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Effect of myofascial trigger points release with shockwave therapy on shoulder hand syndrome in stroke patients

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Abstract

Introduction. To investigate the influence of Myofascial Trigger Points (MTrPs) release combined with shockwave therapy on pain and the functions of the upper extremity with shoulder hand syndrome (SHS) in stroke patients with diabetic neuropathy.
Methods. Two groups of thirty stroke patients, divided equally into, the study group: which received MTrPs release with shockwave therapy and conventional physical therapy program, and the control group: received the conventional physical therapy program. All the patients were evaluated pre-and post-intervention by the severity score of the Complex Regional Pain Syndrome (CRPS), Motor Evaluation Scale Upper Extremity Stroke Patients (MESUPES), the figure-of-eight test for hand swelling, and the Visual Analogue Scale for pain (VAS-P).
Results. Highly significant improvement of affected upper extremity functions, with a significant reduction of SHS symptoms, swelling, and pain of the study group compared to the control group ($p < 0.05$), also there was a negative significant correlation between MESUPES-all-out score and VAS-P.
Conclusions. The combination of both MTrPs release with shockwave therapy had a significant improvement effect on the upper extremity function and a significant reduction of both SHS symptoms and pain in stroke patients with diabetic neuropathy, which leads to improvement in stroke patients' functional rehabilitation.
Key words: stroke, myofascial trigger points release, shockwave, shoulder hand syndrome, diabetic neuropathy

Introduction

Stroke is typical cerebrum damage due to the rupture or impediment of cerebrovascular structures [1]. Among stroke patients, shoulder hand syndrome (SHS) is very common, as both the spasticity and paresis of the shoulder muscles are considered the principal hazard factors, with the incidence rates changing from 12% to 49% [2]. Reflex sympathetic dystrophy or complex regional pain syndrome (CRPS) type I, likewise alluded to as post-stroke SHS [3], is an endless neurological issue including the extremities described by pain, swelling, motor dysfunctions, and vasomotor unsteadiness [4].

Post-stroke neurological CRPS problems in the form of SHS are generally characterized by a painful shoulder and wrist, with a relatively spared elbow [5], the damage actuated the interaction between sensory fibers and postganglionic efferent sympathetic axons that could be the premise of SHS [6]. SHS is created between nearly from one to six months after a stroke as it starts by shoulder pain and loss of range of motion (ROM) trailed by the warmth of the distal part of the upper extremity (UE) [7–8]. Various examinations have stated that CRPS is also one of the complications of the musculoskeletal system in diabetes mellitus (DM) patients [9]. The DM is greatly associated with CRPS, as in stroke patients with uncontrolled hyperglycaemia diabetes it could influence the CRPS events, due to the expanded rates of glycosylated haemoglobin (HbA1c), so CRPS incidence expanded as well [10].

In spastic stroke patients, the myofascial trigger point (MTrPs) is characterized by the existence of a nodule in a tight band of skeletal muscle during palpation [11]. The spontaneous pain is represented in the active MTrP, while the latent MTrP is not related to spontaneous pain but rather evokes localized pain during pressure on it. Both MTrPs can be related to ROM limitation and muscle weakness or dysfunctions [12]. Myofascial trigger point release therapy intended to discharge the restrictions and barriers inside the more profound layers of the fascia, trailed by static stretching to affect the spastic muscles [11], as the underlying-mechanism manages neuro-reflexive change with the manual pressure during Myofascial release (MFR), which could lead to stimulation of afferent through the receptors, which gives the reaction by central processing at the spinal cord and cortical levels, thus it brings about inhibition of the efferent and hence promotes relaxation [1], consequently permitting expanded ROM, flexibility, circulation and pain reduction [12–13].

The painful shoulder after stroke could be treated by Extracorporeal Shock Wave Therapy (ESWT), which is a non-invasive therapy [14], as it helps in the reduction of muscle tone and improves ROM, neurotransmission speed, and muscle power [15], and likewise advances cellular generation and decreases pain by creating low-energy waves and electromagnetic excitation that increments the regional bloodstream, with neovascular changes, a decrease in inflammatory cytokines, and expanding the collagen strands and ligament flexibility [16].

