Comparing the Effect of Combined Therapy of Extracorporeal Shock Wave Therapy and Ice Massage with Combined Therapy of Therapeutic Ultrasound with Paraffin Wax Bath in Treating Trigger Finger

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Abstract

Introduction: Trigger finger is a common hand disorder characterized by locking, catching, or clicking with range of motion of the affected finger. Purpose: The aim of this study was to compare the effectiveness of combined therapy of extracorporeal shockwave therapy (ESWT) and ice massage to the combined therapy of therapeutic ultrasound (US) and paraffin wax bath in treating trigger finger. Method: 19 patients were assigned to the US + wax bath group while the remaining 10 were assigned to ESWT + ice massage group. The effectiveness of the treatment was assessed using visual analog scale (VAS) to measure pain score and Quick-Disabilities of the Arm, Shoulder, and Hand (Quick DASH) questionnaire to assess the functionality of the affected limb at 1st, 2nd, 3rd and 4th week after the initial treatment. Results: The US + wax bath group had reduced more pain and improved more hand function than the ESWT + ice massage group for all visits. Conclusion: This study was not able to prove the hypothesis that ESWT + ice massage group was better than US + wax bath in treating trigger finger. However, a similar study like this but with larger sample size, individualized protocols for ESWT participants, longer study durations and conducted by experts in ESWT is able to show which treatment is better in treating trigger finger.

Keywords: *Trigger finger, shockwave therapy, ultrasound, paraffin wax bath, ice massage.*

Introduction

Trigger finger also known as Stenosing tenosynovitis is one of the most common hand disorders. It occurs when there is difference in size between the tendon and the pulley which the tendon passes through[1]. This difference may due to Narrowing or thickening of the A1 pulley or enlargement of tendon (flexor digitorum profundus and flexor digitorum superficialis) secondary to Degeneration or Tendinosis.[2] This abnormality results in characteristic locking, catching, or Clicking with range of motion. Women are six-times more likely to develop trigger finger than men, with a higher Incidence in patients with Diabetes Mellitus (DM) and Rheumatoid Arthritis (RA) (Adams & Habbu, 2015)[3]. Trigger Finger has no known cause. Female gender, DM, RA, gout and occupations that requiring repetitive finger motions are known risk factors for developing trigger finger (DynaMed, 2017)[4]. Patient may complaint of pain at the level of the A1 Pulley (around the metacarpophalangeal joint)[5], reduced grip strength, and clicking, triggering or locking of digi[6]t. He/she also having difficulty in the extension of digit, a full range of Motion of the affected digit can only achieved by using the opposing hand to assist. In advanced disease, flexion contracture may occur (digit becomes fixed in flexion)

