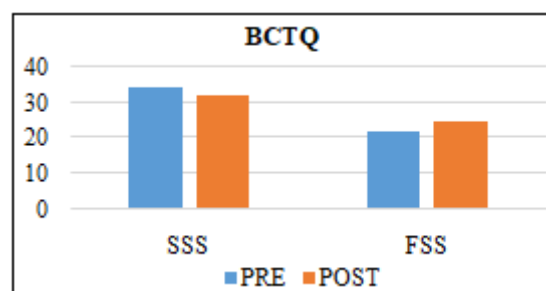
Variable	Female	Male
Age (Years) Mean \pm SD	38.92 ± 6.78	42.57 ± 3.28
Gender	27	7
Affected Side		
Right	16 (59.2)	5 (71.4)
Left	11 (40.7)	2 (28.5)



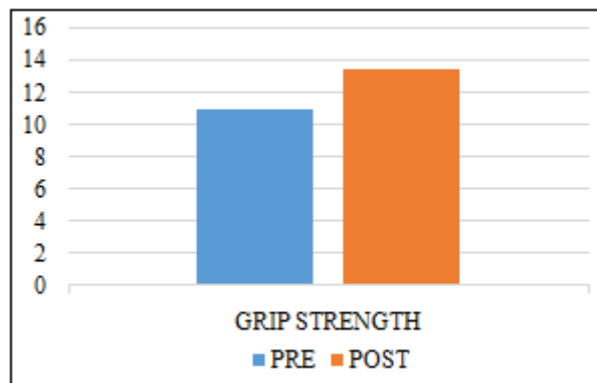
Graph 1: Demographic Characteristics

Table 2: Mean and Standard Deviation Values of Variables

Variable	PRE Mean \pm SD	POST Mean \pm SD	P value	T stat
BCTQ				
SSS	34.33 ± 2.23	31.14 ± 2.18	0.001	3.44
FSS	21.91 ± 3.63	24.58 ± 3.20	0.005	2.97
Grip Strength	10.97 ± 2.25	13.54 ± 3.34	0.0006	3.7



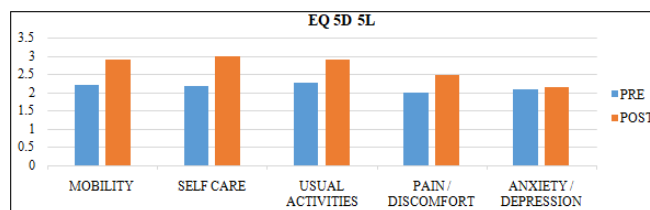
Graph 2: Pre and Post BCTQ



Graph 3: Pre and Post Grip Strength

Table 3: Mean and Standard Deviation of EQ5D5L

	EQ5D5L	PRE Mean ± SD	POST Mean ± SD	P value	T stat
1.	Mobility	2.23 ± 0.90	2.91 ± 0.85	0.14	1.48
2.	Self Care	2.20 ± 0.75	3 ± 0.84	0.002	5.72
3.	Usual Activities	2.29 ± 0.85	2.91 ± 0.74	0.01	4.05
4.	Pain/ Discomfort	2 ± 0.84	2.55 ± 0.73	0.01	3.79
5.	Anxiety/ Depression	2.11 ± 0.83	2.17 ± 0.95	0.01	0.34



Graph 3: Pre and Post EQ5D5L

Result from the Analysis

The final analysis proves that there is significant difference between the baseline and after treatment values. The mean value of BCTQ and Grip Strength indicated changes post treatment and higher values are recorded for post treatment outcome and also the standard deviation shows the limited consistency with post treatment value which is more than the pre value. Based on the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values when p-value is less than the 5% significance level(i.e. < 0.05) in the study and therefore it justifies the improvements in health outcome post intervention.

This states that the techniques which are tendon gliding exercise with grip strengthening exercise have good reliability in terms of rehabilitation. A comparison of the initial and follow-up data revealed significant improvements in the grip strength scores in the group. The p value of the symptom severity score were <0.05. Significant improvements in functional status scores < 0.05. Moreover, scores in the self-care, usual activities, pain and anxiety domain of the EQ5D5L (Table 3). Thus, the observed improvements in symptoms and functioning were more prominent, which might lead to a better quality of life.