However, SHS is considered one of the common reasons for chronic severe shoulder pain after stroke with hyperesthesia, swelling, and dystrophic changes in the skin of the affected UE, especially in diabetic neuropathy patients. The rehabilitation of hemiplegic patients is often severely affected by the development of SHS, leading to a prolonged and at

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times permanent disability [17], so the purpose of this study was to investigate the influence of the MTrPs release with ESWT on SHS in stroke patients with Diabetic Peripheral Neuropathy (DPN).

Subjects and methods

Design and settings of the study

Pre- and post-experimental design study, including two equal groups, were: the study group who received MTrPs release combined with ESWT and a conventional physical therapy program and the control group that received a conventional physical therapy program. This study was conducted in the outpatient clinic of the October 6 University hospital.

Participants

Thirty stroke patients were selected randomly from Neurological Department of Kasr El-Aini, and October 6 university hospital, with the following inclusion criteria: all the patients from both sexes were referred and diagnosed by a neurologist as having had a stroke from 4 to 8 months prior; with the age ranging from 45 to 60 years, body mass index (BMI) ranging from 20 to 30 kg/m^2, all the patients were identified with SHS as diagnosed by the Diagnostic criteria for SHS post-stroke [18] and were in stage I of the syndrome evolution [19], with upper limb spasticity grades, ranging from 1 to 3 according to the Modified Ashworth Scale [20] and with stage N2a mild diabetic peripheral neuropathy according to the Diabetic Neuropathy staging scale [21] due to type II DM, while the exclusion criteria were: any other causes of shoulder pain in the side of the hemiplegia, any pain of central origin, superficial sensory loss in affected UE, impairment in mental or cognitive functions that impeded assessment and participation with treatment, structured joint deformity in the painful shoulder or hand, and any other musculoskeletal disorders of hemiparetic UE.

Randomization

The patient's consent form was read and signed before the study started, with the assurance of confidentiality and anonymity, and the performance of all the procedures complied with institutional guidelines and relevant laws. The patients were allocated equally into two groups (study and control) using the program of computer-based randomization. No dropping out of participants from the study was reported after starting the intervention (Figure 1).

Interventions

Evaluation protocol to measure the following

Complex Regional Pain Syndrome (CRPS) severity score

This is a quantitative index and a valid and reliable instrument to score and monitor the severity of CRPS and SHS. The CRPS Checklist included both the history and the physical assessment, as 1 = presence and 0 = absence for every item of 17 diagnostic CRPS signs and symptoms, the total scores ranging between 0 and 17, with the greater scores showing more CRPS severity [22].

