

Efficacy of soothing cream gel on the range of motion and chronic pain at shoulder and elbow: Protocol of a Double-blinded, Randomized, Placebo-controlled Trial

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Abstract

Background: Upper limb problems are very common, which affects about 4-35% of people worldwide. Among the joints of the upper limbs, the point prevalence of shoulder pain was 7-26% and elbow pain was 11%. Due to the pain symptom, it will affect the range of motion of the joints and even the quality of life of those populations. Nowadays, the treatment for pain symptoms usually includes nonsteroidal anti-inflammatory drugs or corticosteroids. However, the relapse rate and the treatment cost are very high. Therefore, many patients seek non-pharmaceutical therapies or complementary and alternative medicine to relieve the symptoms. To offset this shortcoming, topical treatment is another option for upper limb problems with fewer side effects.

Objective: To evaluate the efficacy of soothing cream gel (SCG) on the range of motion and chronic pain at the shoulder and elbow.

Methods: Soothing cream gel and placebo gel will be used in this double-blinded, randomized, placebo-controlled trial. The soothing cream gel consists of Vitis Vinifera essence, Melaleuca Viridiflora essential oil, and Eucalyptus Globulus essential oil, and is produced and packed by a manufacturer with a Good Manufacturing Practice certificate. Placebo cream gel is provided by the same manufacturer, it does not contain any active ingredients but will match the appearance, texture and smell as closely as the soothing cream gel. A total of 70 participants who suffer from upper limb problems and fulfil the eligibility criteria will be randomized into the treatment group (soothing cream gel) or the placebo group (placebo gel) for 2 weeks. The range of motion of the upper limb will be measured as the primary outcome; active flexion and abduction will be measured by a goniometer for the shoulder and active flexion and extension will be measured for the elbow. The primary efficacy analyses will be based on the full analysis set (FAS) following the intention-to-treat principle.

Discussion: The study medication used in this trial is an extraction of some botanicals, which have inflammatory and analgesic effects. We expected that the soothing cream gel could refresh the sore and fatigued muscles and improve the participants' motor ability of the affected upper limb. Besides, we hope to provide evidence of an effective and safe treatment for this prevalent health problem. Trial registration: This trial was registered at ClinicalTrials.gov on 7 June 2023, with the registration ID: NCT05799391.

Background

Upper limb problems are very common in the general population, usually presenting with pain or inability to move. The prevalence rates (the number of people affected with a disorder at a specified point in time) of this problem varied between studies, which ranging from 4–35% in 2003 (1). In 2014, up to 48% of working-aged English adults reported upper limb pain (2), with 14% persistent pain (> 6 months), and 10% of disabling pain (affecting sleep, getting dressed and doing chores) (3). Upper limb pain causes considerable morbidity, sickness absence and brings out a significant economic impact (4). The prevalence rate is still increasing nowadays, especially among the working population and athletes.

The overhead athlete is an athlete who uses their hand in an overhead position. They participate in sports such as baseball, softball, volleyball, water polo, lacrosse, javelin, golf, swimming, football, and many kinds of racquet sports, such as tennis and badminton (5–9). Overhead athletes place high demands as well as overload on the upper limb mobility, strength and stability during training and competition. Therefore, injuries to the shoulder and elbow are very common in this group. A systematic review was conducted in 2015, it concluded that among the joints of the upper limbs, the point prevalence of shoulder pain was 7–26% and elbow pain was 11% (10). Pieper reported that 45% of handball players suffered from shoulder pain (11).

Whether overhead athletes or general populations, pain can have a huge impact on our bodies. For example, upper limb pain or disorder may affect the performance in the handgrip strength test. Cesar and colleagues reported that there were statistically significant differences in the handgrip strength in the patients with or without shoulder pain (12). A trial conducted in Korea found that patients with upper limb pain had lower handgrip strength (13) and the stability of the strength test was also affected (14). Several studies reported that athletes with greater handgrip strength usually had better sports performance or sporting ability (15–18).

Besides that, a decrease in the range of motion is another problem for those athletes. The internal and external rotation degree of the shoulder in the pain group is lesser than in the non-pain group (19), which indicates that their activities will be limited or affected by the pain symptom.

Other than the negative impact on the physical function, patients' psychological, and behavioural functions are also affected (20). A number of studies concluded that pain has a significant adverse effect on the quality of life of patients (21–23), regardless of the pain category and the affected site. Several studies used a 36-Item Short Form Survey (SF-36) and Psychological General Well-Being Scale (PGWB) to measure the quality of life of patients and showed that patients with chronic pain scored lower in QOL than other diseases, e.g. gastrointestinal, hypertension, or even psychiatric problem (21, 24–27). Therefore, there is a need to treat this problem.