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(DynaMed, 2017)[7]. Initial conservative management in adults with trigger finger is recommended by the European HANDGUIDE Group (Huisstede et.al)[8]. Conservative treatments that can be used include oral nonsteriodal anti-inflammatory drugs (NSAIDs) for temporary pain relief, corticosteroid injection[9] (first line treatment for trigger finger), splinting and physical therapy[10]. Surgical intervention is only recommended if the symptoms persists and are significant in nature after the start of conservative management more than one month (Huisstede et.al)[11]. Ultrasound (US) has been used in clinical practice since the 1950s and still remains as a popular intervention for a various clinical problems (Watson, 2017). US waves can be delivered continuously or in pulses. Continuous US generate heat which increases the tissue temperature[12]. This thermal effect is often used in chronic sprains and strains, and for pain relief. Pulsed US tend to generate non-thermal effects such as cavitation and micro streaming. The non-thermal effects are used in stimulation of tissue regeneration, protein synthesis in fibroblasts and tendon repair (Tsai, Tang & Liang, 2011).Since the early 1990s, extracorporeal shock wave therapy (ESWT) has been used in the management of tendon pathologies to ease pain and improve function (Malliaropoulos et.al, 2016)[13]. The physiological and therapeutic mechanism of ESWT is not fully identified but there are some effects that have been confirmed (Watson, 2015). One of the reasons of using ESWT in therapy is that it can bring a tissue from a more chronic to a more acute stage and stimulates repair sequence that has been stalled [14]. There are several treatment effects of ESWT that have been confirmed: mechanical stimulation, increased local blood flow, increased cellular activity, analgesic effect on afferent nerves and breaking down of calcific deposits (Watson, 2015).Therapeutic ultrasound (US) and extracorporeal shockwave therapy (ESWT) have been compared in various conditions in other studies but there are no studies comparing these two modalities in treating trigger finger [15]. So this study is able to compare the 2 modalities and see which one is better in treating trigger finger. Yildirim et.al (2015) had conducted a randomized clinical trial that compared the efficacies of ESWT and corticosteroid injection for the management of trigger finger. In his study, 40 patients with trigger fingers were randomly assigned to ESWT or corticosteroid injection group (20 patients for each group). Visual analogue scale (VAS) was used to measure pain. A 0- to -10 point trigger finger assessment was used to measure the frequency of triggering (FT), the severity of triggering (ST) and functional impact of triggering (FIT)[16]. The Quick-Disabilities of the Arm, Shoulder, and Hand (QuickDASH) self-administered questionnaire was used to measure the symptom severity and functional status of the patient. All these clinical measures were assessment before treatment and after one, two and six months. At the end of study, 36 patients out of the original 40 patients completed the study (19 from ESWT group; 17 from injection group). Both groups showed statistically significant improvements in all outcome measures after treatment. In conclusion, ESWT was suggested as an alternative treatment for patients who didn't prefer corticosteroid injection. Malliaropoulos et.al (2016) had conducted a retrospective cohort study to evaluate the effectiveness of radial extracorporeal shockwave therapy (rESWT) for the treatment of trigger finger. 44 patients with 49 affected fingers or thumb who took part in the study were each given an individually adapted rESWT protocol. The Roles and Maudsley score was used to assess functional outcome after rESWT treatment. VAS was used to measure pain severity. Outcome measures were assessed at baseline (pretreatment) and after one, three and twelve month follow-up appointments (post-treatment). At the end of study, significant reductions in pain score and functional improvement were seen between baselines and all follow up assessments. The study was able to prove the effectiveness of rESWT in treating trigger finger but requiring randomized controlled trials to provide further evidence of the effect [17]. Dogru et.al (2017) had conducted a study that investigated the effect of rESWT in treating trigger finger. 16 patients (18 affected fingers) diagnosed with trigger finger grade 1, 2 and 3 according to Quinnel classification took part in the study. They were subjected to 10 sessions, twice a week of rESWT. Pain scores, general functional, range of motion, grip strength and pinch strength were assessed at every week for five weeks during treatment and 3 months after treatment. It was observed that the patients shown decrease in pain levels and increase in general functional capacity, range of motion, grip strength and pinch strength[18].

Methodology

This was a prospective randomized controlled clinical trial with follow-up at 1st, 2nd, 3rd and 4th week after the initial treatment. Patients who signed informed consent were selected after they were given a brief but detailed explanation of the study aims, benefits and the study procedures. The research protocol was reviewed and approved by the AIMST University

Human Ethics Committee (AUHEC), and it was carried out in accordance with the principles of the Declaration of Helsinki. A formula for a two sided-test of 5%, is $m(size\ per\ group) = \frac{2c}{\delta 2} + 1$ where $\delta = \frac{[\mu 2 - \mu 1]}{\sigma}$ is the standardized size and μ1 and μ2 are the means of the two treatment group, σ is the common standard deviation . The study was started at 17th December 2018 and ended at 13th February 2019. The treatment duration for each visit was about one hour including examination of the patient's condition, and retaking the measurement of pain score and QuickDASH score, and providing the necessary treatments to treat the patient. The details of the treatments are in 3.8 Techniques. There are 2 groups in this study: the US + wax bath group (Group A) and the ESWT + ice massage group. (Group B) These 2 groups will be using different techniques: Group A will be using ultrasound and wax bath; Group B will be using ESWT and ice massage. However, both groups will be given identical exercises that are beneficial in treating trigger finger.