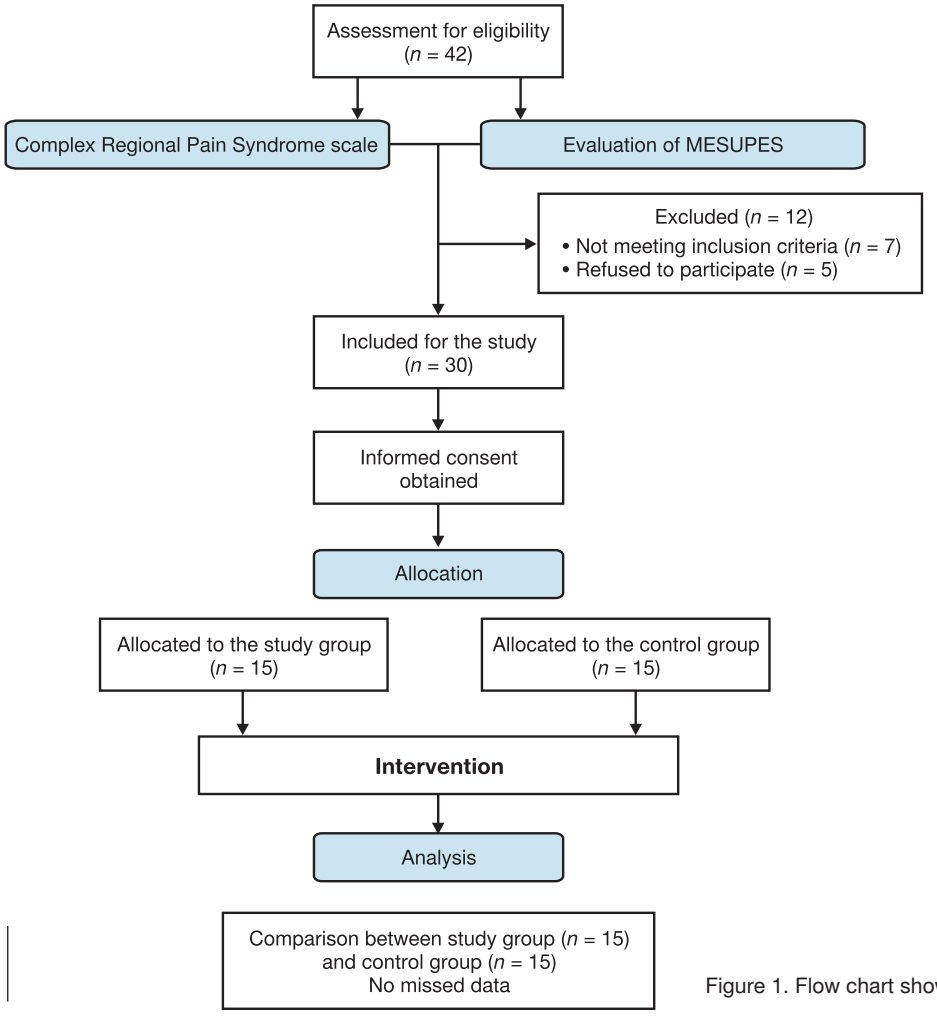

Figure 1. Flow chart showing the experimental design of the study

Motor evaluation scale for upper extremity in stroke patients (MESUPES-arm, hand and all-out score)

The MESUPES evaluates the UE functional outcomes of the hemiparesis arm and hand for stroke patients. It consisted of 17 categories (all-out score – 58; MESUPES-arm score – 40; MESUPES-hand score – 18), as the MESUPES-arm: includes 8 items with 6 scores (0:5) as 0 scores represented the failure to adjust the muscle tone to the movement, while 5 scores represented the capacity to finish a movement without help, and MESUPES-hand: includes 9 items with 3 scores (0:2), as 3 scores as follows: 0 = incorrect or no movement; 1 = partial or no movement and 2 = full movement [23]. A score of 0 was given when the patient exhibited deficient tone, irregular muscle constrictions, mass movement patterns, or synergy (flexor/extensor). The MESUPES demonstrates a high concurrent validity in the UE motor assessment [24].

Figure-of-eight method for measuring hand swelling

The figure-of-eight technique utilizing tape measurement for hand size, as in comparison with volumetric measurements, which had a great concurrent validity and reliability [25], the measurement procedures were as follow: with the therapist assistant the forearm of the patient was pronated and extended out over the edge of the table, then the therapist started the measurement using the tape as follows: firstly the starting point of measurement was in the anatomical position of the ulnar styloid process distal part, at that point, the tape was moved over the wrist palmar surface on the radial styloid process distal part, then the tape was moved diagonally across the dorsum of the hand with the arrangement of tape on the 5th metacarpophalangeal (MCP) joint line, then the tape was moved across the palmar aspect of the MCP joints and placed on the 2nd MCP joint, then the tape was crossed diagonally on the dorsum of the hand returning to the starting point. The hand size of the affected limb was measured in centimeters (cm) and compared pre and post the intervention.

Visual analogue scale for pain (VAS-P) for pain assessment

The VAS for pain is a valid and reliable assessment of pain intensity, as a straight horizontal line of a fixed length (10 cm) is considered the simplest VAS, the ends represented from the left the highest pain limits (worst) to the right (best). The distance was measured from the "no pain" point and the mark of the patient on the line, giving a scope of values from 1 to 10 cm, as a higher score represented a higher pain score [26].

Intervention

Study group: they received a therapeutic intervention program including MTrP release combined with shockwave therapy and conventional physical therapy program, for four weeks; every other day, three times per week.