In general practice, oral nonsteroidal anti-inflammatory drugs (NSAIDs) or NSAID gels are often used for painful symptoms. However, those treatments only last for a short period. The injection of corticosteroids also has been used for many years. About 90% of participants can obtain a rapid response and it can last as long as 6 weeks after the injection, but the relapse rate and the treatment cost are very high (28, 29).

In view of the situation, patients would like to seek non-pharmaceutical therapies or complementary and alternative medicine (CAM) to relieve the symptoms. In general, those therapies will be divided into three groups, which are peripheral therapies (e.g. Transcutaneous Electrical Nerve Stimulation (TENS), hot-cold treatment, acupuncture and acupressure, exercises, positioning, immobilization massage, and hydrotherapy); another group is cognitive-behavioural therapies (e.g. relaxation-respiration techniques and dreaming, distraction, praying, meditation, yoga, hypnosis, biological-feedback, behavioural therapy); and the last group is other therapies (e.g. reflexology, herbal treatments, aromatherapy, chiropractic, and musical therapy) (30).

Nowadays, more and more people seek and even use natural remedies because of the side effects of drugs or other treatments. In fact, many herbal plant extracts have curative effects, but relatively side effects are lesser, and many natural or botanical products have been launched to the market. Topical herbal remedies are used to treat various diseases such as common colds, muscle pain, and rheumatism. The soothing cream gel consists of *Vitis Vinifera* essence, *Melaleuca Viridiflora* essential oil, and *Eucalyptus Globulus* essential oil. *Vitis Vinifera* and *Eucalyptus Globulus* have been reported to possess a broad spectrum of pharmacological and therapeutic effects, such as anti-oxidative, anti-inflammatory, and antimicrobial activities, etc. (31). *Eucalyptus Globulus* also process central and peripheral analgesic effects (32). *Melaleuca Viridiflora* is a compound that is extracted from Niaouli, the pale yellow oil is a potent antiseptic, particularly against yeast infections, and is widely used in cosmetic products, including skin care lotions, soaps, mouthwashes, and toothpaste (33).

Among the topical analgesics for treating upper limb pain, most of them contain opioids or nonsteroidal anti-inflammatory drugs (NSAIDs). Although the side effects are comparatively less than oral administration, many patients still hesitate to use these products. On the other hand, there is a lack of clinical evidence for using natural herbal extracts to relieve upper limb pain, therefore, we aim to explore a more effective and safer treatment method for those patients.

Objectives

To evaluate the efficacy of soothing cream gel (SCG) on the range of motion and chronic pain at the shoulder and elbow.

Hypothesis

We hypothesize that the range of motion of the participants' shoulder and elbow can be improved and the pain symptom can be relieved after using the soothing cream gel.

Methods

Study design

This is a double-blinded, randomized, placebo-controlled clinical trial that will investigate the efficacy of the SCG in participants with chronic pain and range of motion problems at the shoulder or elbow. Participants will be randomized into a treatment group or placebo group for 2 weeks and followed up by 2 weeks of the post-treatment period. Total of 70 participants will be recruited in this trial; the range of motion will be measured as the primary outcome (Fig. 1).

Study population

Participants will be recruited from the following clinics/Chinese medicine centres: (1) The CUHK Chinese Medicine Specialty Clinic and Teaching and Research Centre on CUHK campus (CUHK-CMSCTRC); (2)

Department of Sports Science and Physical Education, CUHK; (3) The two Integrative Medical Centres, Hong Kong Institute of Integrative Medicine at Shatin and Wan Chai. Advertisements of posters and internet platforms, such as CUHK mass mail, Facebook, emails, and websites will be made to facilitate recruitment. Potential participants who meet the eligibility criteria will be recruited.

Inclusion criteria

- Age 18–60;
- Participates in regular physical activity, at least once a week for 30 minutes;
- Chronic pain in the shoulder or elbow longer than 3 months;
- 11-items Numeric pain rating scale ≥ 4 ; and
- Willing to provide written informed consent.

