Effect of Shock Wave Therapy on Pillar Pain After Carpal Tunnel Release in Hand Burn

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ABSTRACT

Background: *Carpal tunnel release surgery is one of the most common procedures performed by hand surgeons. In burn cases, pillar pain is the more common and troublesome complication of carpal tunnel release surgery and may take several months to resolve that can affect the patients' quality of life negatively. Shock Wave Therapy (SWT) is a non-invasive treatment to reduce pain.* ***Purpose:*** *To find out if shock wave therapy has a therapeutic effect on pillar pain after carpal tunnel surgery in hand burn.* ***Subjects and methods:*** *This randomized, single blind controlled trial was conducted on fifty-two hand burned patients who had a pillar pain after carpal tunnel release, their ages ranged from 20 to 35 years. The patients were randomly recruited from The Outpatient Clinic of Burn in Mansoura Hospitals, Egypt, and were randomly assigned into two equal groups, each group consisted of 26 patients. Patients in group A (shock wave therapy group) were managed by shock wave therapy one session per week in addition to the traditional physical therapy at a frequency of three times each week while patients in group B (control group) were only managed by the traditional physical therapy at a frequency of 3 times each week. Visual analogue scale (VAS) was measured pre and post twelve-weeks of intervention.* ***Results:*** *After 12th week of intervention, the two groups revealed significant change in VAS. Between groups comparison revealed that there was a statistical substantial difference in the pain measures in favour of the shock wave therapy group ($p< 0.001$).* ***Conclusion:*** *Shock wave therapy is effective in improving pillar pain after carpal tunnel release in hand burn*

Keywords: *Burn; Carpal tunnel release; Pillar pain; Shock wave therapy.*

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most prevalent peripheral mono-neuropathy, characterized by pain, numbness, and hypoesthesia in the wrist caused by pressure on the median nerve. The most common cause of CTS is a congenital, other contributing factors include stressful work, trauma, injury, burns, endocrine disorders, joint deformities, fluid retention, and the development of any space occupying lesions in the tunnel [1]. In burn cases, the reported causes of CTS are increased volume of carpal tunnel content due to edema and synovitis, wrist hyperextension deformity, tight dressing, fibrosis, and direct burn to the nerve. The most prominent symptom of CTS is numbness and pain at night [2]. Carpal tunnel release surgery is one of the most common procedures performed by hand surgeons. They are two types of pain that occur in the palm of the hand after carpal tunnel surgery, incisional pain and pillar pain. The incision pain typically only lasts for a few days or weeks after surgery. While the pillar pain is a diffuse aching pain and tenderness in the thenar and hypothenar area. The etiology of pillar pain is unclear. However, the most prevalent theory is the neurogenic theory, which attributes the pain to the damage of small nerve branches of palmar cutaneous branches of median nerve after surgical incision, with resulting entrapment of the nerves in the scar tissue at the incision site [3].

Treatment of pillar pain usually helps to improve the post-operative symptoms that may include rest, massage, and hand physical therapy. Hand physical therapy is sometimes recommended like stretches, nerve gliding exercises, scar massage, splinting, iontophoresis, and other modalities can be used by hand therapists to reduce pain. Steroid injections are occasionally used to reduce scar tissue formation as well [4].

Shockwave therapy is a safe, non-invasive treatment with substantial evidence supporting its effectiveness, derived from a large body of research and clinical trials. The primary benefits of shockwave therapy include pain relief and the restoration of function. It has proven to be an effective treatment modality for a variety of conditions, including musculoskeletal disorders, tendinopathies, plantar fasciitis, calcific shoulder tendinitis, and other chronic pain conditions. It involves the administration of high-intensity sound waves arising from sudden pressure changes to the body. Those changes result in strong waves that cause compression and tension [5]. There are two basic effects of shockwave; the primary effect is the direct mechanical forces that result in the maximal beneficial pulse energy concentrated at the target point where treatment is provided, and the secondary effect is the indirect mechanical forces by cavitation. These two effects cause anesthesia of the nerve fibers through biochemical changes and reduced inflammation in the soft tissue. It is believed that the release of angiogenesis-related growth factors of the mechanism of action in the soft tissues after shock wave accelerates the formation of new vessels and increases oxygenation in the environment, resulting in accelerated tissue recovery [1].

MATERIALS AND METHODS

Study design:

The study was single-blind (participants) randomized control trial that was conducted between October 2023 to March 2024. Before the beginning of the study, ethical approval was given from Cairo University Faculty of Physical Therapy's Ethical Committee (P.T.REC/012/004646).