There were three main steps of the MTrP release technique, the initial step was to recognize and find the trigger points (TP) by the therapist's palpation to detect the specific common location of each trigger point within the belly of the muscle, as each trigger point was felt as firm and localized hyperirritable nodules. The TP for the shoulder muscles were commonly found at supraspinatus, infraspinatus, teres major, subscapularis, and pectoralis major [27, 28], while for the hand muscles the TP commonly were at the pronator teres (PT), flexor carpi radialis (FCR), and flexor carpi ulnaris (FCU**)** [29, 30]. Then the second step after TP localization and palpation was the MTrP release technique, using one or both hands, the thumbs or four fingers of the therapist applying a maintained pressure over the TP and pushing internal toward the middle until a tissue restriction was felt, then the movement stopped and maintained until the restriction scattered or a "melting away" sensation of the tissue occurred under the treating fingers. At that point, with further maintained pressure, moving again the internal to the midline as if a new tissue resistance appeared so the therapist stopped and maintained steady force against the tissue, then the therapist repeated until the inability to palpate the TP, or for five repetitions at each site. Between every TP release application, a 10-second rest was given to take into consideration blood reperfusion to the site [30]. The duration for each pressure gradually increased as a 120-second hold of MFR for each muscle was given to enable the tissue to soften. The third step for powerful trigger point therapy was the myofascial stretching (MFS) exercises to keep up the relaxation and carry the muscle to its full length, with a slow prolonged stretch for each muscle that exceeded 30 seconds followed by 30-second relaxation, with (3–5) MFS repetitions for every muscle [29].

Extracorporeal Shockwave Therapy (ESWT) application

The application of pressure pulses of ESWT was centred around the hypertonic flexor muscles of the hand mean, 3200 shots over the intrinsic muscles, flexor carpi ulnaris and radialis, and the flexor digitorum tendon of the hand, with 800 for each muscle by an ultrasound pointer [15] with energy applied 0.030 mJ/mm^2. Because low energy was used, the application was not painful. The patients received ESWT also on the shoulder, as the stimulation sites were the supraspinatus and subscapularis insertion sites, with the following parameters a frequency of 12 Hz/session, 3.000 pulses, at 1.500 pulses/site, and with the submaximal pressure between 0.39 and 1.95 mJ/mm^2 (1.0 and 5.0 bar) [14]. For the stimulation at the insertion of the subscapularis, the shoulder was in lateral rotation, with 90° flexed elbow, while to stimulate the insertion of the supraspinatus, the shoulder was in medial rotation with a slightly extended elbow [14]. The Masterpuls MP200 (Storz Medical AG, Tagerwilen, Switzerland) was used to apply ESWT [14].

Control group: received a conventional program using a selected designed physical therapy program for SHS for four weeks; every other day, three times per week, as follow: The objectives of treatment were to lessen the swelling and pain and to improve the functional recovery; therefore, to reduce the swelling: a cold pack was applied around the shoulder and wrist joints for 10 minutes with gradual inspection of the skin, followed by lymphatic drainage massage of the upper extremity. Then there was a program of exercises to improve the bloodstream, power and function of affected UE [18] as follows:

Passive ROM exercises were performed by the therapist: lateral rotation was performed with shoulder slightly abducted, forearm supination, and for the wrist joint all passive ROM exercises were performed. The exercises stopped at the point of pain, and during the next session, the therapist attempted to increase ROM as far past this point of pain as possible within the pain limit, also flexion and extension exercises for the Metacarpophalangeal (MP) joint and interphalangeal (IP) joint of fingers and thumb were practiced. Every exercise was repeated from 5 to 10 times.

Passive and active-assisted movement by the patient: The patient utilized the non-affected UE to move the affected

hand and shoulder, and at that point, the passive and active-assisted movements were encouraged as much as possible, informing on of lateral rotation, elbow extension, forearm supination, and wrist joint ROM exercises. The patient also moved the MP joint and IP joint of the fingers and thumb. The patient was instructed also to keep the hemiparetic UE elevated and avoid keeping the UE in a lowered position.

Neurodevelopmental approach (Bobath prolonged stretch): The intervention methods for Bobath involved the activation of key points of control for the reduction of tone that was abnormal and interferes with normal execution. Bobath prolonged stretch was applied using a distal key point of control (wrist, fingers, and thumb) with a prolonged stretch between 10 or 15 minutes until a tone reduction occurred. The therapist performed abduction and extension of the patient's thumb and fingers, then wrist extension with forearm supination to decrease the flexion tone of the wrist and fingers, then elbow extension and shoulder lateral rotation with a 90° abduction to decrease UE flexion tone, and at which point of shoulder pain the therapist applied shoulder and scapular mobilization, then repeated the prolonged stretch again [31].