Exclusion criteria

- The patient had received previous physiotherapy, acupuncture, Tui Na massage, or bone-setting treatment for distal upper limb pain within the past 2 weeks;
- The pain was due to a fracture or known complex regional pain syndrome.
- History of upper limb surgery;
- Known severe medical conditions (e.g. rheumatoid arthritis, osteoporosis, cardiac, renal, hepatic, haematological diseases, vertigo, seizure, infection, malignancy, neurological impairment);
- Concomitant drugs of NSAIDs, any kind of painkillers, or anti-inflammatory drugs 15 days prior to randomization;
- Known impaired haematological profile and liver / renal function;
- Known allergic history to any topical cream;
- Known pregnant or lactating; or
- Unable to complete questionnaires

Study outcome (Table 1)

Table 1
Study outcomes

Primary outcome (Compared with baseline)	Time of assessment
Range of motion of shoulder and elbow measured by goniometer	Week 2 and week 4
Secondary outcome (Compared with baseline)	
Scores of Numeric Pain Rating Scale (NPRS)	Week 2 and week 4
Handgrip strength measured by a dynamometer	Week 2 and week 4
Scores of the back-scratch test	Week 2 and week 4
Scores of American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASESp-S)	Week 2 and week 4
Scores of American Shoulder and Elbow Surgeons Standardized Elbow Assessment Form (ASESp-E)	Week 2 and week 4
Scores in quality of life measured by 36-Item Short Form Survey (SF-36v2)	Week 2 and week 4
Rescue drugs or treatments used for pain symptoms	Baseline to week 4

Patient visits schedule (Table 2)

Table 2
Patient visits schedule

Items	Screening & Baseline	Treatment period	Post-treatment follow up
	Day 0	Week 2 (± 3 days)	Week 4 (± 3 days)
Clinical Assessment			
Informed consent	✓		
Eligibility	✓		
Medical consultation and assessment	✓	✓	✓
Medical history	✓		
Concomitant medication	✓	✓	✓
Vital sign (BP /pulse)	✓		
AE/SAE assessment		✓	✓
Outcome Assessment			
Range of motion of upper limb (shoulder, elbow)	✓	✓	✓
Numeric pain rating scale (NPRS)	✓	✓	✓
Upper extremity strength	✓	✓	✓
Back-scratch test	✓	✓	✓
ASESp-S (for shoulder pain)	✓	✓	✓
ASESp-E (for elbow pain)	✓	✓	✓
SF36	✓	✓	✓
Intervention			
Administration of study products	✓	✓	

Screening and baseline visiting (Day 0)

Potential participants will be invited for screening, all participants will be provided a written informed consent before any screening procedures. Details of the trial, benefits and risks, assessment and data collection process will be explained to the participants. The research team has to confirm the participants understand the study and have all questions answered to his/her satisfaction during the consent process.

Medical and surgical history will be obtained, and all eligibility criteria will be confirmed by investigators. Baseline assessment including the range of motion, upper extremity strength, back-scratch test, and

questionnaires such as numeric pain rating scale, ASES and SF-36 will be done. Those eligible participants will be randomized into the treatment group (soothing cream gel) or placebo group (placebo cream gel) for 2 weeks. Instruction for applying the cream gel on the pain area will be provided to participants. A participant diary will be provided to the participants for recording compliance.

Follow-up visit (Week 2)

Participants will return for follow-up at 2 weeks after randomization. Outcome assessments which include the range of motion, upper extremity strength, back-scratch test, and questionnaires such as numeric pain rating scale, ASES and SF-36 will be done at this visit to assess any differences after the treatment. Adverse events or serious adverse events will be assessed and recorded, as well as any rescue drugs or treatments used for the pain in this period.

End of study visit (Week 4)

Participants will come back for a post-treatment visit (2 weeks after the treatment) to assess all outcome parameters (the range of motion, upper extremity strength, back-scratch test, and questionnaires such as numeric pain rating scale, ASES and SF-36). Adverse events, serious adverse events, and rescue drugs or treatment will also be assessed and recorded.

Study intervention

Eligible participants will be randomized into a treatment group (SCG 1g twice daily) or placebo group (placebo cream gel 1g twice daily) for 2 weeks. The active ingredient of SCG consists of Vitis Vinifera essence, Melaleuca Viridiflora essential oil, and Eucalyptus Globulus essential oil. One daily dose (2g) of SCG will be sealed into 2 aluminium sachets. Patients will apply one sachet on the pain area (shoulder or elbow) twice daily.

The placebo cream gel consists of a natural base cream and edible pigment and flavouring agent. It will be matched as closely as possible to the appearance, texture and smell of SCG.

Both SCG and placebo cream gel will be produced and packed by a manufacturer with a Good Manufacturing Practice certificate. Since the study product does not fulfil the criteria of the Pharmacy and Poisons Ordinance (Chap. 138) or the definition under Regulation 36B (the regulation) of the Pharmacy and Poisons Regulations, a Certificate for Clinical Trial/Medicinal Test (the certificate) for a pharmaceutical product is not required.

