

Treating Frozen Shoulder with Integrative Medicine approach by the Energy Accumulator

Kevin Ki-Wai Ho¹ , Anthony Wai-Leung Kwok², Wai-Wang Chau³ , Leung-Kim Hung⁴

ABSTRACT

Background: Frozen shoulder is a painful and disabling disorder of unclear cause, affecting middle-aged people after their 5th decade. They suffer from annoying pain and limited shoulder mobility. Energy Accumulator provides a better way of relief through an integrative medicine concept.

Objectives: This study aims to evaluate the effectiveness of localized heat therapy using the Energy Accumulator on acupoints combined with mobilization exercise for the treatment of frozen shoulder.

Methods: Thirty-eight subjects (26 females, 12 males) of age 45–65 (mean age 55.43) were recruited. An orthopedic surgeon diagnosed frozen shoulder using Codman's 12 criteria. An eight-session Traditional Chinese Medicine (TCM) treatment applying heat and stroking massage was offered. All subjects completed the questionnaire set including Oxford Shoulder Scale (OSS), Shoulder Pain & Disability Index (SPADI), and Visual Analog Scale (VAS) for pain. Range of Motion (ROM), muscle power, muscle circumference, and grip strength were measured.

Results: Comparing with the controls from literature, the treatment group showed improvement in the OSS (mean change = 4.93, $p < 0.01$), SPADI (mean change = -18.9, $p < 0.01$), SF-12 physical (mean change = 2.5, $p < 0.01$), SF-12 mental (mean change = 2.6, $p = 0.03$), VAS (mean change = -0.5, $p < 0.01$), active ROM (mean change = 21.6, $p < 0.01$), and passive ROM (mean change = 23.7, $p = 0.01$).

Conclusion: The results demonstrated an efficient and effective treatment effect of using the Energy Accumulator in treating frozen shoulders among middle-aged patients. This study was a good example of integrating Western Medicine with the TCM for efficient and effective treatment outcomes.

Keywords: Energy accumulator, Frozen shoulder, Integrative medicine, OSS, SPADI, VAS.

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INTRODUCTION

Frozen shoulder is common among middle-aged persons in the 5th and 6th decades.¹ The pain can be acute or chronic. Patients feel stiffness over the shoulder, shown by restriction in range of motion. The etiology includes trauma, cervical disc degeneration, physical strain, psychosocial problems, and even genetic factors.^{2,3} The predisposing factors include immobilization of the arm for a long time, rotator cuff or biceps tendinitis, tenosynovitis of the long head of the biceps, congenital deformity of the shoulder girdle, scapula-costal cementing, ligamentous injury, osteoarthritis, muscular fibrosis, or nutritional deficiencies.⁴ The pathology is unclear but it is widely believed that it is related to inflammation in the joint and surrounding soft tissues which lead to fibrosis.² Frozen shoulder can be divided into the primary frozen shoulder which occurs spontaneously without other diseases; and secondary frozen shoulder is associated with joint diseases, such as osteoarthritis or fractures.^{2,4}

There are different ways to treat this condition, including physiotherapy, manipulation under injection (MUI),⁵ steroid injection and MUI with an arthroscopic release, and MUI with arthroscopic hydro-distension.^{2,4} In physiotherapy, it is common to use heat, and shockwave therapy to treat the pain, and home exercise is always taught and is found beneficial.⁴ This is also the most common first-line treatment modality used in Hong Kong. The form of heat delivered varies but should not be over 40°C to avoid injury to the skin. Some believe that frozen shoulder is self-recovery, although the duration may be lengthy.⁵ However, many patients are left with mild residual stiffness and a tendency for recurrence or easy injury. Therefore, a more proactive approach is favorable.

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UKFROST was a multicentre randomized clinical trial comparing three parallel groups (arms) of frozen shoulder patients treated (1) under anesthesia + steroid injection, (2) under anesthesia + arthroscopy, and (3) physiotherapy + steroid injection.⁶ Results from UKFROST showed frozen shoulder patients gained faster access to structured physiotherapy sessions with steroid injection in NHS. A nested study on developing and implementing stand-alone and postoperative protocols under UKFROST showed flexible physiotherapy programs were beneficial for frozen shoulder patients in secondary care.⁷ This large-scale study proves physiotherapy program beneficial to frozen shoulder patients, and, the effectiveness might further improve by introducing East-Meets-West component–Chinese Medicine.