Statistical analysis

The patients' characteristics were compared between both groups using the descriptive statistics, *t*-test, and chi-square test (χ^2). The data normal distribution was analysed using the Shapiro-Wilk test, and Levene's test for homogeneity of variances was performed to ensure homogeneity between the groups. Mixed design MANOVA was conducted to compare within and between groups effects, while for the subsequent multiple comparisons the Bonferroni correction was carried out by post-hoc tests. The significant level was ($p < 0.05$) for all statistical tests. The statistical methods for data collection and analysis were performed through the (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA).

Ethical approval

The research related to human use had complied with all the relevant national regulations and institutional policies had followed the tenets of the Declaration of Helsinki, and had been approved by the Institutional Ethics Committee of the Faculty of Physical Therapy, Cairo University, Egypt (approval No.: P.T.REC/012/002459). Agreed with the current study and the clinical trials.gov ID: NCT04627636.

Informed consent

Informed consent had been obtained from all individuals included in this study.

Results

Baseline characteristics

Comparison of the mean values and standard deviation (*SD*) between both groups of patient's characteristics revealed no significant differences in age, body mass index (BMI), duration of stroke (months), diabetes mellitus (DM) duration (years), mini-mental state examination (MMSE), sex, or degree of spasticity ($p > 0.05$), as shown in Table 1.

Table 1. Basic characteristics of all the patients

	Study group (mean ± *SD*)	Control group (mean ± *SD*)	*p*-value
Age (years)	56.4 ± 3.68	55.8 ± 3.76	0.66
BMI (kg/m²)	26.06 ± 0.96	25.87 ± 1.06	0.59
Duration of stroke (months)	5.13 ± 0.9	5.4 ± 0.91	0.43
DM duration (years)	6.47 ± 1.46	7.06 ± 1.28	0.24
MMSE	26.73 ± 0.96	27 ± 1.19	0.5
	N (%)	*N* (%)	*p*-value χ^2
Sex			
Male	7 (46.7%)	6 (40%)	0.71 $\chi^2 = 0.13$
Female	8 (53.3%)	9 (60%)	
Spasticity			
Grade I	1 (6.7%)	2 (13.3%)	0.86 $\chi^2 = 0.72$
Grade I⁺	3 (20%)	2 (13.3%)	
Grade II	7 (46.7%)	6 (40%)	
Grade III	4 (26.6%)	5 (33.4%)	

BMI – body mass index, DM – diabetes mellitus, MMSE – mini-mental state examination

Effect of treatment on MESUPES-arm, MESUPES-hand, MESUPES- all-out score, Severity score of CRPS, figure-of-eight test and VAS-P

Mixed MANOVA showed a significant interaction of treatment and time ($F_{(6,23)} = 62.91$, $p = 0.001$). There was a significant main effect of time ($F_{(6,23)} = 541.93$, $p = 0.001$). There was a significant main effect of treatment ($F_{(6,23)} = 9.99$, $p = 0.001$).

Within-group comparison

There was a significant increase in MESUPES-arm, MESUPES-hand, MESUPES- all-out score post-treatment in the study and control groups compared with that pre-treatment ($p < 0.05$). Also, there was a significant decrease in severity score of CRPS, figure-of-eight test and VAS-P post-treatment in the study and control groups compared with the pre-treatment ($p < 0.05$) (Table 2).

Between groups comparison

There were no significant differences between all parameters for both pre-treatment groups ($p > 0.05$), while the comparison between the study and control groups post-treatment revealed a significant increase in MESUPES-arm, MESUPES-hand, MESUPES- all-out score and a significant decrease in severity score of CRPS, figure-of-eight test and VAS-P of the study group compared with that of the control group ($p < 0.05$) (Table 2).

Correlation between motor function and pain levels

Pearson Correlation Coefficient was conducted to determine the correlation between UE motor function, and pain, across the two groups post-treatment. The correlation between MESUPES- all-out score and VAS-P was a moderate negative significant correlation with *r*-value = –0.61 and *p*-value = 0.0001.