Prohibited treatment/drugs

Any kind of painkillers, NSAIDs, anti-inflammatory drugs, traditional Chinese medicine which is treating for the pain symptoms, or treatments such as occupational therapy, therapeutic massage, acupuncture therapy, and use of fascia gun or massage devices are prohibited during the study period.

Study assessments

Range of motion (ROM)

For the shoulder, active flexion and abduction ROMs are measured using a goniometer while the participants are standing. Flexion ROM is measured in the sagittal plane with the test arm at the side and the forearm pronated, while abduction ROM is measured in the coronal plane with the test arm at the side and the shoulder externally rotating. Participants are instructed to move their arms as far as possible for all movements, limited by pain. Each movement is performed three times, and the best value is used for the data analyses (34).

For the elbow, both flexion and extension will be measured by a goniometer in a standing position, the goniometer was placed on the lateral epicondyle; the stationary arm was placed in the centre of the upper arm, pointing toward the middle third of the lateral edge of the acromion. The distal limb of the goniometer was placed along the dorsal surface of the forearm. The participant was then asked to actively flex and extend his/her arm through the full range of motion. Each movement is performed three times, and the best value is used for the data analyses (35).

Numeric pain rating scale (NPRS)

The Numeric Pain Rating Scale is a unidimensional measure of pain intensity in adults. It contains 11 items in which participants select a whole number (0–10 integers) that best reflects the average intensity of participants' pain in the past week. The 11-point numeric scale ranges from '0' representing one pain extreme (e.g. "no pain") to '10' representing the other pain extreme (e.g. "pain as bad as you can imagine" or "worst pain imaginable") (36).

Upper extremity strength

Handgrip strength is a common test for assessing the sports performance of athletes. Most sports-specific actions involving the hand used the precision grip (used for grasping sphere-shaped objects, e.g. balls), power grip (used for grasping cylindrical-shaped objects, e.g. rackets, paddles), or a variation of these grips. In this trial, handgrip strengths are measured by a dynamometer (12-0604 Digital Dynamometer, Jamar Plus, Bolingbrook, IL, USA) on the dominant hand of the participant. Participants are instructed to hold the device with the arm at the right angle and elbow to the side of the body. The maximum effort will be taken from three attempts (37).

Back-scratch test

The back-scratch test is used to measure the overall shoulder ROM. It is performed by measuring the distance between (or the overlap of) the middle fingers of both hands behind the back with a ruler (38, 39).

American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form – Patient self-evaluation (ASESp-S)

The ASES_p-S consists of 18 questions from 3 sections: pain, instability and activities of daily living (ADL). Among the 18 questions, 11 self-report items represented functional ADL dimension (10 items) and pain dimension (1 item). The ADL section was scored on a 4-points-graded ordinal scale, ranging from 0 (unable to do) to 3 (not difficult) and cumulative scores were collected. The pain section was derived from the 10-points-graded visual analogue scale (VAS) ranging from 0 (no pain) to 10 (maximum pain) (40, 41).

American Shoulder and Elbow Surgeons Standardized Elbow Assessment Form – Patient self-evaluation (ASESp-E)

The ASES_p-E consists of 3 sections: pain, function, and satisfaction. Patients are asked about the spot of pain in their elbow and asked to rate pain on a visual analogue scale (VAS) in different situations, such as the worst of pain, at rest, lifting a heavy object, doing a task with repeated elbow movements and at night. The VAS ranges from 0 (no pain) to 10 (maximum pain). In the function section, patients are asked to rate their ability to perform 10 ADLs and their usual work and sporting activities with a scale from 0 (unable to do) to 3 (not difficult) (42).

36-Item Short Form Survey (SF-36v2) (1-week interval)

Quality of life (QOL) is an important parameter in the evaluation of therapeutic interventions in upper limb pain patients. QOL includes health-related factors, such as physical, functional, emotional, and mental well-being, and also non-health-related elements, such as jobs, family, friends, and other life circumstances (43, 44).

SF36 is a generic instrument to measure general health status. It will be used to assess the patient's health status using 8 different dimensions including vitality, physical functioning, bodily pain, general health perceptions, role limitations due to physical health, role limitations due to emotional health, social role functioning and mental health. The possible score ranges from 0 to 100 points whereby 0 points represent the greatest possible limitation of health, while 100 points represent the absence of health restrictions.

