



REVIEW ARTICLE (META-ANALYSIS)

Comparative Effectiveness of Nonoperative Treatments for Chronic Calcific Tendinitis of the Shoulder: A Systematic Review and Network Meta-Analysis of Randomized Controlled Trials

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Abstract

Objective: To investigate the effectiveness of various nonoperative treatments for chronic calcific tendinitis of the shoulder, a systematic review and network meta-analysis of randomized trials was performed to evaluate changes in pain reduction, functional improvements in patients with calcific tendinitis, and the ratio of complete resolution of calcific deposition.

Data Sources: Studies were comprehensively searched, without language restrictions, on PubMed, Embase, Cochrane Controlled Trials Register, the Cochrane, and other databases. The reference lists of articles and reviews were cross-checked for possible studies.

Study Selection: Randomized controlled trials from before August 2016 were included. Study selection was conducted by 2 reviewers independently.

Data Extraction: The quality of studies was assessed and data extracted by 2 independent reviewers. Disagreements were settled by consulting a third reviewer to reach a consensus.

Data Synthesis: Fourteen studies with 1105 participants were included in the network meta-analysis that used a random-effect model to investigate the mean difference of pooled effect sizes of the visual analog scale, Constant-Murley score, and the ratio of complete resolution of calcific deposition on native radiographs.

Conclusions: The present network meta-analysis demonstrates that ultrasound-guided needling (UGN), radial extracorporeal shockwave therapy (RSW), and high-energy focused extracorporeal shockwave therapy (H-FSW) alleviate pain and achieve complete resolution of calcium deposition. Compared with low-energy focused extracorporeal shockwave therapy, transcutaneous electrical nerve stimulation, and ultrasound therapy, H-FSW is the best therapy for providing functional recovery. Physicians should consider UGN, RSW, and H-FSW as alternative effective therapies for chronic calcific tendinitis of the shoulder when initial conservative treatment fails.

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Calcific tendinitis of the shoulder is characterized by inflammation around deposits of calcium carbonate apatite crystals in the tendons.^{1,2} The prevalence of calcific tendinitis ranges from 7% to 36%.² It is a common disease that manifests most frequently in middle-age adults, and symptoms affect women more than men.^{3,4} The supraspinatus tendon of the rotator cuff appears to be the most

affected.⁵⁻⁷ The predominant clinical features of the disease include shoulder pain, decreased range of motion, and increased disability of the shoulder.

The natural course of the disease can range over a span of months to years.⁸ Calcific tendinitis can be classified into 3 stages.⁹ In the precalcific stage, the site of calcification involves cellular changes. During the subsequent calcific stage, there is calcium deposition. This stage includes an initial resting phase,

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which is followed by a resorptive phase, during which most patients complain of pain. Finally, the calcium deposition becomes less intense and fades away gradually in the postcalcific stage. The initial conservative treatments we provide for calcific tendinitis include physiotherapy and nonsteroidal anti-inflammation drugs.^{10,11} When some cases progress to chronic calcific tendinitis, we consider alternative therapies such as local injection,¹² extracorporeal shockwave therapy (ESWT),^{6,13-21} ultrasound therapy,^{22,23} transcutaneous electrical nerve stimulation (TENS),¹³ and an ultrasound-guided needling (UGN) procedure.²⁴⁻²⁷ Surgery might be considered after 6 months of treatment²⁸; however, it is an invasive and costly procedure, and postoperative complications sometimes occur.²⁷

A growing body of literature indicates that ESWT is usually considered when conservative treatment fails. ESWT uses different types of shockwave generators, such as focused extracorporeal shockwave therapy (FSW) and radial extracorporeal shockwave therapy (RSW). FSW uses acoustic pulses that are converted into a sequence of high peak pressure waves focused on the desired target region. Its biological effects have been reported, including denervation of pain receptors, deposit fragmentation, phagocytosis, and neovascularization.^{24,29,30} The device has been used for lateral epicondylitis, calcific tendinitis, and plantar fasciitis.¹² Clinically, FSW can be further divided into low-energy FSW (L-FSW) and high-energy FSW (H-FSW), with an energy flux density of $<0.12\text{mJ/mm}^2$ or $\geq 0.12\text{mJ/mm}^2$, respectively.^{2,31,32} RSW involves the acceleration of a projectile by compressed air that is then transmitted radially from the applicator to the tissue.^{19,20} In using this therapy, reduction in pain and improvement in shoulder function for calcific tendinitis have been reported.²⁰ However, it is not clear which shockwave therapy regimen is the most effective treatment for pain relief and function improvement in patients with chronic calcific tendinitis.