Discussion

The main objective of the present study was to investigate the influence of MTrPs release combined with shockwave

Table 2. Mean values of MESUPES-arm, MESUPES-hand, MESUPES- all-out score, Severity score of CRPS, figure-of-eight test and VAS-P pre and post-treatment of the study and control groups

		Study group (mean ± *SD*)	Control group (mean ± *SD*)	MD (95% CI)	*p*-value
MESUPES-arm	Pre	17.93 ± 3.89	18.13 ± 3.11	–0.2 (–2.83: 2.43)	0.87
	Post	34.53 ± 3.58	26.6 ± 3.64	7.93 (5.23: 10.63)	0.001
	MD (95% CI)	–16.6 (–18.01: –15.18)	–8.46 (–9.88: –7.04)		
		p = 0.001	*p* = 0.001		
MESUPES-hand	Pre	8.53 ± 1.88	7.33 ± 2.22	1.2 (–0.34: 2.74)	0.12
	Post	15.26 ± 2.12	11.4 ± 2.67	3.86 (2.06: 5.66)	0.001
	MD (95% CI)	–6.73 (–7.55: –5.91)	–4.06 (–4.89: –3.24)		
		p = 0.001	*p* = 0.001		
MESUPES-all-out score	Pre	25.8 ± 3.5	25.46 ± 4.47	0.34 (–2.67: 3.33)	0.82
	Post	49.8 ± 4.01	37.33 ± 6.84	12.47 (8.27: 16.65)	0.001
	MD (95% CI)	–24 (–26.21: –21.78)	–11.86 (–14.07: –9.65)		
		p = 0.001	*p* = 0.001		
Severity score of CRPS	Pre	12.53 ± 1.13	12.73 ± 0.88	–0.2 (–0.95: 0.55)	0.59
	Post	6.33 ± 1.58	9.26 ± 1.22	–2.93 (–3.99: –1.87)	0.001
	MD (95% CI)	6.2 (5.7: 6.69)	3.46 (2.97:3.95)		
		p = 0.001	*p* = 0.001		
Figure-of-eight test (cm)	Pre	45.13 ± 2.07	45.57 ± 1.6	–0.44 (–1.81: 0.94)	0.52
	Post	39.5 ± 1.95	42.27 ± 2.31	–2.77 (–4.36: –1.16)	0.001
	MD (95% CI)	5.63 (4.45: 6.8)	3.3 (2.12: 4.47)		
		p = 0.001	*p* = 0.001		
VAS-P (cm)	Pre	8.06 ± 0.79	8.13 ± 1.06	–0.07 (–0.76: 0.63)	0.84
	Post	3.13 ± 0.83	6.06 ± 1.09	–2.93 (–3.66: –2.2)	0.001
	MD (95% CI)	4.93 (4.44: 5.42)	2.06 (1.57: 2.56)		
		p = 0.001	*p* = 0.001		

MD – mean difference, CI – confidence interval, MESUPES – motor evaluation scale for upper extremity in stroke, CRPS – complex regional pain syndrome, VAS-P – visual analogue scale for pain

therapy on pain and functions of UE with SHS in thirty stroke patients with DPN. All the patients were diagnosed via MESUPES, CRPS scale, the figure-of-eight test, and VAS-pain scores, and the findings showed that there was a highly significant improvement in UE functions, with a significant reduction in SHS symptoms, hand swelling, and pain level of the study group compared to the control group.

Together these results were in agreement with a previous study that showed that after MTrPs release of the shoulder in stroke patients, the patients presented with significantly lower pain levels and a larger ROM for passive abduction [11], also another study stated that in stroke patients, the prevalence of MTrPs release was high, so its examination and treatment were important, as the outcomes demonstrated that the highest incidence of active MTrPs had a rate of infraspinatus 50%, supraspinatus 34%, upper trapezius 20% and teres minor 12%, and there was a moderate correlation between the measurements of UE dysfunctions using the DASH and MTrPs in infraspinatus and active MTrPs of the supraspinatus [32].