The result of this study emphasizes the efficacy of conservative treatment in carpal tunnel syndrome. To improve the functional status and quality of life of patients with carpal tunnel syndrome, the combination of tendon

gliding exercises, grip strengthening exercises and ultrasound treatment might be more effective.

7. Discussion

In this study, the mean change in the Boston carpal tunnel questionnaire score in symptom severity was 3.19, which can be considered a clinically meaningful improvement in health-related quality-of-life. There was also a significant difference in the mean change of the functional status score 2.67 which indicates that patients who performed tendon gliding exercises experienced greater improvements in their functional status and in the physical aspects of quality-of-life.

Rather than being a steady progressive disorder, carpal tunnel syndrome could be a condition characterised by remissions and exacerbation. In several cases, the symptoms will be managed non-surgically. It is probable that a precise share of patients can have resolution of their symptoms with ancient treatment strategies.¹⁴

Tendon gliding exercises may improve the longitudinal excursion of the median nerve because they could provide maximum differential gliding for both flexor tendons, it is important to prevent the formation of adhesions. Maximum differential gliding for both flexor tendons are provided by three of the positions described. With the straight-fist position, the superficialis tendon achieves maximum gliding in respect to skeletal muscle sheath and bone. With the fist position, the profundus tendon achieves its own maximum

gliding in respect to sheath and bone and conjointly provides a decent quantity of gliding over the superficialis tendon. Lastly, in the hook position, between the two flexor tendons maximum gliding is achieved.¹³

Previous studies have not looked at the effect of stretching on the median nerve as in vivo it is tethered at the point of maximal compression. Due to the compression from the overlying transverse carpal ligament and adhesions between the median nerve and surrounding structures the nerve may stretch, excursion of flexor tendon is nearly five times greater than that of the nerve. Guiding the wrist and the fingers through a program of tendon gliding exercises may help maximize the relative median nerve excursion in the carpal tunnel and the excursion of the flexor tendons relative to one another. Remodelling and stretching of the investing, adhesive tenosynovium around these structures may occur when the exercises are performed, thus diminishing their adherence to the structures inside the canal. In addition, by bringing the nerve through its maximal excursion, there may be redistribution of the point of maximal compression on the median nerve inside the carpal canal varying points of the nerve are exposed to the maximal compressive area underneath the transverse carpal ligament. Venous return from the median nerve would be promoted by the "milking" effect, thus decreasing the pressure inside the perineurium. The linear relationship between median nerve and flexor tendon displacement may be restored by increasing the motion of the median nerve.¹⁴

There are no reported adverse effects associated with the use of tendon and nerve gliding exercises in the treatment of carpal tunnel syndrome.¹⁵

The results of this study suggest that a program of tendon gliding exercises coupled with grip strengthening and ultrasound reduces symptoms.

Strength is also a vital factor in limiting the cellular injury that happens from repetitive motion and increasing muscular strength by exercise training can have a protecting effect against injury like carpal tunnel disease.¹⁶

LEGG'S, et.al. 2018 participants were trained with the Powerball thrice per week for four weeks, and every session lasted for five minutes using the Powerball showed an overall increase in grip strength, and therefore the device might have possible benefits as a rehabilitative tool for the wrist joint and arm.

RANDOLPH, et.al. 2000 a significant increase in strength was observed following 6 weeks of exercise training.

SEHER Ü, et.al. 2018 the grip strength of all the patients significantly improved. As is understood, patients with HD try and defend their hands with a fistula and barely move their hands throughout dialysis treatment. Using the ball might also facilitate help carpal tunnel syndrome. Thus, this exercise ball may be used as a conservative treatment in mild carpal tunnel syndrome before attempting the other non-operative treatment type as steroids injection and can take place within the current treatment type of mild carpal tunnel syndrome in patients with HD.¹⁶

SZUMSKI, et.al. 1960 summarized the effects of ultrasound on nervous tissue as follows: it selectively heats peripheral nerves, may alter or block impulse conduction and may increase membrane permeability and tissue metabolism. He pointed out that any of the above-mentioned mechanisms may be due to the thermal effect of ultrasound and may cause pain relief. There is an inverse relationship between fibre size and sensitivity to ultrasound: the smallest C fibers are more sensitive, and the larger A fibers are less affected. This selective absorption by smaller fibers may allow a decrease in pain transmission. Ultrasound could elicit anti-inflammatory and tissue stimulating effects. In this way, ultrasound has the potential to accelerate normal resolution of inflammation.