Sample size calculation

The primary outcome is the range of motion of active shoulder abduction at week 2 measured with a digital goniometer. Because there is no previous clinical study about soothing cream for patients with chronic shoulder pain on range of motion measured by a goniometer, the data from other studies on acupuncture or physiotherapy were used for estimation of clinically meaningful mean difference in range of motion and standard deviation (SD) (45, 46). In this trial, software Power Analysis & Sample Size (PASS) and a linear mixed model will be used to calculate the sample size. In order to detect an estimated clinically meaningful difference of 20 degrees in the range of motion of shoulder abduction between treatment and placebo control groups, 28 participants in each group will be needed based on the

assumed SD of 26.5 with a two-sided significance level of 0.05 and a power of 80%. Therefore, a total of 70 patients will be needed in this trial, presuming a 20% dropout rate.

Statistical analysis

The primary efficacy analyses will be based on the full analysis set (FAS) following the intention-to-treat principle. Secondary efficacy analyses will be based both on the FAS and the per-protocol set. Continuous variables will be presented as mean value and standard deviation or medians and interquartile ranges, while categorical variables will be presented as frequency and percentage. Differences at baseline between groups will be examined by employing Student's t-test or the Wilcoxon rank-sum test as appropriate for continuous variables and with the use of the Chi-square test for categorical variables. Linear mixed models will be used to compare the primary and secondary outcomes between two groups and explore whether participant characteristics are associated with some outcomes. All statistical tests will be two-sided, and $p < 0.05$ is considered statistically significant. The statistical software of SPSS 26.0 will be used for analysis.

Adverse events will be categorized and the percentage of those experiencing some AEs and serious AEs will be documented. Chi-square tests will be performed to examine differences in the proportion of total and categories of AEs between groups.

Discussion

Upper limb problem is very common and the prevalence rate is increasing from time to time worldwide. The reasons for inducing upper limb problems vary, such as improper posture, repetitive strain injury, or even external injury etc. Among the symptoms of upper limb problems, mostly present as painful, sore sensation, and a decrease of the range of motion of limbs. In addition to the direct impact on the affected area, it will also affect the patient's sleep, mood and other quality of life. Although different treatments can relieve the symptoms, the effects only last for a short period and even come with some side effects. For some patients with severe symptoms, injection of corticosteroid is another choice instead of the conventional oral treatment. However, the treatment cost is usually very high, which will limit the choice of treatments for the patients.

In this century, people are eagerly seeking different natural remedies or products for their health. In this trial, the soothing cream gel will be used for treating upper limb problems. It consists of a few kinds of essential oils from natural botanicals, which have been reported to have an anti-inflammatory and analgesic effect. Among different routes of administration, we believe that topical use of medicinal products is much safer and the side effects are much less than the oral route (47–49). In addition, topical use of medicinal products can have a direct therapeutic effect on the affected area. Therefore, we aim to explore an alternative product that can effectively relieve the symptoms of the upper limb problem, other than the conventional treatment. We expected that the range of motion and the pain symptom of the upper limb could be improved and relieved after using the soothing cream gel.

However, since this is a clinical trial, the dosage of the investigational medicinal products was fixed for all participants. Although we tried our best to standardize the dosage that can cover most of the affected areas of the participants, some participants still required more soothing cream gel for a larger affected area. Besides, some participants get accustomed to having a massage while applying the soothing cream gel on the upper limb, which may also be a confounding factor of positive outcome in this trial.

Abbreviations

QOL

Quality of Life

NSAIDs

Nonsteroidal Anti-Inflammatory Drugs

CAM

Complementary and Alternative Medicine

TENS

Transcutaneous Electrical Nerve Stimulation

SCG

Soothing Cream Gel

NPRS

Numeric Pain Rating Scale

ASESp-S

American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form

ASESp-E

Americans Shoulder and Elbow Surgeons Standardized Elbow Assessment Form

SF-36v2

36-Item Short Form Survey

CUHK-CMSCTRC

The CUHK Chinese Medicine Specialty Clinic and Teaching and Research Centre

CUHK

The Chinese University of Hong Kong

ROM

Range of Motion

ADL

Activities of Daily Living

VAS

Visual Analog Scale

SD

Standard Deviation

FAS

Full Analysis Set

Declarations

Ethics approval and consent to participate

This study complies with the Declaration of Helsinki in ICH-GCP. The study was approved by the Chinese University of Hong Kong Ethics committee. Participants will be informed of ensuring the confidentiality of all information and data will be maintained anonymity. Informed consent will be obtained from all the participants and/or their legal guardians. All information will be encrypted and only the involved investigators can access it. A password is required to access the data. Participants are free to withdraw at any time without giving a reason or punishment. The personal data of the participants will only be kept for 7 years and will be destroyed afterwards. Clinical trial insurance will be purchased before the trial commences.