The impact of MTrPs release for UE of stroke patients in a previous study utilizing by dry needling which had the same qualities of manual MTrPs release, the results approved that the MTrPs release using dry needling for the infraspinatus, teres major, teres minor, and pectoralis major could immediately increase shoulder passive ROM, so the MTrPs release considered a highly effective technique during the early rehabilitation of hemiparetic shoulder pain syndrome [28], as it also diminished the spastic muscles of UE and increased the function of UE in strokes. The findings of the current study supported also by Bron et al. [33] who surveyed the adequacy of MTrPs release in patients with chronic pain at shoulder, by manual pressure of the MTrPs followed by MFS, as the outcomes showed decreased questionnaire scores of Disabilities of the Arm, Shoulder, and Hand functions (DASH) and also a reduction in VAS-P scores.

Because of the contracted tight band of MTrPs, the motor dysfunctions represent; hence the painful affected muscles around the shoulder girdle may represent a weakness of the involved muscles and limited ROM in the shoulder joint [34] that also may affect the position of the scapula and lead to scapular malpositioning and dyskinesia in stroke patients [35]. The examination of the suitability of MTrPs release for

shoulder muscles in patients with chronic shoulder pain of myofascial origin was investigated in a previous study and the outcomes demonstrated a significant reduction in the pain of the shoulder and scores of dysfunction index [36]. In the current study, Myofascial Passive stretching showed improvement in UE functions outcome scores for MESUPES as it was directed at stretching the over-shortened and spastic muscle fibres, and it involved a slow prolonged stretch with suitable concentration and relaxation that inhibit the gamma spindle response [37]. Hence Myofascial Passive stretching involves stretching the muscle as far as possible for nearly 45 seconds for maintenance until the relaxation of the muscle, and also stimulates the Golgi tendon organs that results in a reflex relaxation of the muscle within 60 seconds of static or prolonged stretches, for enabling the muscle to stretch through relaxation before reaching the extensibility limits [37].

Therefore the findings of the present study showed that the SHS in stroke patients was related to constrained ROM of the shoulder, which was believed to be because of both capsular fibrosis and synovial inflammation, which could be disturbed due to, loss of motion, spasticity, paralysis, or synergy of movements, leading to pain and decrease shoulder movement [38]. The ESWT used in the current study resulted in a reduction in VAS- pain scores and improvement in UE functions of stroke patients with DPN that was in agreement with Kim et al. [14] who investigated the impact of ESWT on hemiplegic shoulder pain (HSP) syndrome at the insertion sites of subscapularis and supraspinatus, as the results showed that the VAS score, and the shoulder joint ROM, including medial and lateral rotation, flexion and abduction, were fundamentally improved post-intervention.

The pain reduction after ESWT lasted for at least 4 weeks, while the ESWT immediate pain reduction following application can be clarified by the after-effect of a hyperstimulation pain-relieving impact [14]. In previous work that recognized the impacts of ESWT on motor skills and the mechanical properties of muscles in stroke patients, the findings affirmed a significant decrease in muscle tone post ESWT intervention in patients with spastic hemiplegia as the ESWT is considered to diminish the hypertonia of spastic muscles in stroke patients by changing the rheological properties of the thixotropic tissues, where fibrosis was diminished and veins were improved [15]. The ESWT also had a great effect in patients with diabetic frozen shoulder, as showed in the findings of previous work that demonstrated that the ESWT could lead to an improvement in the functional outcomes and ROM of the shoulder joint and could reduce the shoulder pain in diabetic patients [39]. Another study showed that the ESWT was effective on reducing the shoulder disability index, improving ROM, and reducing pain severity in the painful shoulder of patients with DPN [40]. However, the improvement of SHS symptoms in stroke patients who received a conventional program including cold application, lymphatic drainage, and ROM exercises [18], could be due to improving circulation and enhancing the UE function; hence, the selection of the suitable treatment method at a specified stage of recovery varies among stroke patients [41]. For future studies, it would be beneficial to assess the effect of MTrPs release in a stroke without diabetic neuropathy, on other trigger points, on other causes of shoulder pain, and sensorimotor functions of the hemiparetic upper extremity.

Conclusions

The Myofascial Trigger Points release combined with shockwave therapy had a great impact on SHS in stroke patients with diabetic neuropathy, as the findings showed a significant reduction in SHS symptoms including pain and swelling, and also improvement in the level of upper extremity functions, thus both the MTrPs release and ESWT application should be considered as a potential rehabilitation program in stroke patients with SHS.

Disclosure statement

No author had any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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