	Intervention
Group A: US, paraffin wax bath and therapeutic exercise	US: Sonopuls 490 that was available in the hospital was used to administer US. The dosage was 3MHz, intensity of 0.5 W/cm^2 and duty cycle 50%. Duration: 5 minutes. The ultrasound gel was applied at the top of the skin of the palm. An electrode was then placed on the area covered by the gel. The electrode was then moved in uniform speed and in circular motion at the affected area for 5 minutes. Paraffin wax bath: The subject was asked to wash his hand before dipping his hand into the wax bath. The subject dipped his hand inside the wax bath for 1 second and then lifted up his hand from the wax bath. He needed to dip his hand 7 times to form a coat of wax around his hand. Subject's hand was wrapped by a plastic before further wrapped by an insulator grove to prevent the heat from dissipating. Treatment duration: 15 minutes. Stretching. The subject's affected finger was stretched by hyper-extending his affected finger and held the position for 10 seconds. The stretch was then released. This was repeated for 15 times. Resisted finger spread using rubber band. Begin by pinching the tips of fingers and thumbs. Put an elastic band around the fingers. The fingers were moved away from the thumb so that the band became tight The position was held for 10 seconds and the stretch was released. This was repeated for 15 times.
Group B: ESWT, ice massage and therapeutic exercise	ESWT: It was administered using Shock Master 500. The dosage is 1000 shocks, 2.1 bars and 15 Hz. Ultrasound gel was placed on the skin of the affected area. The d-actor electrode was placed on subject's affected area. Ice massage for 5 minutes. It was being performed on the area which ESWT was given by using cyrocup. Stretching. The subject's affected finger was stretched by hyper-extending his affected finger and held the position for 10 seconds. The stretch was then released. This was repeated for 15 times Resisted finger spread using rubber band. Begin by pinching the tips of fingers and thumbs. Put an elastic band around the fingers. The fingers were moved away from the thumb so that the band became tight The position was held for 10 seconds and the stretch was released. This was repeated for 15 times.

Data analysis was done by using Statistical Package for the Social Sciences (SPSS) verison 21 (Armonk, NY, IBM Corp). Analysis of varience (ANOVA) with repeated measure was used to test differences in the pain score and QuickDASH scores between 2 groups at the baseline (initial visit) and subsequent visit. Independent t-test was used to compare the difference between US + wax bath group and ESWT + ice massage group on the 1st visit and subsequent visit.

Result

Table 1: Demographics And Clinical Data Of The Patients

	Frequency	Percentage (%)
Study Group		
US+ paraffin wax bath	19	65.5
ESWT+ ice massage	10	34.5
Gender		
Male	6	20.7
Female	23	79.3

	Frequency	Percentage (%)
Ethnicity		
Malay	12	41.4
Chinese	17	58.6
Age range		
40-49	8	27.6
50-59	13	44.8
60-69	6	20.7
70-79	2	6.9
Affected digits		
Thumb	5	17.2
Index	11	37.9
Middle	2	6.9
Ring	10	34.5
Little	1	3.4

Table 1 showed that there are 29 patients taking part in this study. There were no dropouts. 19 patients in US + wax bath group (65.5%) while 10 patients in ESWT + ice massage group (34.5%).

Table 2 Mean Pain Scores of Both Study Groups and Tests of Within-Subjects Effects

Quick DASH	Mean	SD	df	F	P	Partial Eta Square
1st visit						
Ultra sound	36.8316	18.20406				
ESWT	31.8000	11.13613				
2nd visit						
US	34.1000	17.09662				
ESWT	31.6200	9.39537				
3rd visit						
US	30.5474	15.41988	1.991, 53.754	8.067	0.000	0.230
ESWT	33.1600	10.56800				
4th visit						
US	24.8737	15.86778				
ESWT	31.3400	10.42595				
5th visit						
US	22.4895	12.88836				
ESWT	31.3400	10.42595				

Note: SD: standard deviation, df: degree of freedom

Table 2 showed the mean pain scores of both study groups: US + wax bath group and ESWT + ice massage group in each visit and Tests of Within-Subjects Effects.