UGN is a minimally invasive treatment that makes use of a needle to lavage with or without aspiration. This procedure has been referred to by different names (eg, lavage, barbotage, irrigation).³³ The UGN procedure is usually combined with a sub-acromial steroid injection. Although this procedure is performed widely, high-quality randomized controlled trials have not been conducted to prove its effectiveness.

Therapeutic ultrasound therapy increases temperature and improves soft tissue healing. High-intensity therapeutic ultrasound therapy may break up microcrystals by increasing the intracellular calcium level and increasing blood flow and metabolism, thereby possibly facilitating deposit disruption.^{23,34} A TENS device is another commonly used clinical therapy, which produces electrical stimulation based on the gate control theory of pain. The

gating mechanism regulates the stimulation of pain receptors in the dorsal horn of the spinal cord, as the electrical stimulation from TENS can inhibit this pathway.¹² However, like UGN, the effectiveness of TENS has not been fully confirmed.

Previous meta-analyses compared the effectiveness of 2 treatment strategies, such as different energy levels of shockwave therapy,^{27,35-37} or different UGN approaches.³³ Since no comprehensive systematic review and network meta-analysis has investigated different nonoperative treatments, we conducted a systematic review and network meta-analysis to compare the effectiveness of several nonoperative treatments for patients with chronic calcific tendinitis of the shoulder.

Methods

Study selection

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines for conducting a systematic review. We comprehensively searched PubMed, Embase, Cochrane Controlled Trials Register, and the Cochrane databases by using the keywords *calcific tendinitis*, *ultrasound*, *shock wave*, *needling*, *shoulder*, and *rotator cuff* and their expansions combined in algorithms, from the earliest record up to August 31, 2016. We searched the electronic databases without language or date restriction for all relevant articles and included randomized controlled trials. The details of our search strategy can be found in [supplemental appendix S1](#) (available online only at <http://www.archives-pmr.org/>). We searched additional databases, such as [opengrey.eu](http://www.opengrey.eu) for gray literature and clinical trials (www.clinicaltrials.gov) for ongoing clinical trials, and manually screened reference lists of previous review articles for additional related articles. We screened the titles and abstracts first and then identified the potentially relevant records by reviewing the full text of articles. When there was disagreement concerning selected studies, we engaged in discussion to reach a consensus and consulted the third reviewer (W.-C.T.) if disagreement was not resolved. The selection process was recorded in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram ([fig 1](#)), and reasons for exclusion of studies were summarized and are illustrated in [supplemental appendix S2](#) (available online only at <http://www.archives-pmr.org/>).

Inclusion criteria

Types of studies

We included clinical trials in which patients were randomly assigned to nonoperative treatments for chronic calcific tendinitis of the shoulder or to control treatments such as sham or physiotherapy. Studies were excluded if the control group received similar treatment. Studies were excluded if data of outcome measures could not be extracted or if the site of treatment was not the shoulder. Studies were also excluded if patients were assigned to the same energy level of shockwave therapy or if patients were assigned to different sections or a different total energy of shockwave therapy.

Types of participants

Participants in the included studies were adult patients who were aged ≥ 18 years and were diagnosed with clinical symptoms related to calcific tendinitis of the shoulder confirmed by

List of abbreviations:

CI	confidence interval
CMS	Constant-Murley Score
CrI	credible interval
ESWT	extracorporeal shockwave therapy
FSW	focused extracorporeal shockwave therapy
H-FSW	high-energy focused extracorporeal shockwave therapy
L-FSW	low-energy focused extracorporeal shockwave therapy
RSW	radial extracorporeal shockwave therapy
TENS	transcutaneous electrical nerve stimulation
UGN	ultrasound-guided needling
VAS	visual analog scale

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