In Chinese Medicine Theory, it is believed that frozen shoulder is related to “coldness,” “wind,” and “dampness” in the context

of Chinese Medicine meaning of the terms. These “anomalies” will affect the blood circulation at the shoulder and induce pain and restriction in movement. Therefore, there has been different ways of providing heating therapy to clear the “wind,” “coldness,” and “dampness” around the shoulder, usually according to meridians or acupoints, leading to reduction of pain, and improving the circulation along the meridians over the shoulder region.^{8,9} Moxibustion is usually combined with acupuncture to deliver localized and focused heat treatment.¹⁰ The effective rate of moxibustion is reportedly between 65 and 97%.¹⁰⁻¹² However, moxibustion is not acceptable by some patients because of the smoke invoked during its use and also the need to perform needle acupuncture which is not welcomed by some patients. Modified techniques using electrical apparatus have shown that 75–94% of the subjects had improvement in the pain level.^{12,13}

A modified heat delivery equipment, the “Energy Accumulator,” was constructed on a similar concept. The principle is that dry heat produced by a heating coil is blown through a nozzle resulting in a regular stream of warmed air. Temperature is controlled with thermostatic electronics to be between 40 and 45°C. The nozzle is equipped with a perforated ceramic plate that would dissipate heat evenly and allow temporary contact with skin without causing irritation or damage. In this study, we investigated the effect of using this equipment to deliver localized and focused heat treatment for frozen shoulder, following the principles of moxibustion and acupoint concepts.

This study aims to evaluate the effectiveness of localized heat therapy using the Energy Accumulator on acupoints combined with mobilization exercise for the treatment of frozen shoulder through a cohort study. The hypotheses are that localized dry heat therapy delivered by the Energy Accumulator utilizing acupoint concepts is more effective than conventional thermal therapy in

physiotherapy treatment of frozen shoulders, in terms of faster pain control, better patient acceptance, and more rapid and better improvement of movements.

MATERIALS AND METHODS

Thirty-eight subjects were recruited by convenience sampling method. Patients were recruited between September 2014 and August 2015 from a frozen shoulder care unit of a regional specialized orthopedic clinic. They were assessed and diagnosed by an orthopedic surgeon to have frozen shoulders based on Codman's

Table 1: Codman's criteria for frozen shoulder (At least 6 of the 1–10 criteria, together with criteria 11 and 12)

1. The condition comes on slowly
2. Pain is felt near the insertion of deltoid
3. Inability to sleep on the affected side
4. Painful and incomplete elevation
5. Painful and incomplete external rotation
6. Restriction of movement of both spasmodic type
7. Restriction of movement of adherent type
8. Atrophy of the supra- and infra-spinatus muscles
9. Little local tenderness
10. X-rays is negative except for bony atrophy
11. The pain is rated as significant to every one of them
12. They were all able to continue their daily habits and routines with their affected arms

Reference

Codman EA. The shoulder; rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston, Mass: [T. Todd Company, printers]; 1934.



Figs 1A to E: Details on the Energy Accumulator (A) outlook; (B) Ceramic plate with temperature sensors at the hot air outlet; (C) handle with on/off switch and air inlets; (D and E) The 2-way holding of the device

12 criteria¹⁴ (Table 1). This study was conducted in compliance with the Declaration of Helsinki and was approved by The Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee (Ethics approval number: 2014.092-T).

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) male or female gender with age between 40 and 65; (2) affect one shoulder only; and (3) onset is more than 3 months at the time of inclusion into the study. Exclusion criteria included: (1) unstable medical conditions; (2) unstable mental state; (3) have skin lesion over the shoulder; (4) skin sensitivity to heat; (5) pregnant or under lactation; and (6) could not comply with heat treatment of the shoulder.

Treatment Components: (1) Energy Accumulator and (2) Home Exercise Program

Heat therapy was carried out on an outpatient basis by a physiotherapist and requested to exercise at home. At the same time, a research assistant attended the heat therapy sessions responsible for subject recruitment, conducting questionnaires, assisting with assessment, and data analysis.

Energy Accumulator (Figs 1A–E)

Energy Accumulator was a portable handheld device invented for local heat therapy for healthcare purpose. The outlook from different angles was shown in 1A to E. It had received the patent from mainland China (Publication number: CN 101,212,946A) and international (Publication number: WO2006/ 086,920-Chi-2006.8.24), registered and passed the safety manufacturing requirements of Hong Kong Productivity Council and was approved by the Hong Kong Electrical and Mechanical Services Department as a safe-to-use healthcare device. There were two inlets in the Energy Accumulator: one of the inlets produced hot air similar to a blow dryer while the other inlet was connected to a ceramic plate. A temperature sensor at the ceramic plate monitored the temperature and cut-off heat transmission when a preset temperature of 45°C was reached. The heat produced was even, mild and usually well tolerated by patients. Potential adverse effects that might be associated with the Energy Accumulator included overheating and burning, skin rashes due to the heat and rubbing, or allergy to materials. Any one of these adverse effects might cause blister formation. Extreme caution was given to avoid such adverse effects to happen. No adverse effects were recorded.