Sample size determination:

The sample size was calculated using the G*Power software (version 3.0.10). F-

test MANOVA within and between interaction effects was selected. Considering a power of 0.80, an α level of 0.05 and effect size of 0.4; two groups and two measurements, a generated sample size of at least fifty-two participants.

Participants:

The study involved 52 patients who met the inclusion criteria of being subjects from both genders, their ages were between 20-35 years and all patients who had had pillar pain one month post carpal tunnel release after 2nd degree upper limb burn. These patients were randomly recruited from The Outpatient Clinic of Burn in Mansoura Hospitals, Egypt. Participants were ruled out if they have one of the following: sensory or motor neuropathy, systemic inflammatory diseases or local infections at the hand level [6]. Patients who rejected to join the study, or to sign in the written consent form were ruled out also [7]. After being informed about the study's nature, objectives, and potential benefits, the 52 patients were randomly assigned into two equal groups, each group consisted of 26 patients. Group A (Shock Wave therapy (SWT) group) and group B (control group). Participants were randomly allocated to their groups using sealed envelopes that contained name cards. Based on the card drawn, participants were assigned to the appropriate group. Treatment commenced one week after the randomization process. Every participant enrolled in the study was required to sign a written informed consent form. To minimize bias and ensure balance between the two groups, patients were randomly assigned with a 1:1 distribution ratio.

Interventions:

Patients in the Shock wave therapy (SWT) group were asked to place his forearm on the table with the palm facing up, shock wave device probe was oriented perpendicular on the thenar and hypothenar area, the protocol parameters were 2000 shocks at a frequency of 5 Hz and energy level of 4 bars, one session per week, for twelve weeks, in addition to traditional therapy, three sessions per week, for twelve weeks [8].

While the patients in the control group received the same traditional physical therapy of the SWT group which consisted of edema management (rest, elevation, and massage), ultrasound therapy for scar management, ten-minute hot pack around wrist and forearm to progress range of motion, splinting, range of motion exercise, gentle stretching exercises, tendon gliding exercise, median nerve glide, and strengthening exercise, three sessions per week, for twelve weeks [8].

Outcome measures:

The evaluation of outcome measures occurred at the beginning, and at the end of the twelve-week post interventions. The outcome measure was the visual analogue scale (VAS).

The visual analogue scale was used to measured pillar pain. Patient was asked to determine the ordinary pain by encircle on a point from 0 – 10 (0 –no pain and 10 – worst pain) [6].

Data analysis

Unpaired t-test was conducted for comparison of subject characteristics between groups. Chi-squared test was conducted for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene`s test for homogeneity of variances was conducted to test the homogeneity between groups. Unpaired t test was conducted for comparison of VAS between groups. Paired t test was conducted for comparison between pre and post treatment in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies

(SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

RESULTS

***- Subject characteristics*:**

Table (1) shows the subject characteristics of group A and B. There was no significant difference between groups in age, weight, height, BMI and sex distribution ($p > 0.05$).

Table 1. Comparison of age between group A and B:

	Group A	**Group B**	**MD**	**t- value**	**p-value**
	Mean ±SD	**Mean ±SD**			
Age (years)	29.38 ± 3.46	28.11 ± 4.21	1.27	1.18	0.24
Weight (kg)	80.34 ± 3.75	78.73 ± 6.02	1.61	1.16	0.25
Height (cm)	165.46 ± 7.35	164.57 ± 9.49	0.89	0.37	0.71
BMI (kg/m²)	29.45 ± 2.26	29.35 ± 4.12	0.1	-0.91	0.91
Sex, n (%)					
Females	13 (50%)	15 (58%)		($\chi^2 = 0.31$)	0.57
Males	13 (50%)	11 (42%)			

SD, Standard deviation; MD, Mean difference; χ^2, Chi squared value; p value, Probability value.

- Within group comparison:

Following treatment, the VAS decreased significantly as compared to pre-treatment in both groups ($p > 0.001$). In group A, VAS change percentage was 61.35%, whereas group B was 41.82%, Table (2).

- Between group comparison:

Prior to therapy, there was no significant difference between the groups in VAS values ($p > 0.05$). After treatment, a comparison between groups showed that group A had a significant decrease in VAS values decreased compared to the values of group B ($p < 0.01$), Table (2).