Table 3 Mean Quick DASH Scores of Both Study Groups and Tests of Within-Subjects Effects

Pain score	Mean	SD	df	F	P	Partial Eta Square
1st visit						
Ultra sound	5.2632	1.62761				
ESWT	2.6000	1.57762				
2nd visit						
US	4.8241	1.53707				
ESWT	2.6000	1.57762				
3rd visit						
US	3.9474	1.47097	2.031,	13.739	0.000	0.337
ESWT	2.6000	1.57762	54.842			
4th visit						
US	3.2632	1.40800				
ESWT	2.8000	1.22927				
5th visit						
US	3.0000	1.15470				
ESWT	2.8000	0.42164				

Note: SD: standard deviation, df: degree of freedom

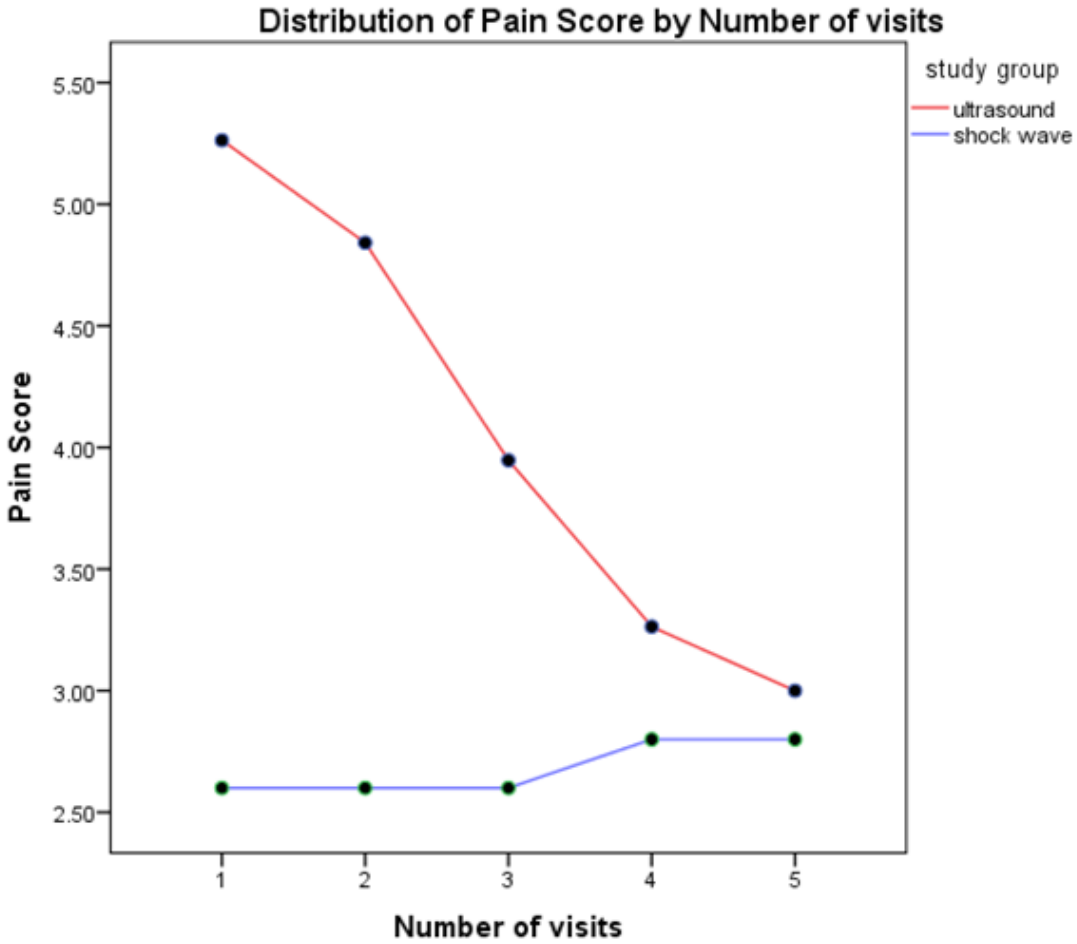

Figure 1 Graph of Distribution of Pain Score by Number of Visits

Figure 1 showed that the mean pain score recorded in the US + wax bath group declined steadily from the 1st visit until the 5th visit.