Home Exercise Program (Fig. 2)

Home exercises aimed at providing gentle mobilization at the shoulder and were capable of carrying out at home. Patients were requested to perform the movements on a daily basis within the first 4 weeks of treatment. Four movements were involved: Movement 1– Pendular Exercise, Movement 2– Circle Exercise, Movement 3– Wall Climbing Exercise, and Movement 4– Lie on bed and move both arms up and down.

Energy Accumulator–Acupoint Concepts

All subjects were treated with thermal therapy using the Energy Accumulator by acupoint concepts. The course included eight sessions of treatment, twice every week for 4 weeks. Each session lasted for 30–45 minutes. During heat therapy, the ceramic nozzle of the Energy Accumulator was lightly pressed in contact with the skin, without any contact medium, and moved slowly along the meridians with some circular movements. The concept of acupoints followed roughly three related meridians: “Triple Energizer (TE),

Large Intestine (LI), and Small Intestine (SI),” and the line along the frontal plane to EX–UE 12 (Table 2 and Fig. 3) according to standard Chinese meridian concept. Each meridian was run 10 times.

Table 2: Acupuncture points that are covered in the meridians

Jianyu (LI 15)	Anterior-inferior to the acromion, on the upper portion of Deltoids and between the acromion and greater tuberosity of humerus
Jianqian (EX-UE 12)	In the midpoint of anterior crease of the axilla and Jianyu (LI 15)
Binao (LI 14)	Superior to the lower end of Deltoids
Naoshu (SI 10)	In the depression vertically above the posterior crease of the axilla and below the lower border of the spine of scapular
Jianzhen (SI 9)	Posterior and inferior to the shoulder joint. When the arm is adducted, it is located 1 inch above the posterior end of the axillary fold
Jianliao (TE 14)	In the depression posterior to the acromion when the arm is abducted
Naohui (TE 13)	Lateral side of the forearm, 3 inches below TE 14 and on the posterior border of Deltoids

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Data Collection Timepoints

The subject undergone pain (VAS) assessment every session while range of movement (Range of Motion Assessment), shoulder function (Oxford Shoulder Score, Shoulder Pain, and Disability Index), and their quality of life while living with the frozen shoulder (SF-12) and days of sick leave before Session 1 and after Session 8 were measured to document any changes before and after treatment. The frequency and duration of home exercises were charted.

Outcome Measures

Primary outcome measures included VAS (measure the changes in pain level), Oxford Shoulder Score (OSS),² and Shoulder Pain and Disability Index (SPADI). Secondary outcome measures included SF-12, Days of sick leave per month, and Range of Motion Assessment.



Figs 2A to D: Demonstration of home exercises (4 movements). (A) Movement 1–pendular exercise: swing the affected arm forward and backward 6 times. 3 times a day. (B) Movement 2–circle exercise: circle in clockwise direction 6 times; and in anti-clockwise direction 6 times. 3 times a day. (C) Movement 3–wall climbing exercise: move the affected arm up and down the wall 6 times. 3 times a day. (D) Movement 4–lie on bed and move both arms up and down: grasp both hands and keep the elbows straight. move the arms up above the shoulders, and down 6 times. 3 times a day

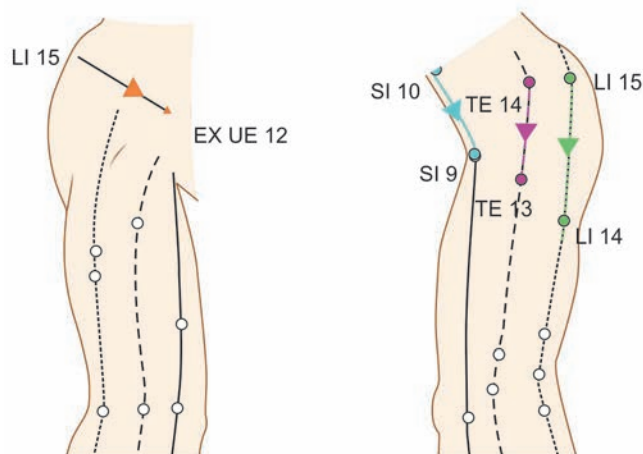


Fig. 3: Meridians and acupoints used for the treatment of frozen shoulder in this study