Consent for publication

Not applicable, no personal data will be published in this manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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The investigational medicinal products were manufactured and provided by Vitas Limited.

Authors' contributions

LZX, CKL, LKK for the conceptualization. SKWR, LFLE, YYJ, CKL, LCW design the study. SCH, LWL responsible for outcome assessment. LKW helps with outcome training. HSH coordinates the trial. LCW prepares the first draft of the manuscript. All authors read and approved the final manuscript.

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References

1. Walker-Bone K, Palmer KT, Reading I, Coggon D, Cooper C. Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. *Arthritis Care Res.* 2004;51(4):642–51.

2. Palmer K, Calnan M, Wainwright D, O'Neill C, Winterbottom A, Watkins C, et al. Upper limb pain in primary care: health beliefs, somatic distress, consulting and patient satisfaction. *Fam Pract*. 2006;23(6):609–17.
3. Palmer KT, Calnan M, Wainwright D, Poole J, O'Neill C, Winterbottom A, et al. Disabling musculoskeletal pain and its relation to somatization: a community-based postal survey. *Occup Med*. 2005;55(8):612–7.
4. Silverstein B, Welp E, Nelson N, Kalat J. Claims incidence of work-related disorders of the upper extremities: Washington state, 1987 through 1995. *Am J Public Health*. 1998;88(12):1827–33.
5. Abrams JS. The overhead athlete: examination, testing, and treatment of shoulder instability. *Arthroscopy*. 2003;19(10):38–41.
6. Mach L. Raising the Bar for the Overhead Athlete. *ACSM's Health & Fitness Journal*. 2023;27(3):8–12.
7. Van Den Bekerom MP, Eygendaal D. Posterior elbow problems in the overhead athlete. *Sports Med Arthrosc Rev*. 2014;22(3):183–7.
8. Bakshi N, Freehill MT. The overhead athletes shoulder. *Sports Med Arthrosc Rev*. 2018;26(3):88–94.
9. Kibler WB, Kuhn JE, Sciascia AD, Uhl TL. The Overhead Athlete. In: Milano G, Grasso A, editors. *Shoulder Arthroscopy: Principles and Practice*. London: Springer London; 2014. pp. 229–47.
10. Thwaites L, Walker-Bone K. Epidemiology of upper extremity pain syndromes. *Manual Therapy for Musculoskeletal Pain Syndromes: an evidence-and clinical-informed approach*. 2015:3.
11. Pieper H-G. Humeral torsion in the throwing arm of handball players. *Am J Sports Med*. 1998;26(2):247–53.
12. Lobo CC, Morales CR, Sanz DR, Corbalán IS, Romero EAS, Carnero JF, et al. Comparison of hand grip strength and upper limb pressure pain threshold between older adults with or without non-specific shoulder pain. *PeerJ*. 2017;5:e2995.
13. Kang SY, Lim J, Park HS. Relationship between low handgrip strength and quality of life in Korean men and women. *Qual Life Res*. 2018;27:2571–80.
14. Innes E. Handgrip strength testing: A review of the literature. *Aust Occup Ther J*. 1999;46(3):120–40.
15. Bonitch Góngora JG, Almeida F, Padial Puche P, Bonitch-Dominguez JG, Feriche Fernández-Castanys MB. Maximal isometric handgrip strength and endurance differences between elite and non-elite young judo athletes. 2013.
16. Demirkan E, Ünver R, Kutlu M, Mitat K. The comparison of physical and physiological characteristics of junior elite wrestlers. *Beden Eğitimi ve Spor Bilimleri Dergisi*. 2012;6(2):138–44.
17. García-Pallarés J, López-Gullón JM, Muriel X, Díaz A, Izquierdo M. Physical fitness factors to predict male Olympic wrestling performance. *Eur J Appl Physiol*. 2011;111:1747–58.
18. Grant S, Hasler T, Davies C, Aitchison TC, Wilson J, Whittaker A. A comparison of the anthropometric, strength, endurance and flexibility characteristics of female elite and recreational climbers and non-climbers. *J Sports Sci*. 2001;19(7):499–505.