O BAYSAL, et.al. 2006 The result of the study confirms that ultrasound may accelerate the healing process in damaged tissues. These mechanisms may explain the findings including pain relief, increased grip and pinch strength, improvement in functional status and symptom severity scale in carpal tunnel syndrome patients treated with ultrasound.⁷

Clinical implications in physiotherapeutic treatment:

- The major use of this treatment is in home exercise protocol and it can also be included in daily physiotherapeutic treatment as well.
- As tendon gliding and grip strengthening exercise along with ultrasound treatment can be given as conservative treatment, we can accelerate the healing process in damaged tissues, initiate pain relief, increase grip strength in patients with carpal tunnel syndrome.
- This protocol may be used as a conservative treatment in mild to moderate carpal tunnel syndrome before attempting the other non-operative type of treatment.
- Therefore, it can be included in Rehabilitation for patients who is advised for reducing symptom severity status, improving functional status in the physical aspects of quality-of-life.

8. Conclusion

- The treatment combinations were significantly effective at 3 weeks of treatment duration. Overall, our results suggest that a combination of tendon gliding exercise, grip strengthening exercise and ultrasound therapy is a preferable and an efficacious conservative type of treatment in carpal tunnel syndrome.
- This exercise treatment demonstrated no absolute contraindications, significant decrease in carpal tunnel syndrome symptoms, and improvement in functional status of patients.
- The strengths of this study were reliable and valid outcome measures. The additional benefits of this treatment are being self-administered, low cost, and practical. These are the advantages of this exercise to prefer before other alternative treatments.

9. Limitations

- Proper distribution of males and females can be done.

- The compliance to the exercise might be potentially biased as we did not know how often and how regularly the patients performed the exercises.
- The study results were related only to patients with mild-to-moderate carpal tunnel syndrome. Thus, these results cannot be generalized to patients with severe carpal tunnel syndrome.

10. Future Scope

- Study can be done in population with bilateral carpal tunnel syndrome.
- Study can be done to compare male and female.
- Study can be done on larger population.
- Study can be done for a longer period of duration.
- Future research should assess for these differences prospective.

Acknowledgement

Praise and Glory to the God Almighty who is the source of my strength, foundation of my knowledge and the source of inspiration in every walk of life.

I take this wonderful opportunity to thank all the “HANDS” which have joined together to make this project a SUCCESS. It's my great pleasure and privilege to express my deep-felt gratitude to respected Guide **Dr. Harshada R. Patil**, Associate Professor, Department of Musculoskeletal Physiotherapy who immensely helped me and rendered their advice, precious time, constant encouragement, knowledge and relevant information regarding my study, and whose suggestion and guidance has enlightened me on this subject. I express my sincere thanks to *all the teaching & non-teaching staff* of the Miraj Medical Centre, College of Physiotherapy. Above all, I would like to thank my parents for their blessings, love, constant support, affection and encouragement.

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Author Profile



Grace John Barla, was born on 17th of December in the year 1998, did her bachelorette from College of Physiotherapy, Wanless Mission Hospital, Miraj Medical Centre. She learnt the term 'physiotherapy' at a young age as her grandmother was a chronic stroke patient. She regularly accompanied her to a therapist. The skill of the

physiotherapist with the impatient grandmother led to her increased interest in the profession. After one year of treatment, Grace saw an improvement in her functional status, and she resolved to pursue this as her career path. After gaining theoretical and practical experience, she realized that she wanted to study musculoskeletal physiotherapy in-depth to continue her research into this fascinating field. Grace has researched to find and is convinced that this field has great potential in treating and rehabilitating patients.



Dr. Harshada R. Patil, is an Associate Professor from the Department of Musculoskeletal Physiotherapy in Miraj Medical Centre, College of Physiotherapy, Wanless Mission Hospital and has known Grace John Barla since 2017 when she began her Bachelor's degree

in Physiotherapy. She taught her Electrotherapy in her first and second years. In her third year, she educated her on the subjects of Functional Diagnosis and Physiotherapeutic Skills. Thereafter, she tutored Grace on the topic of Musculoskeletal Physiotherapy and Synopsis in her fourth year. Currently, she has been her mentor for the Research in Internship