Statistics and Sample Size Calculation

Change in VAS was used as the primary outcome of our study. It was reported that the minimal clinical important change of VAS is 30%,¹⁵ taking it as the difference between two groups at the end of the study. Using 80% power and 5% type I error, the total sample size would be 68. If there is a 10% dropout rate, then a total of 76 subjects will be needed. In this consideration, the testing group is set at 38 subjects. IBM SPSS 26 was used for

data analysis. Factors were considered significant at a level of $p < 0.05$. Independent t -test was used for between-group comparisons for continuous variables whereas Chi-square tests was performed for categorical variables. The primary dependent variables to determine the success of the program were (1) VAS, (2) OSS, (3) Shoulder Pain and Disability Index. The secondary outcomes included (1) Range of Motion Assessment, (2) sick leave days, and (3) SF-12. The outcome measures were analyzed according to the intention-to-treat principle for those drop-out cases.

RESULTS

A total of 38 patients were treated by the Energy Accumulator and analyzed with an intention to treat method (Table 3).

The results are shown in Table 4. VAS was significantly reduced by 2.05 points ($p < 0.01$), and improvement in OSS by a mean of 10 points, vs a mean of 4.93 points reported ($p < 0.01$), after 4 weeks of treatment. The SPADI showed improvement in both the pain scale (a mean reduction of 35.91 points, $p < 0.01$), and the disability scale (a mean reduction of 20.4 points, $p = 0.01$).

There was an improvement with a range of movement, with an average improvement of active movement of 58.94 degrees ($p < 0.01$), and a passive range of movement of 48.94 degrees ($p < 0.01$). Active flexion was a mean of 158 degrees, abduction 165.48 degrees, and external rotation 79.35 degrees. Passive flexion was a mean of 163.55 degrees, abduction 167.42 degrees, and external rotation 80.48 degrees. Handgrip also showed an improvement of 2.64 Kg force.

Table 4: Shoulder problem, Pain, QOL, and ROM at baseline and after 4 weeks

	Localized thermal therapy			p-value
	Mean ± SD / N(%)			
Variables	Baseline (N = 38)	After 4 weeks (N = 32)	Mean change ± SD	
Oxford shoulder score (OSS)				
0–19 (severe)	2 (5.3%)	–		
20–19 (moderate to severe)	5 (13.2%)	–		
30–39 (mild to moderate)	23 (60.5%)	5 (15.6%)		
40–48 (satisfactory)	8 (21.1%)	27 (84.4%)		
Mean ± SD	33.39 ± 6.08	42.81 ± 3.39*	10.28 ± 4.78	<0.01
SPADI				
Pain scale	51.16 ± 18.11	18.09 ± 13.67*	–35.91 ± 14.68	<0.01
Disability scale	37.99 ± 20.51	11.80 ± 13.14*	–28.87 ± 16.50	0.01
Total	43.06 ± 18.06	14.22 ± 12.80*	–31.57 ± 13.10	<0.01
SF-12				
Physical	39.69 ± 8.15	45.03 ± 7.79*	6.32 ± 6.40	<0.01
Mental	46.95 ± 11.70	53.94 ± 6.51*	6.60 ± 9.57	0.03
VAS	4.09 ± 2.05	2.09 ± 1.20*	-2.05 ± 1.91	<0.01
Grip strength	22.82 ± 9.65	25.14 ± 8.81*	2.64 ± 4.91	
Active ROM, degrees†	356.79 ± 83.86	402.90 ± 51.59*	58.94 ± 47.98	<0.01
Flexion	138.50 ± 29.14	158.06 ± 20.40*	24.90 ± 17.74	
Abduction	148.55 ± 35.16	165.48 ± 25.28*	21.13 ± 30.95	
External rotation	69.74 ± 25.01	79.35 ± 17.02*	12.90 ± 15.04	
Passive ROM, degrees†	372.53 ± 76.85	411.45 ± 47.12*	48.94 ± 46.14	<0.01
Flexion	146.74 ± 25.78	163.55 ± 16.08*	21.03 ± 17.01	<0.01
Abduction	153.29 ± 31.74	167.42 ± 24.76*	17.26 ± 28.16	0.03
External rotation	72.50 ± 24.46	80.48 ± 16.95*	10.65 ± 14.53	0.18