Table 2. Mean VAS and MHQ pre and post treatment of A and B groups:

	Group A	Group B			
	Mean ±SD	**Mean ±SD**	**MD**	**t-value**	**p value**
VAS					
Pre treatment	6.96 ± 1.58	7.27 ± 1.12	-0.31	-0.81	0.42
Post treatment	2.69 ± 0.97	4.23 ± 1.21	-1.54	-5.05	0.001
MD	4.27	3.04			
% of change	61.35	41.82			
t-value	20.17	14.39			
	p = 0.001	***p = 0.001***			

SD, Standard deviation; MD, Mean difference; p value, Probability value

DISCUSSION

Carpal tunnel syndrome (CTS) following a burn injury can be a complicated condition resulting from the interplay of scar tissue formation, inflammation, and nerve compression within the carpal tunnel. Burn injuries often cause significant swelling and scar tissue development, which can exert extra pressure on the median nerve, thereby worsening or initiating CTS symptoms. This condition may present as pain, numbness, tingling, and weakness in the hand and fingers [2]. Carpal tunnel release surgery is frequently performed to reduce the symptoms of carpal tunnel syndrome by easing the pressure on the median nerve. However, one possible complication following this surgery is pillar pain [3].

This study was conducted to investigate the effect of Shock wave therapy in improving pillar pain after carpal tunnel release in hand burn patients. To our knowledge, no research has specifically investigated the effectiveness of SWT in alleviating pillar pain following carpal tunnel release in patients with hand burns. Our trial outcomes are consistent with previous studies, which have demonstrated that SWT has positive therapeutic effects on pain [1,9,10].

Moreover, Turgut et al. (2021) examined the effectiveness of ESWT for post-carpal tunnel release pillar pain. Sixty patients were randomly assigned to either the ESWT group, which received three weekly sessions of ESWT, or the control group, which received three sessions of sham ESWT. Participants were evaluated before treatment, and three weeks, three months, and six months after treatment. Pain was measured using the visual analogue scale (VAS). The ESWT group showed significant improvements in the VAS scores at all post-treatment time points compared to the control group ($P < 0.001$) [1].

Haghighat et al. (2019) conducted a prospective randomized controlled trial with forty patients experiencing pillar pain for at least one month after carpal tunnel release surgery. Patients were randomly divided into two groups: the ESWT group received four weekly sessions of ESWT, while the control group received sham ESWT at the same intervals. Pain scores were assessed at baseline, 1 month, and 3 months. After 1 month, the pain score in the ESWT group was 3.7 compared to 4.7 in the control group ($P = 0.066$). After 3 months, the ESWT group showed significantly lower pain scores (1.6 vs. 3.6, $P < 0.0001$) than the control group. The study concluded that ESWT reduced pain faster than the sham treatment, suggesting it as a safe and effective noninvasive technique for pillar pain after carpal tunnel release [9].

Also the study made by Romeo et al. (2011) who evaluated the effectiveness of low-energy, flux density–focused extracorporeal shock wave therapy (ESWT) for treating pillar pain. They administered ESWT to 40 patients who had experienced pillar pain for at least six months following carpal tunnel release surgery. The results indicated significant improvement in all patients: the mean visual analogue scale (VAS) score dropped from 6.18 (±1.02) to 0.44 (±0.63) 120 days after treatment, and the redness and swelling of the surgical scar significantly decreased [10].

While there was observed improvement in pain scores in the control group throughout the study period due to the effect of the traditional physical therapy on decreasing pain and inflammation, ESWT demonstrated a swifter recovery in both aspects. From our point of view, this may be attributed to the additional SWT anti-inflammatory properties and its ability to promote neural regeneration. SWT facilitates the generation of endothelial nitric

oxide (NO) synthase within inflamed tissue, consequently elevating the physiological levels of NO. This augmentation of NO levels plays a significant role in inhibiting the inflammatory response.

The study has certain limitations. Firstly, it did not consider additional factors that could potentially influence pillar pain, such as patient activity level, hand dominance, and comorbidities. Therefore, further research is needed to address these factors adequately. Secondly, the study's statistical analysis was limited by the lack of long-term follow-up data, hindering a comprehensive evaluation of the treatment's lasting benefits. Consequently, additional research is necessary to assess the long-term effectiveness of SWT in alleviating pillar pain following carpal tunnel release in hand burn patients.

Conclusion

Given the findings of this study, it can be concluded that SWT proves effective in reducing pillar pain after carpal tunnel release in hand burn patients when incorporated into the conventional physical therapy regimen.

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Conflict of interest

There was no disclosure of any potential conflicts of interest related to this article.

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