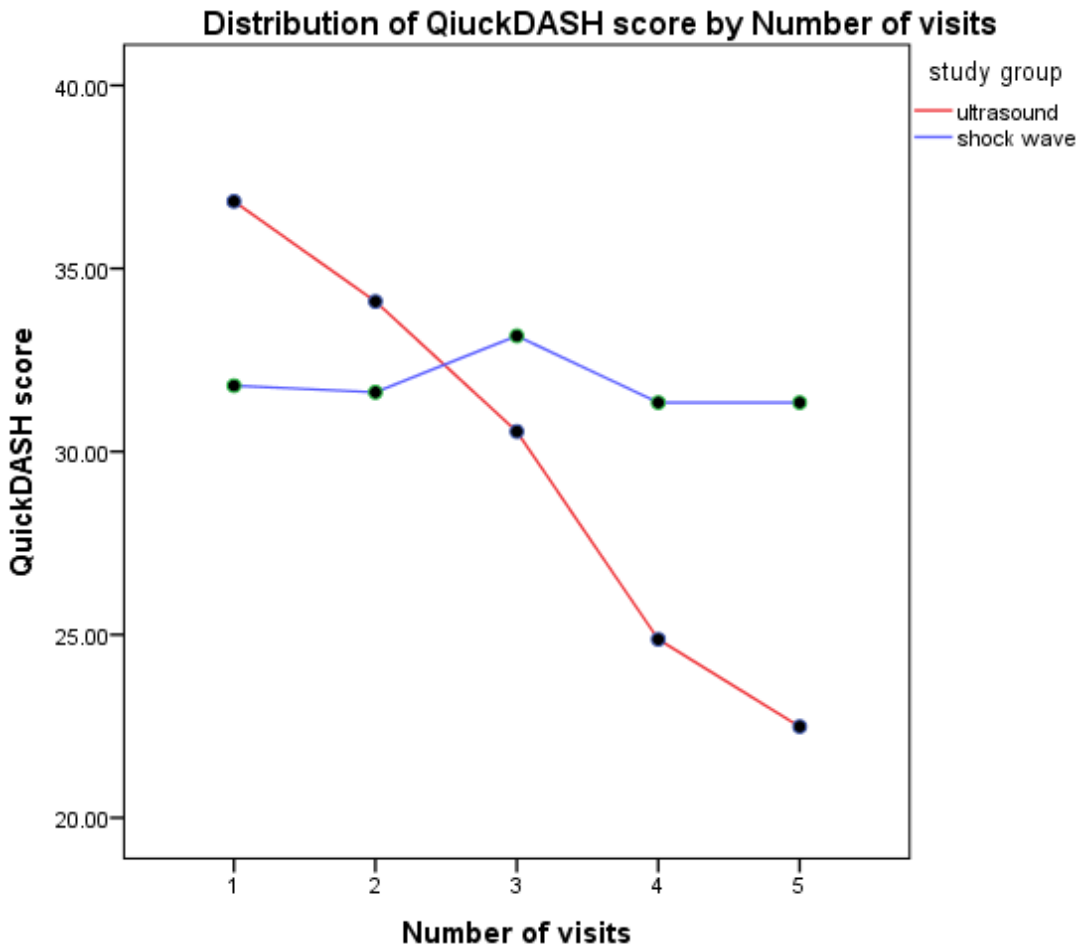

Figure 2 Graph of Distribution of QuickDASH Score by Number of Visits

Figure 2 showed that mean QuickDASH score recorded in the US + wax bath group declined steadily from the 1st visit until the 5th visit.

Table 4. Mean difference in pain score between visits of both groups

	Mean	SD
Mean difference of pain score between 1st and 2nd visit		
US + wax bath	-.4211	.76853
ESWT + ice massage	.0000	.00000
Mean Difference of pain score between 2nd and 3rd visit		
US + wax bath	-.8947	.45883
ESWT + ice massage	.0000	.00000
Mean Difference of pain score between 3rd and 4th visit		
US + wax bath	-.6842	.74927
ESWT + ice massage	.2000	.42164
Mean Difference of pain score between 4th and 5th visit		
US + wax bath	-.2632	.56195
ESWT + ice massage	.0000	1.15470

Note: SD: standard deviation

Table 4 showed the mean difference of pain scores between visits of both study groups: US + wax bath group and ESWT + ice massage group.