QOL, = Quality of life; ROM, Range of motion; SF-12, Short Form 12; VAS, Visual analog scale; † Sum of amplitudes of movement in flexion, abduction, and external rotation; *p-value < 0.001 of paired t test, comparing baseline and after 4 weeks; ‡p-value of t-test, comparing localized thermal therapy with control; ^a Change in 6 weeks for patients with home exercise, Russell S, Jariwala A, Conlon R, et al. A blinded, randomized, controlled trial assessing conservative management strategies for frozen shoulder. J Shoulder Elbow Surg. 2014; 23:(4)500–7. doi: 10.1016/j.jse.2013.12.026; ^b Change in 6 weeks for patients with saline injection alone. Carotte S, Moffett H, Tardif J, et al. Intraarticular corticosteroids, supervised physiotherapy, or a combination of the two in the treatment of adhesive capsulitis of the shoulder. Arthritis and rheumatism, 2003; 48:(3)829–838; ^c Change in 6 weeks for patients with placebo injection (5 mL of 1% lidocaine), Yoon SH, Lee HY, Lee HJ, et al. Optimal dose of intra-articular corticosteroids for adhesive capsulitis: A randomized, triple-blind, placebo-controlled trial. The American journal of sports medicine. 2013; 41:(5)1133–1139

Table 3: Subject characteristics

Demographic characteristics	Mean \pm SD or N(%)
Gender	
Female	26 (68.4)
Male	12 (31.6)
Age (Years)	
< 50	7 (18.4)
50–59	18 (47.4)
60 or above	13 (34.2)
Mean \pm SD	55.4 \pm 6.3
Dominant hand–Right	37 (97.4)
Affected hand–Right	22 (57.9)

SF-12 quality of life measure showed a physical scale average improvement of 6.32 points (vs 2.5 points reported, $p < 0.01$), and

mental scale an average improvement of 6.60 points (vs 2.6 points reported, $p = 0.03$).

DISCUSSION

The etiology of frozen shoulder is multifactorial, and the pathology is not completely understood. However, pain and stiffness of the shoulder are the two symptoms most reported by patients and are the primary goals for treatment. Among all treatment modalities, heat therapy has been found to be most effective in pain control and early reduction of stiffness. The heat treatment provided by the Energy Accumulator is different from conventional modalities. With the Energy Accumulator, the heat delivered is regulated at a consistent temperature. It is not just applied to any localized tender point. It is not static but is instead moved over a broad area around the shoulder following meridian points. The result of our study showed that this form of

heat treatment has resulted in much better pain reduction and improvement in shoulder movement.

Traditional Chinese medicine principles consider the cause of frozen shoulder a result of abnormal “wind,” “coldness,” and “dampness” in the shoulder. Heat applied by the Energy Accumulator along the meridians probably counterbalanced such disturbances resulting in rapid resolution of symptoms. The meridian chosen in our study was designed based on information from standard Chinese medicine literature and expert opinion from acupuncture and moxibustion specialist. With the Energy Accumulator, it was not necessary to locate each acupoint exactly along the meridians, because the ceramic nozzle has a diameter of around 3 cm, and it is a nonpenetrating device. An approximate tracing along the meridians was sufficient for the effects to be delivered.

Our patients were carefully selected and assessed to ensure that they were suffering from an established frozen shoulder. Patients with symptoms under 3 months had a chance for spontaneous improvement and were excluded from the study. Therefore, most of our patients had received some form of prior treatments which did not work, and they were looking for new solutions. They were reluctant to undergo another course of conventional treatment as “control.” We ended up having one prospective treatment group using the Energy Accumulator and compared our results with reported, historical data, which showed that the Energy Accumulator produced much better results than conventional means. These preliminary efficacy data should form the basis for a randomized controlled trial in the future. For further study, it may be better to have a larger sample size, longer treatment cycle, double-blinded design, and a post-treatment evaluation.

Limitation of this Study

In this cohort, due to the available resources, subjects received eight treatment sessions in 4 weeks. Some other studies, such as the reported by Li et al. who used self-administered acupressure over 8 weeks gave a significant reduction of pain and good improvement in physical functions in older adults.¹⁴ Lack of follow-up evaluation for long-term effects, such as at 6-month and/or 12-month interval post-treatment regime was another limitation. A parallel controlled group was recommended to compare frozen shoulder patients under conventional treatment, which should have been performed limited by available resources as mentioned.

CONCLUSION

Heat therapy delivered by the Energy Accumulator along traditional meridians over the shoulder was effective in reducing pain and improving stiffness among patients with frozen shoulder of over 3 months. The results were superior to reported data using conventional modalities. A randomized controlled trial with controls to further establish the clinical efficacy is warranted.

List of Abbreviations Used

TCM: Traditional Chinese Medicine
OSS: Oxford Shoulder Scale
SPADI: Shoulder Pain & Disability Index
VAS: Visual Analog Scale
ROM: Range of Motion
MUI: manipulation under injection

TE: Triple Energizer
LI: Large Intestine
SI: Small Intestine

Patient Declaration Statement

“The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.”

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