19. Almeida GPL, Silveira PF, Rosseto NP, Barbosa G, Ejnisman B, Cohen M. Glenohumeral range of motion in handball players with and without throwing-related shoulder pain. *J Shoulder Elbow Surg.* 2013;22(5):602–7.
20. Organizations JCoAoH. Pain assessment and management: an organizational approach. (No Title). 2000.
21. Becker N, Thomsen AB, Olsen AK, Sjøgren P, Bech P, Eriksen J. Pain epidemiology and health related quality of life in chronic non-malignant pain patients referred to a Danish multidisciplinary pain center. *Pain.* 1997;73(3):393–400.
22. Skevington SM. Investigating the relationship between pain and discomfort and quality of life, using the WHOQOL. *Pain.* 1998;76(3):395–406.
23. Hagen K, Kvien T, Bjørndal A. Musculoskeletal pain and quality of life in patients with noninflammatory joint pain compared to rheumatoid arthritis: a population survey. *J Rheumatol.* 1997;24(9):1703–9.
24. Stewart AL, Hays RD, Ware JE Jr. The MOS short-form general health survey: reliability and validity in a patient population. *Med Care.* 1988;724–35.
25. Wells KB, Stewart A, Hays RD, Burnam MA, Rogers W, Daniels M, et al. The functioning and well-being of depressed patients: results from the Medical Outcomes Study. *JAMA.* 1989;262(7):914–9.
26. Ware J, John E, Gandek B. The SF-36 Health Survey: Development and use in mental health research and the IQOLA Project. *Int J mental health.* 1994;23(2):49–73.
27. Arnold LM, Witzeman KA, Swank ML, McElroy SL, Keck PE Jr. Health-related quality of life using the SF-36 in patients with bipolar disorder compared with patients with chronic back pain and the general population. *J Affect Disord.* 2000;57(1–3):235–9.
28. Bisset L, Beller E, Jull G, Brooks P, Darnell R, Vicenzino B. Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. *BMJ.* 2006;333(7575):939.
29. Bisset L, Paungmali A, Vicenzino B, Beller E. A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. *Br J Sports Med.* 2005;39(7):411–22.
30. Demir Y. Non-pharmacological therapies in pain management. *Pain management-Current issues and opinions: IntechOpen;* 2012.
31. Nassiri-Asl M, Hosseinzadeh H. Review of the pharmacological effects of *Vitis vinifera* (Grape) and its bioactive compounds. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives.* 2009;23(9):1197–204.
32. Silva J, Abebe W, Sousa S, Duarte V, Machado M, Matos F. Analgesic and anti-inflammatory effects of essential oils of *Eucalyptus*. *J Ethnopharmacol.* 2003;89(2–3):277–83.
33. Rabinovich D. Essential chemistry. *Chem Int.* 2016;38(3–4):33.

34. Hayes K, Walton JR, Szomor ZL, Murrell GA. Reliability of five methods for assessing shoulder range of motion. *Australian J Physiotherapy*. 2001;47(4):289–94.
35. Meislin MA, Wagner ER, Shin AY. A comparison of elbow range of motion measurements: smartphone-based digital photography versus goniometric measurements. *J Hand Surg*. 2016;41(4):510–5. e1.
36. Jensen MP, McFarland CA. Increasing the reliability and validity of pain intensity measurement in chronic pain patients. *Pain*. 1993;55(2):195–203.
37. Cheng KYK, Chow SKH, Hung VWY, Wong CHW, Wong RMY, Tsang CSL, et al. Diagnosis of sarcopenia by evaluating skeletal muscle mass by adjusted bioimpedance analysis validated with dual-energy X-ray absorptiometry. *J cachexia sarcopenia muscle*. 2021;12(6):2163–73.
38. Hui SS-C, Liu J, Yang Y-J, Wan JH-P, Suen BK-P. Yi Jin Bang exercise versus usual exercise therapy to treat subacromial pain syndrome: A pilot randomised controlled trial. *Res Sports Med*. 2023;31(6):846–58.
39. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Act*. 1999;7(2):129–61.
40. Richards RR, An K-N, Bigliani LU, Friedman RJ, Gartsman GM, Gristina AG, et al. A standardized method for the assessment of shoulder function. *J Shoulder Elbow Surg*. 1994;3(6):347–52.
41. Tie T-HA, Hong C-K, Chua I, Kuan F-C, Su W-R, Hsu K-L. The Chinese version of the American shoulder and elbow surgeons standardized shoulder assessment form questionnaire, patient self-report section: a cross-cultural adaptation and validation study. *BMC Musculoskelet Disord*. 2021;22(1):382.
42. King GJ, Richards RR, Zuckerman JD, Blasier R, Dillman C, Friedman RJ, et al. A standardized method for assessment of elbow function. *J Shoulder Elbow Surg*. 1999;8(4):351–4.
43. Gill TM, Feinstein AR. A critical appraisal of the quality of quality-of-life measurements. *JAMA*. 1994;272(8):619–26.
44. Golchin M, Attarchi M, Mirzamohammadi E, Ghaffari M, Mohammadi S. Assessment of the relationship between quality of life and upper extremity impairment due to occupational injuries. *Med J Islamic Repub Iran*. 2014;28:15.
45. Hayes K, Ginn KA, Walton JR, Szomor ZL, Murrell GA. A randomised clinical trial evaluating the efficacy of physiotherapy after rotator cuff repair. *Australian J Physiotherapy*. 2004;50(2):77–83.
46. de Hoyos JAG, Martín MCA, Lopez MV, López TM, Morilla FAV, Moreno MJG. Randomised trial of long term effect of acupuncture for shoulder pain. *Pain*. 2004;112(3):289–98.
47. Klinge SA, Sawyer GA. Effectiveness and safety of topical versus oral nonsteroidal anti-inflammatory drugs: a comprehensive review. *The Physician and sportsmedicine*. 2013;41(2):64–74.
48. Rannou F, Pelletier J-P, Martel-Pelletier J, editors. Efficacy and safety of topical NSAIDs in the management of osteoarthritis: evidence from real-life setting trials and surveys. *Seminars in arthritis and rheumatism*. Elsevier; 2016.