Table 5 Result of mean difference in Pain Score between US + wax bath group and ESWT + ice massage group in First and Subsequent Visits

	t	df	P	Mean difference	Std. error Difference	95% Confidence Interval of Difference	
						Lower	Upper
Pain score difference between 1st and 2nd visit	-2.388	18.000	0.28	-.42105	.17631	-.79147	-.05063
Pain score difference between 2nd and 3rd visit	-8.500	18.000	.000	-.89474	.10526	-1.11589	-.67359
Pain score difference between 3rd and 4th visit	-4.065	26.784	.000	-.88421	.21754	-1.33074	-.43768
Pain score difference between 4th and 5th visit	-.832	27	.413	-.26316	.31618	-.91190	.38559

Note = df: degree of freedom

Table 5 showed the comparison of the mean difference of pain scores between visits in the US + wax bath group with the mean difference of pain scores between visits in the ESWT + ice massage group.

Discussion

The findings of the study show that the combined therapy of therapeutic US and wax bath is more effective than the combined therapy of ESWT and ice massage in reducing pain scores and improving upper limb functionality of trigger finger patients in all visits. The effectiveness of both groups in treating trigger finger can be seen clearly in figure 4.1 and figure 4.2 as both groups show that the US + wax bath group is able to decrease pain score and QuickDASH score steadily throughout the visits but there are no improvement in the ESWT + ice massage group

Ethical Clearance: No ethical approval is needed.

Source of Funding: Self

Conflict of Interest: Nil

References

1. Adams JE, & HR. Tendinopathy of the hand and wrist. JAAOS-Journal of the American Academy of Orthopaedics Surgeons. 2015; 23(12): p. 741-751.
2. Chan YH. Randomised controlled trials (RCTs)-sample size: the magic number?. Singapore medical journal. 2003; 44(4): p. 172-174.
3. Cohen J. Statistical power analysis for the behavioral sciences. Rutledge. 1988.
4. Plus D. Ipswich (MA): EBSCO Information Services. 1995. Record No. 114490, Trigger finger (Stenosing tenosynovitis) in adults. 2018 Nov 28.
5. El Rahman HEA. Effect of shock wave therapy in treatment of trigger finger. CU Theses. 2012.
6. Hartzell TL,RR, & HM. Therapeutic modalities—an updated reviews for the hand surgeon. The Journal of hand surgery. 2012; 37(3): p. 597-621.
7. Huisstede BM,HP,CJH,FJ, & EHG. Multidisciplinary consensus guideline for managing trigger finger: results from the European HANDGUIDE Study. Physical therapy. 2014; 94(10): p. 597-621.
8. Langer D, LS, MM, & MA. Long-term functional outcome of trigger finger. Disability and rehabilitation. 2018; 40(18): p. 90-95.
9. Malliaropoulos N,JR,PD,PN,TJ,K & LH. Radial extra corporeal shockwave therapy for the treatment of finger tenosynovitis (trigger digit). Open access journal of sports medicine. 2016; 7: p. 143.
10. Prentice WE. Therapeutic modalities in rehabilitation. McGraw Hill Professional. 2017.
11. QuickDASH. .
12. Saini D. Cryotherapy–an inevitable part of sports medicine and its benefits for sports injury. Int J Adv Res. 2015; 14: p. 324-327.
13. Salim N,AS,SJ, & HNHM. Outcome of corticosteroid injection versus physiotherapy in the treatment of mild trigger fingers. Journal of Hand Surgery. 2012; 37(1): p. 27-34.
14. Starkey C. Therapeutic modalities. FA Davis. 2013;: p. 168-180.
15. Ultrasound TW(d). .
16. Therapies. TW(d)S. .

17. Tsai WC,TST, & LFC. Effect of therapeutic ultrasound on tendons. American journal of physical medicine & rehabilitation. 2011; 90(12): p. 1068-1073.
18. Yildirim P,GA,YA,KAY, & TF. Extracorporeal shock wave therapy versus corticosteroid injection in the treatment of trigger finger: a randomized controlled study. Journal of Hand Surgery. 2016; 41(9): p. 977-983.