49. Zeng C, Doherty M, Persson M, Yang Z, Sarmanova A, Zhang Y, et al. Comparative efficacy and safety of acetaminophen, topical and oral non-steroidal anti-inflammatory drugs for knee osteoarthritis: evidence from a network meta-analysis of randomized controlled trials and real-world data. Osteoarthr Cartil. 2021;29(9):1242–51.

Figures

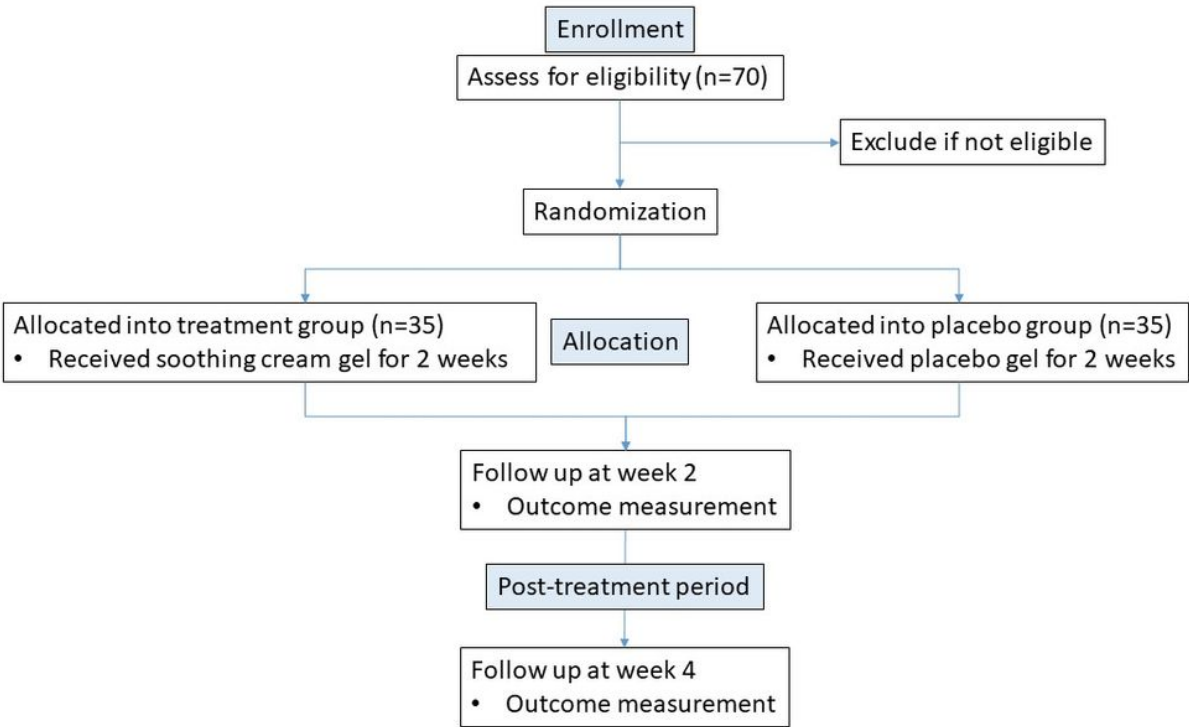


Figure 1

Study design